

## Design of a Decision Support System for Selecting Exemplary Health Officers with the Topsis Method

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### Abstract

In this case, as a motivation to improve the performance of health workers at the Selat Panjang Health Center UPT, an exemplary health worker election was held. It also aims to reward those who have served themselves at the Selat Panjang Health Center for a long time. However, the method of selecting exemplary health workers still uses the manual method, especially in determining the final score of all stages of the assessment. In addition, the assessment team was still considered not to be transparent in deciding which health worker received the highest or best score. The development of a computing system is indispensable to facilitate the work of the jury team in selecting and assigning the best health workers objectively, professionally and transparently. Therefore a web-based decision support system was designed by applying the TOPSIS (Technique For Others Reference by Similarity to Ideal Solution) method. The TOPSIS method is a multicriteria decision-making method or an alternative choice which is an alternative that has the smallest distance from the positive ideal solution and the largest distance from the negative ideal solution from a geometric point of view using Euclidean distance. The results obtained from this study are those who fulfill the requirements as exemplary health workers, namely alternative 1 named Rizky with a value of 0.5869. With the construction of the new system, it is hoped that it will be able to overcome the problems experienced by the UPT Selat Panjang Health Center.

Keywords : Puskesmas, Health Workers, TOPSIS, Website, Alternatives .

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### 1. Introduction

Human resources (HR) play a very dominant role in company activities. The success or failure of a company in achieving its goals is highly dependent on the ability of its human resources or employees to carry out the tasks assigned so that employees are required to always be able to develop themselves proactively within a company, one of which is a health center [1]. Puskesmas is a very important basic health service facility in Indonesia . Puskesmas is a strategic unit in supporting the realization of changes in public health status towards increasing optimal health status. In order to realize an optimal degree of health, efforts are certainly needed to develop a basic health service system that is able to meet the needs of the community as consumers of these basic health services. The availability of resources, both in terms of quality and quantity, greatly affects service [2].

Health workers are those who work to devote themselves in the health sector, master the knowledge and competency skills through formal education in the health sector with proof of expertise certificates that are legalized by the health service (RI, 2014). In certain areas of expertise, proof of skills from formal education is needed to carry out health efforts [3].

In this case, as a motivation to improve the performance of health workers at the Selat Panjang Health Center UPT, an exemplary health worker election was held. It also aims to reward those who have served themselves at the Selat Panjang Health Center for a long time. The selection can also motivate them to become health workers who are nationalist, ethical and professional, to become health workers who have a high spirit of dedication, are disciplined, creative, knowledgeable, skilled, virtuous and maintain a code of ethics and professional ethics for health workers [3]. . However, the method of selecting exemplary health workers still uses the manual method, especially in determining the final score of all stages of the assessment. In addition, the assessment team was still considered not to be transparent in deciding which health worker received the highest or best score. The development of a computing system is indispensable to facilitate the work of the jury team in selecting and assigning the best health workers objectively, professionally and transparently.

Assessments that are still manual are considered less productive, subjective, and less efficient. Decision Support Systems (DSS) have been widely implemented to support solving decision-making problems [4].

Decision Support System (SPK) is an information system aimed at semi-structured decision making [5]. A decision support system is a system that can interactively make decisions through data users and decision models to solve semi-structured and unstructured problems [6]. A Decision Support System (DSS) is needed to facilitate the assessor's work in deciding on exemplary health workers in an objective, professional and transparent manner. The TOPSIS method gives output results in the form of the ideal solution distance from the criterion [7].

The TOPSIS method is a multi-criteria decision-making method or alternative choice which is an alternative that has the smallest distance from the positive ideal solution and the largest distance from the negative ideal solution from a geometric point of view using Euclidean distance [8].

The TOPSIS method is a decision-making method, which in producing a decision will choose an alternative that is not only closest to the positive ideal solution, but also farthest from the negative ideal solution [9].

Previous research on the feasibility of granting credit with the Topsis method at the Bmt itQan Sharia Cooperative found that by implementing a decision support application to help provide financing so that the decision results are more accurate and objective. With the Topsis method, it can solve measurable problems for the decision support system for financing feasibility. So that the assessment is more objective [10].

