Measuring Village Head Performance using Fuzzy TOPSIS Method

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Abstract. The village head is the leader of the village in Indonesia. The village head is the leader of the village government. The tenure of the village head is six years, and can be extended for another one term if the government officials at the village level show good performance in organizing the government. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method can help decision making in determining the performance index of the village head. This research is conducted by looking for the performance of positive and negative ideal solutions. Applications with the highest V value will occupy the top size in this system. Then the criteria for determining the performance index of the head of the village are timeliness, discipline, responsibility, leadership, presence, value. The results of the decision-making system resulted in 6 alternatives suggested performance indexes of village heads, with the highest score of Sendang Agung Village.

Keywords: TOPSIS, performance index, decision-making

1. Introduction
The village head is the leader of the village government. The tenure of the village head is six years and can be extended for another one term. UUD No. 110 the year 2016 article 46 performance of head of the village explain about BPD doing supervision on the performance of village head. Implementation of supervision as referred to in paragraph (1) shall be conducted through: (a) planning of village government activities; (b) implementation of activities; and (c) reporting on the administration of village government. The forms of BPD supervision as referred to in paragraph (1) shall be in the form of monitoring and evaluation. Article 47 the results of the performance of the village head's performance supervision as referred to in article 46 paragraph (1) shall be part of the performance report of BPD.
Research conducted by Nugraha [1] explains the determination of the performance of village head according to education level in Replace Sub-district, Gresik Regency. Implementation of local government regulations on village governance has shown that village heads, especially Replace Sub-district, have different backgrounds or educational attitudes. As well as irrefutable, the village head in Replace Sub-district produced a variety of performance in running the government in his village.

Based on this research, it will help a decision support system for assessment of performance index of the head of the village of Sendang Agung Central Lampung using TOPSIS method. TOPSIS is one of the decision-making methods where the chosen alternative is the best alternative that has the closest distance from the ideal solution and furthest from the ideal negative solution. Given the performance of the Village Head’s assessment of the competency aspect, the head of the village can improve his performance as we know that the village head develops his duties as a village leader and serves the community. For the village head who has the best performance index based on predetermined criteria will get rewards/rewards in the form of salary, allowances from the government.

2. Literature Review

2.1. Head of the village
The village head is the head of government at the village level is expected to be able to run the government with good performance in providing services to the community. So, when the government apparatus in the large village show a good performance in organizing the government. It will affect the performance of the government at the district, provincial and central levels. The Village Head is also the leader of his way of government affairs in the village which is the organizer and also responsible for the way the wheels of government and development within its territory [2][3].

2.2. Decision support system
Decision Support System (DSS) is an approach or methodology to support the decision. The Decision Support System employs a flexible, interactive and adaptable CBIS (Computer Based Information System), developed to support solutions to specific unstructured management problems. SPK uses data, provides an easy user interface and can incorporate decision maker thinking [4][5]. Decision Support System typically uses a variety of models and is built by an interactive and iterative process. It supports all decision-making phases and can incorporate a knowledge component [6].

2.3. Fuzzy multiple attribute decision making
Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to find the optimal alternative of some alternatives with certain criteria [7]-[9]. The core of FMADM is to determine the weight value for each attribute, then proceed with the ranking process which will select the alternatives already given [10]. Several methods can be used to solve FMADM problems they are: Simple Additive Weighting Method (SAW), Weighted Product (WP), ELECTRE, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP)[11][12].

2.4. TOPSIS method
Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is based on the concept that the best-chosen alternative not only has the shortest distance from the ideal solution but also has the longest distance from the ideal solution. MADM troubleshooting steps with TOPSIS: 1) create a normalized decision matrix, 2) create a normalized weighted decision matrix, 3) determine the matrix of positive ideal solutions & matrices of ideal solutions negatively, 4) determine the distance between the value of each alternative with a positive ideal solution matrix & the ideal negative solution matrix, and 5) specifies the preference value for each alternative [13].

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is based on the concept that the best-chosen alternative not only has the shortest distance from the ideal solution but also has the longest distance from the ideal solution. In general, TOPSIS procedure uses the completion steps...
in this way [14]. TOPSIS requires performance rating of each alternative \( A_i \) on each of the normalized \( C_j \) criteria, ie:

\[
r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}
\]

by \( i=1, 2, \ldots, m \); and \( j = 1, 2, \ldots, n \). The ideal solution of \( A^+ \) and the ideal solution of negative \( A^- \) can be determined based on the normalized weighted rating \( y_{ij} \) as:

\[
y_{ij} = w_{ij} \cdot r_{ij}^{\frac{1}{2}} \quad \text{for} \quad i=1,2,\ldots,m; \text{and} \quad j=1,2,\ldots,n.
\]

\[
A^+ = (y_1^+, y_2^+, \ldots, y_n^+);
\]

\[
A^- = (y_1^-, y_2^-, \ldots, y_n^-);
\]

where: \( j = 1, 2, \ldots, n \). Determine the spacing between the value of each alternative with a matrix of positive ideal solutions and the matrix of ideal solutions negatively The distance between the value of each alternative with the ideal solution matrix is defined as:

\[
D_i^+ = \sqrt{\sum_{j=1}^{n} (y_i^+ - y_{ij})^2}
\]

\[
D_i^- = \sqrt{\sum_{j=1}^{n} (y_i^- - y_{ij})^2}
\]

