



# Decision Support System For Governor Of Student Executive Board Governor (BEM) Selection Using The TOPSIS Method

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## ARTICLE INFO

## ABSTRACT

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The application of Decision Support System (DSS) is basically motivated by the challenges and needs of an organization to provide a system that can assist them in making the right decisions. The selection of the Governor of the Student Executive Board (BEM) can also be done with the help of the SPK. The purpose of implementing this DSS is to help select from many existing candidates into a number of candidates that will be chosen by students. If done without the help of DSS then this will require a lot of resources. The Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method is very appropriate for this purpose. TOPSIS has the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. The criteria that will be used in this research are GPA, number of seminar and workshop certificates, assessment of vision and mission, and initial support. The results showed that the TOPSIS method could be used to assist the selection process for the Governor of BEM.

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## 1. Introduction

The Decision Support System (DSS) was first introduced by Gorry and Scott Morton in 1971 to provide decision makers with a number of considerations to assist them in making decisions (Gorry & Scott Morton, 1971). DSS has shown good ability in assisting decision making, especially those related to forecasting and selection functions (Li et al., 2020). DSS is a system to assist a manager in making decisions in semi-structured situations (Sharda et al., 2019). DSS is not intended to automate decision making, but provides an interactive tool that allows decision makers to perform various analyzes using available models (Ali et al., 2020).

Decision support system (DSS) is defined as a system intended to support managerial decision makers in semi-structured decision situations (Barzehkar et al., 2021). DSS is intended to be a tool for decision makers to expand their capabilities (Ford et al., 2021). However, not to replace their judgment. DSS is intended for decisions that require judgment or for decisions that cannot be supported by algorithms at all (Turban et al., 2007). In other words, a DSS is a set of model-based procedures for processing and evaluating data to help managers make decisions (Mustafidah & Mayasari, 2019).

TOPSIS is a multi-criteria decision support system. TOPSIS has the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Sutejo, 2016) (Windarto, 2017). The TOPSIS method applies a weighted value to each criterion, this method uses the principle that the chosen alternative must have the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Emecen Kara, 2022). This means that the choices will be sorted based on the resulting value so that the alternative that has the shortest distance with a positive ideal solution is the best alternative (Annema et al., 2015). This concept is widely used in several MADM models to solve practical decision problems (Yang & Xu, 2022). This is because the concept is simple and easy to understand, computationally efficient, and has the ability to regulate the relative performance of decision alternatives in a simple mathematical form (Sharma et al., 2021).

The election of the Governor of the Student Executive Board (BEM) is a routine activity every year in student activities at various universities. In the process of selecting the Governor of BEM, there is an administrative selection process and the selection of candidates for the Governor of BEM first where students



who have registered will pass an administrative selection. Then registrants who have passed the administrative selection will be selected by the committee as candidates who will then be selected by students. The Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method is very appropriate for this purpose. TOPSIS has the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Banjarbaru, 2016). There are a number of criteria used in the election of the Governor of BEM, namely: GPA, number of seminar and workshop certificates, assessment of vision and mission, and initial support. This study will use the TOPSIS method by assuming there are a number of alternatives or candidates for the Governor of BEM that will be selected based on the criteria previously stated.

## 2. Research Methods

The stages of DSS research with TOPSIS are as follows

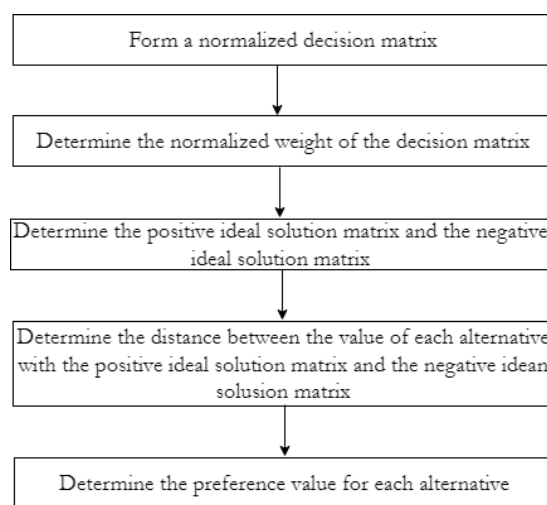


Figure 1. Research Stage

Based on Figure 1, it can be seen that TOPSIS is a multi-criteria decision support system. TOPSIS has the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. The steps in TOPSIS are as follows:

- a. Form a normalized decision matrix

The normalized value of the  $R_{ij}$  decision matrix can be calculated using Equation 1.

$$R_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}^2} \quad (1)$$

where:

$$i = 1, 2, \dots, m$$

$$j = 1, 2, \dots, n$$

- b. Determine the normalized weight of the decision matrix

The normalized weight can be determined using Equation 2.

$$Y_{ij} = W_{ij} R_{ij} \quad (2)$$

Where:

$$i = 1, 2, \dots, m$$

$$j = 1, 2, \dots, n$$

The normalized weight matrix can be divided into a matrix for profit attributes and a matrix for cost attributes. The matrix for the profit attribute can be determined using Equation 3 and the matrix for the cost attribute can be determined using Equation 4.

$$A^+ = (Y_1^+, Y_2^+, \dots, Y_n^+) \quad (3)$$

$$A^+ = (Y_1^-, Y_2^-, \dots, Y_n^-) \tag{4}$$

- c. Determine the positive ideal solution matrix and the negative ideal solution matrix. The positive ideal solution matrix for the profit and cost attributes can be determined using Equation 5, while the negative ideal solution matrix for the profit and cost attributes can be determined using Equation 6.

$$y_j^+ = \begin{cases} \max y_{ij}; \text{ where } j \text{ is a benefit attribute} \\ \min y_{ij}; \text{ where } j \text{ is a cost attribute} \end{cases} \tag{5}$$

$$y_j^- = \begin{cases} \min y_{ij}; \text{ where } j \text{ is a benefit attribute} \\ \max y_{ij}; \text{ where } j \text{ is a cost attribute} \end{cases} \tag{6}$$

- d. Determine the distance between the value of each alternative with the positive ideal solution matrix and the negative ideal solution matrix. The distance between the alternative values and the positive ideal solution matrix can be determined by Equation 7 and the distance between the alternative values and the negative ideal solution matrix can be determined by Equation 8.

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_j^+ - Y_{ij})^2} \tag{7}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (Y_{ij} - y_j^-)^2} \tag{8}$$

- e. Determine the preference value for each alternative. The preference value for each alternative (Vi) can be determined using Equation 9.

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{9}$$

### 3. Result and Discussion

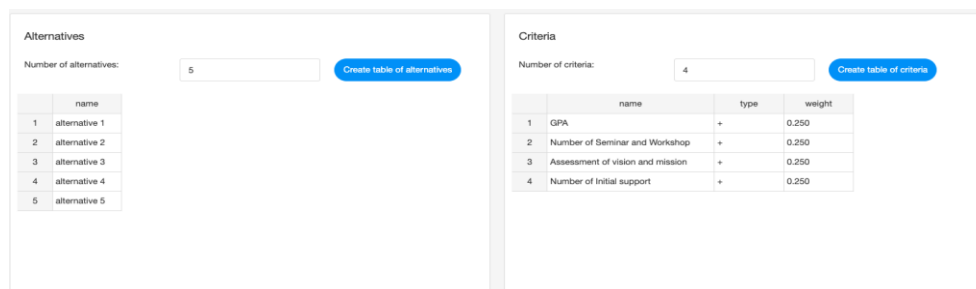
In this study, suppose there are 5 (five) alternative candidates, and 4 (four) criteria as can be seen in Table 1. The criteria to be used in this study are GPA, number of seminar and workshop certificates, assessment of vision and mission, and number of initial support. Suppose there are 3 (three) assessors (expert). The assessment of each assessor for GPA, number of seminar and workshop certificates, and number of initial support is the same and the only difference is in the assessment of the vision and mission.

**Table 2**  
Alternatives and Criteria

	GPA	Number of seminar and workshop	Assessment of vision and mission			Number of Initial support
			I	II	III	
Alternative 1	3.51	3	86	83	84	100
Alternative 2	3.62	2	82	83	86	97
Alternative 3	3.47	3	83	85	81	121
Alternative 4	3.38	4	91	90	85	91
Alternative 5	3.57	3	88	90	89	89

Based on Table 1, the efficiency of each DMU will be measured using the following steps

- a. Enter the Criteria, alternatives, and the weight of each criterion as can be seen in Figure 2.