As for previous research conducted by Dede Wira Trise Putra et al, regarding the decision support system for selecting tourist objects, it was found that a web-based Decision Support System using the TOPSIS method can be used by tourists to obtain information on tourist destinations according to their criteria and needs [11].

Previous researchers regarding determining tourist sites using the topsis method where research was conducted using 17 tourist destinations and 3 criteria. The weight of the criteria is obtained by processing the input values by the user based on their level of importance. The price criterion is a cost criterion, while facilities and stars are benefits. The fuzzification process is carried out on the price criteria, where the price data received is in the form of numbers, while the actual price data is in the form of taste (fuzzy) values. TOPSIS provides a ranking based on the final score obtained by calculating the distance from the positive and negative ideal solutions. The ranking results provided by TOPSIS are basically successful in providing rankings with different values, except for the two alternatives tested. This is due to the similarity of the values of the two alternatives on each criterion. Subsequent research will integrate with Google Maps,

so that it can provide better recommendations by showing tourist locations [12]

Therefore a web-based decision support system was designed by applying the TOPSIS method because the logic is simple, the calculation process is easy to understand, the best alternative chosen is a simple mathematical model. With the construction of the new system, it is hoped that it will be able to overcome the problems experienced by the UPT Selat Panjang Health Center.

## 2. Research methodology

As for the steps taken by the author in this design so as not to deviate from the subject matter, the research will be made systematically so that it can be used as a guideline, which can be seen in Figure 1 as follows : .

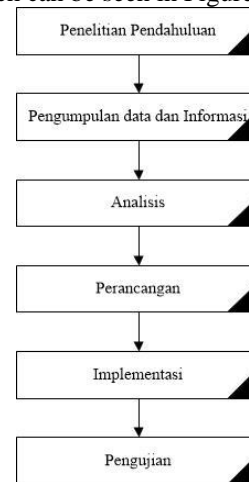


Figure 1. Research Framework

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

### 2.1 Preliminary Research

Preliminary research can provide initial evidence that the problems we will examine in the field really exist. This research was carried out by means of field surveys and data surveys before conducting further research on the object of research. Therefore it takes time for data collection, research time, research locations, research methods, field research, library research .

### 2.2 Data collection

Data collection was carried out by studying and examining books, journals and writings related to this research. The data collection was carried out using the interview method with the UPT Selat Panjang Health Center.

### 2.3 Analysis

In this study the authors analyze the data that has been collected and analyze the system that will be run as a solution to the existing problems, along with the explanation:

#### 1. Data analysis

the criterion data that will be used as many as 5 criteria and data on health workers used in determining exemplary health workers as many as 5 people.

#### 2. Process Analysis

In the analysis phase of this process, the author will design a decision support system using the TOPSIS method. Where the system is expected to be the right solution to solve the problems that exist in the Selat Panjang Health Center UPT.

#### 3. System analysis

The system analysis stage is the basis for designing and planning a decision support system to be made, system analysis is carried out to find out what is needed by the system. This system analysis is carried out to design a system that will be built using the TOPSIS method, the design includes designing the user interface designing the database for the system so that file management is more organized. Where the system will be made using the PHP programming language and MySQL database.

### 2.4 Design

The design will use UML as a design model so that it is organized and structured with the design. Some diagrams focus on the robustness of object-oriented theory and some focus on design and construction details. All are intended as a means of communication between programmer teams and users [13]. UML is a modeling language for paradigm (object-oriented) systems or software [14]

### 2.5 Implementation

System implementation is the stage of laying the system so that it is ready to operate. Implementation aims to confirm the design modules, so that users can provide input to information technology management.

### 2.6 Testing

This stage will test applications created using the PHP programming language and MySql database. This is done in order to find out whether the application can run according to the design that is done.