Determining the preference value for each alternative the preference value for each alternative \( V_i \) is defined as:

\[
V_i = \frac{D_i^-}{D_i^- + D_i^+},
\]

where \( i = 1, 2, \ldots, m \)

3. Analysis and Discussion

3.1. Manual test

The ranking research table used for each performance index criteria is like Table 1 and 2.
### Table 1. Weight value

| Value | Information       |
|-------|-------------------|
| 1     | Very bad          |
| 2     | Bad               |
| 3     | Good enough       |
| 4     | Good              |
| 5     | Very good         |

### Table 2. Value weight criteria

| Code | Criteria      | Weight value |
|------|---------------|--------------|
| C1   | Punctuality   | 25 %         |
| C2   | Discipline    | 20 %         |
| C3   | Responsible   | 15 %         |
| C4   | Leadership    | 20 %         |
| C5   | Presence      | 10 %         |
| C6   | Value         | 10 %         |

#### 3.2. Specify a match rating

The first step determines the alternative first with the criteria value that has been determined, an alternative to be studied are as follows:

Alternative:
- A1 : Head of Sendang Agung Village
- A2 : Head of Sendang Asri Village
- A3 : Head of Sendang Mulyo Village
- A4 : Head of Sendang Mukti Village
- A5 : Head of Sendang Rejo Village

### Table 3. Alternative

| Alternative | C1 | C2 | C3 | C4 | C5 | C6 |
|-------------|----|----|----|----|----|----|
| A1          | 1  | 0.8| 1  | 0.8| 0.4| 1  |
| A2          | 0.8| 0.4| 0.8| 1  | 0.4| 0.4|
| A3          | 0.2| 1  | 0.2| 0.4| 0.8| 0.4|
| A4          | 0.4| 0.6| 0.8| 0.4| 1  | 0.2|
| A5          | 0.2| 0.4| 0.4| 1  | 0.2| 0.6|

Cj = Timeliness (C1), Discipline (C2), Responsibility (C3), Leadership (C4), Presence (C5), Value (C6).

### Table 4. Normalized matrix (R)

| Alternative | C1 | C2 | C3 | C4 | C5 | C6 |
|-------------|----|----|----|----|----|----|
| A1          | 0.729| 0.525| 0.635| 0.465| 0.283| 0.762|
| A2          | 0.583| 0.263| 0.508| 0.581| 0.283| 0.305|
| A3          | 0.146| 0.657| 0.127| 0.232| 0.565| 0.305|
| A4          | 0.292| 0.394| 0.508| 0.232| 0.707| 0.152|
| A5          | 0.146| 0.263| 0.254| 0.581| 0.141| 0.457|
Table 5. Positive Ideal Solutions (A+) and Negative Ideal Matrix (A-)

| Yi | Ideal Solution | Max   | Min   |
|----|----------------|-------|-------|
| Y1 | 0.729; 0.583; 0.146; 0.292; 0.146 | 0.729 | 0.146 |
| Y2 | 0.5252; 0.2626; 0.6565; 0.3939; 0.2626 | 0.6565 | 0.2626 |
| Y3 | 0.635; 0.508; 0.127; 0.508; 0.254 | 0.635 | 0.127 |
| Y4 | 0.4649; 0.5812; 0.2324; 0.2324; 0.5812 | 0.5812 | 0.2324 |
| Y5 | 0.2828; 0.2828; 0.5646; 0.7071; 0.1414 | 0.7071 | 0.1414 |
| Y6 | 0.7624; 0.30499; 0.30499; 0.152498; 0.457495 | 0.7624 | 0.152498 |

Having determined the positive and negative values, it will produce:

| A+ | 0.729324957 | 0.656532164 | 0.635000635 | 0.591238194 | 0.707106781 | 0.762492852 |
| A- | 0.145864991 | 0.262612866 | 0.12700127 | 0.232495277 | 0.141421356 | 0.15249857 |

Preference Value for Any Alternative

\[
V_1 = \frac{18.95382823}{18.95382823 + 5.504721349 + 94.32886497} = 0.774936722
\]

\[
V_2 = \frac{14.32886497}{14.32886497 + 10.85937856 + 90.077144205} = 0.568871146
\]

\[
V_3 = \frac{9.077144205}{9.077144205 + 18.50430638 + 92.111716148} = 0.32910322
\]

\[
V_4 = \frac{9.211716148}{9.211716148 + 15.38681389 + 7.84729294} = 0.374482383
\]

\[
V_5 = \frac{7.84729294}{7.84729294 + 18.67614893 + 94.32886497} = 0.295862542
\]