## 3. Results and Discussion

The application of the TOPSIS method is one of the methods in decision making, which in producing a

decision will choose the alternative that is not only closest to the positive ideal solution, but also farthest from the negative ideal solution. Calculations using the TOPSIS method are calculations that we will use in making decisions in selecting exemplary health workers at the Selat Panjang Health Center UPT. The stages in the Topsis method are as follows:

- a. Create a normalized decision matrix
- b. Create a weighted normalized decision matrix
- c. Determine the positive ideal solution matrix and the negative ideal solution matrix
- d. Determine the distance between the values of each alternative and the positive and negative ideal solution matrices.
- e. Determine the preference value for each alternative

The TOPSIS method requires a performance rating for each alternative  $A_i$  on each normalized  $C_j$  criterion, which can be seen from formula 2.1 as follows:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} = i = 1, 2, \dots, m; \text{ dan } j = 1, 2, \dots, n \quad (2.1)$$

Where, the positive ideal solution  $A^+$  and the negative ideal solution  $A^-$  can be determined based on the normalized weight rating ( $y_{ij}$ ) which can be seen from formula 2.2 as follows:

$$y_{ij} = w_i r_{ij} \text{ dengan } i = 1, 2, \dots, m; \text{ dan } j = 1, 2, \dots, n. \quad (2.2)$$

$$A^+ = y_1^+, y_2^+, \dots, y_n^+ \quad (2.3)$$

$$A^- = y_1^-, y_2^-, \dots, y_n^- \quad (2.4)$$

With the elaboration to find the value of  $A^+$  and  $A^-$  which can be seen from formulas 2.5 and 2.6 as follows:

$$y_j^+ = \begin{cases} \max y_{ij}; \text{ jika } j \text{ atribut keuntungan } i \\ \min y_{ij}; \text{ jika } j \text{ atribut biaya } i \end{cases} \quad (2.5)$$

$$y_j^- = \begin{cases} \min y_{ij}; \text{ jika } j \text{ atribut keuntungan } i \\ \max y_{ij}; \text{ jika } j \text{ atribut biaya } i \end{cases} \quad (2.6)$$

Where,  $j$  is  $1, 2, \dots, n$ . While the distance between alternative  $A_i$  and the ideal positive ideal solution, which is formulated according to formula 2.7 as follows:

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2}; \quad i = 1, 2, \dots, m \quad (2.7)$$

Where, the distance between alternative  $A_i$  and the negative ideal solution can be seen as formula 2.8 below :

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2}; \quad i = 1, 2, \dots, m \quad (2.8)$$

Where, the preference value for each alternative ( $V_i$ ). to find the value ( $V_i$ ) can be seen from formula 2.9 as follows:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}; \quad (2.9)$$

Where, Value  $V_i$  which is larger indicates that  $A_i$  is preferred.

The criteria data used can be seen in Table 1 below:

Table 1. Table Criteria

Criteria Code	Criteria Name
C1	Years of service
C2	Community service
C3	Innovation at work
C4	Responsibility at Work
C5	Teamwork

From the table above it can be seen that in this study using 5 criteria, then the alternative data used can be seen in Table 2 below:

Table 2. Table Alternative

Classification Code	Name of Health Officer
A1	Rizky Ramadhan
A2	Katrina Melinda
A3	Siti Herni
A4	Mardhatillah
A5	Samuel Bahri

Analysis using the TOPSIS method can be explained as follows:

Table 3. Table Criteria Assessment Data

Code	Criteria	Category	Sub Criteria	Mark	Weight
C1	Years of service	Benefits	There isn't any	1	4
			< 1 year	2	
			12 years old	3	
			25 years	4	
			> 5 years	5	
C2	Community service	benefits	not good	1	5
			not good	2	
			Good	3	
			Pretty good	4	
			Very good	5	
C3	Innovation at work	benefits	Good	4	3
			Very good	5	
			not good	1	
			not good	2	
			quite good	3	
C4	Responsibility at Work	benefits	not good	1	3
			not good	2	
			pretty good	3	
			Good	4	
			Very	5	

C4	Teamwork	benefits	good	5	
			not good		1
			not good		2
			pretty good		3
			Good		4
			Very good	5	

The stages in the calculation using the topsis method are explained as follows:

1. Determining the Conformity Rating Value of Each Criterion.

Table 4 . Match Rating Table

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	3	5	4	4	3
A2	5	4	4	5	4
A3	4	4	5	3	5
A4	4	3	4	4	4
A5	4	4	3	4	4

$$X = \begin{bmatrix} 3 & 3 & 5 & 1 & 3 & 5 \\ 4 & 5 & 5 & 1 & 3 & 5 \\ 3 & 5 & 4 & 5 & 5 & 5 \\ 5 & 5 & 4 & 1 & 3 & 5 \\ 5 & 3 & 4 & 5 & 3 & 5 \end{bmatrix}$$