V1 = 0.774936722
V2 = 0.568871146
V3 = 0.374482383
V4 = 0.32910322
V5 = 0.295862542

From the result, it can be concluded that the best alternative of village head of Sendang Agung village is Sendang Agung Village V1 = 0.774936722.
The result of the TOPSIS method testing application on the system is in accordance with the calculation manually. The calculation of decision support using TOPSIS method in the system resulted in the best alternative that is the assessment of performance index of head of a village in Sendang Agung, with a value of alternative (v1) 0.774936722 biggest in the alternative head of Sendang Agung village.

4. Conclusion
From the results of the discussion above can be concluded that the decision to determine the performance index head of the village using Technique for Order Preference by Similarity to Ideal Solution by using criteria of timeliness, discipline, responsibility, leadership, attendance, and value.

References
[1] Guruh Candra Nugraha, “Kinerja Kepala Desa Menurut Jenjang Pendidikan Di Kecamatan Menganti Kabupaten Gresik,” Kaji. Moral dan Kewarganegaraan, vol. 2, no. 1, pp. 1–15, 2013.
[2] M. M. Riyan Suhandi, Leni Anggraeni, “Cara Penentuan Kelayakan Calon Kepala Desa Pada Desa Blitarjo Menggunakan Metode Simple Additive Weighting (SAW),” Konf. Nas. Sist. Inf., vol. 0, no. 0, pp. 65–73, 2016.
[3] Z. Siti Muqodimah, Muhamad Muslihudin, Andino Maseleno, “Measuring Index Performance Village Heads On Sub District Pringsewu Uses The Method Weighted Product,” in ICSTIEM, 2017, p. 6.
[4] E. Turban, R. Sharda, and D. Delen, Decision Support, and Business Intelligence Systems. Chapter 6 Artificial Neural Networks for Data Mining, vol. 8th. 2007.
[5] E. Turban, J. E. Aronson, and T.-P. Liang, “Decision Support Systems and Intelligent Systems,” Decis. Support Syst. Intell. Syst., vol. 7, p. 867, 2007.
[6] R. Irviani, I. Dinulhaq, D. Irawan, R. Renaldo, and A. Maseleno, “Areas Prone of the Bad Nutrition based Multi-Attribute Decision Making with Fuzzy Simple Additive Weighting for Optimal Analysis,” Int. J. Pure Appl. Math., vol. 118, no. 7, pp. 589–596, 2018.
[7] M. Rizqi, A. Akbar, Y. Fitrian, and A. Maseleno, “Dismissal Working Relationship using Analytic Hierarchy Process Method,” Int. J. Pure Appl. Math., vol. 118, no. 7, pp. 177–184, 2018.
[8] M. Muslihudin, T. S. Susanti, A. Maseleno, and S. Pringsewu, “The Priority of Rural Road Development using Fuzzy Logic based Simple Additive Weighting,” Int. J. Pure Appl. Math., vol. 118, no. 8, pp. 9–16, 2018.
[9] S. Mukodimah, M. Muslihudin, A. Andoyo, S. Hartati, and A. Maseleno, “Fuzzy Simple Additive Weighting and its Application to Toddler Healthy Food,” Int. J. Pure Appl. Math., vol. 118, no. 7, pp. 1–7, 2018.
[10] M. Muslihudin, A. Latif, S. Ipnuwati, R. Wati, and A. Maseleno, “A Solution to Competency Test Expertise of Engineering Motorcycles using Simple Additive Weighting Approach,” Int. J. Pure Appl. Math., vol. 118, no. 7, pp. 261–267, 2018.
[11] S. Kusumadewi, S. Hartati, A. Harjoko, and Retanto Wardoyo, Fuzzy Multi-Attribute Decision Making (Fuzzy MADM). Yogyakarta: Graha Ilmu, 2013.
[12] S. Khademolqorani and A. Z. Hamadani, “An Adjusted Decision Support System through Data Mining and Multiple Criteria Decision Making,” in Procedia - Social and Behavioral Sciences, 2013, vol. 73, pp. 388–395.
[13] H. Ibn-Khedher and E. Abd-Elrahman, “CDNaaS Framework: TOPSIS as Multi-Criteria Decision Making for vCDN Migration,” in Procedia Computer Science, 2017, vol. 110, pp. 274–281.
[14] R. A. Krohling and A. G. C. Pacheco, “A-TOPSIS - An approach based on TOPSIS for ranking evolutionary algorithms,” in Procedia Computer Science, 2015, vol. 55, pp. 308–317.