2. Determining the Normalized decision matrix, TOPSIS requires a performance rating for each alternative  $A_i$  on each normalized  $C_j$  criterion, which is explained in Table 5, namely:

Table 5 . Normalized Matrix table

Code	C1	C2	C3	C4	C5
A1	0.3312	0.552	0.441	0.441	0.331
A2	0.552	0.441	0.441	0.552	0.441
A3	0.4417	0.441	0.552	0.331	0.552
A4	0.4417	0.331	0.441	0.441	0.441
A5	0.4417	0.441	0.331	0.441	0.441

Based on equation 1, alternative normalization values will be calculated based on the following criteria:

$$X = \begin{bmatrix} 3 & 5 & 4 & 4 & 3 \\ 5 & 4 & 4 & 5 & 4 \\ 4 & 4 & 5 & 3 & 5 \\ 4 & 3 & 4 & 4 & 4 \\ 4 & 4 & 3 & 4 & 4 \end{bmatrix}$$

3. Calculating normalized and weighted decision matrices.

Weighted normalization is obtained from the matrix multiplication in the normalization table with the criteria weight table, which is explained in Table 6 below:

Table 6 . Normalized and Weighted Decision Matrix

Code	C1	C2	C3	C4	C5
A1	1.325	2.760	1.325	2.208	1.325
A2	2.208	2.208	1.325	2.760	1.766
A3	1.766	2.208	1.656	1.656	2.208
A4	1.766	1.656	1.325	2.208	1.766

A5	1,766	2,208	0,993	2,208	1,766
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4. Positive and Negative ideal solution distance matrix

The ideal solution matrix is obtained based on weighted normalization and criteria attributes ( *cost* and *benefit* ). For a positive ideal solution, the maximum value is taken from the weighted normalization if the criterion attribute is benefit, if the cost is taken, the minimum value is taken. On the other hand, the positive ideal solution is taken from the minimum value of the weighted normalization if the attribute criteria is *benefit* , if maximum *cost* is taken. It can be seen from Table 7 as follows.

Table 7 . Table of Ideal Values D+ and D-

Alternative	D+	D-
A1	1.0936	1,554
A2	1.1795	1.3525
A3	1.3116	1.3115
A4	1.4232	0.89715
A5	1.199593427	1.0000

5. Define Preference Values

The next step is to determine the preference value for each alternative (  $V_i$  ) which can be seen in Table 8 as follows. The preference value for each alternative (  $V_i$  ) can be seen in the formula below :

$$V1 = \frac{1,554}{1,554 + 1,0936} = 0,5869$$

$$V2 = \frac{1,3525}{1,3525 + 1,1795} = 0,5342$$

$$V3 = \frac{1,311302}{1,311302 + 1,311301718} = 0,50000$$

$$V4 = \frac{0,89715}{0,89715 + 1,422810684} = 0,386709129$$

$$V5 = \frac{1,0000}{1,0000 + 1,199593427} = 0,454629473$$

Table 8 . Preference Values table

Alternative	Preference (V)
A1	0.5869
A2	0.5342
A3	0.50000
A4	0.38670
A5	0.45462

From the final results of the TOPSIS method calculations in table 8, it can be ranked based on the final results which can be seen from Table 9 as follows:

Table 9 . Ranking Table

Alternative	Preference	Rank	Decision
A1	0.5869	1	Best
A2	0.5342	2	second rank
A3	0.5000	3	Third rank
A5	0.454629473	4	Rank four
A4	0.3866	5	Fifth rank

Then the ranking value that meets the requirements as an exemplary health worker is obtained by the alternative with the code "A1", namely Risky Ramadhan with a preference score of 0.5869 . This

helps the Selat Panjang Health Center in selecting exemplary health workers.

4. Conclusion

Based on the discussion and analysis that has been received, it can be concluded. With the design of a website-based decision support system, it is possible to select exemplary health workers quickly and efficiently . By using the Technique For Others Reference by Similarity to Ideal Solution (TOPSIS) method, it is possible to quickly select exemplary health workers.

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