**Figure 2.** Enter the Number of Alternatives and Criteria



Based on Figure 2, it can be seen that there are 4 (four) criteria used, namely: GPA, Seminar and Workshop, assessment of vision and mission, and number of Initial Support. The GPA is intended to measure a candidate's academic achievement, the number of seminars and workshops attended is used to measure the candidate's desire to develop skills, the vision and mission assessment is carried out by a designated team consisting of lecturers, and the number of initial support is based on the number of students who propose candidates to become candidates. BEM Governor. In this example, it is assumed that the weights for each criterion are the same, namely 0.25. In this problem, suppose there are 3 (three) assessors (experts).

- b. Enter the ratings of each expert as can be seen in Figures 4, 5, and 6.

decision matrix (expert 1)

	GPA	Number of Seminar and Workshop	Assessment of vision and mission	Number of Initial support
alternative 1	3.51	3	86	100
alternative 2	3.62	2	82	97
alternative 3	3.47	3	83	121
alternative 4	3.38	4	91	91
alternative 5	3.57	3	88	89

Figure 4. Assessment of the First Expert

decision matrix (expert 2)

	GPA	Number of Seminar and Workshop	Assessment of vision and mission	Number of Initial support
alternative 1	3.51	3	83	100
alternative 2	3.62	2	83	97
alternative 3	3.47	3	85	121
alternative 4	3.38	4	90	91
alternative 5	3.57	3	90	89

Figure 5. Assessment of the Second Expert

decision matrix (expert 3)

	GPA	Number of Seminar and Workshop	Assessment of vision and mission	Number of Initial support
alternative 1	3.51	3	84	100
alternative 2	3.62	2	86	97
alternative 3	3.47	3	81	121
alternative 4	3.38	4	85	91
alternative 5	3.57	3	89	89

Figure 6. Assessment of the Third Expert

c. The normalized matrix obtained can be seen in Figure 7.

The normalized matrix

	GPA	Number of Seminar and Workshop	Assessment of vision and mission	Number of Initial support
alternative 1	0.447	0.438	0.44	0.446
alternative 2	0.461	0.292	0.436	0.433
alternative 3	0.442	0.438	0.433	0.54
alternative 4	0.431	0.583	0.462	0.406
alternative 5	0.455	0.438	0.464	0.397

**Figure 7.** Normalized Matrix

d. The weighted normalized decision matrix can be seen in Figure 8

The weighted normalized matrix

	GPA	Number of Seminar and Workshop	Assessment of vision and mission	Number of Initial support
alternative 1	0.112	0.109	0.11	0.112
alternative 2	0.115	0.073	0.109	0.108
alternative 3	0.11	0.109	0.108	0.135
alternative 4	0.108	0.146	0.116	0.101
alternative 5	0.114	0.109	0.116	0.099

**Figure 8.** Weighted Normalized Decision Matrix

e. The ideal positive and negative values for each criterion can be seen in Figure 9.

The positive and negative ideal values

	Positive ideal	Negative ideal
GPA	0.115	0.108
Number of Seminar and Workshop	0.146	0.073
Assessment of vision and mission	0.116	0.108
Number of Initial support	0.135	0.099

**Figure 9.** Positive and Negative Values for Each Criterion

f. The distance from each alternative to the ideal positive and negative ideal can be seen in Figure 10.



Distance to positive and negative ideal points

	Distance to positive ideal	Distance to positive negative
alternative 1	0.044	0.039
alternative 2	0.078	0.012
alternative 3	0.038	0.051
alternative 4	0.034	0.073
alternative 5	0.051	0.038

Figure 10. Distance to Positive and Negative Ideal Points

g. The results of the ranking calculation for each alternative can be seen in Figure 11

	Ci	rank
alternative 1	0.469	3
alternative 2	0.131	5
alternative 3	0.576	2
alternative 4	0.681	1
alternative 5	0.425	4

Figure 11. Ranking Results of Each Alternative

In Figure 11 it can be seen that Alternatives 4 and 3 are alternatives that can be considered as candidates for the Governor of BEM based on the results of the determination using the TOPSIS method.

Symbol	Quantity	Conversion from Gaussian and CGS EMU to SI a
$\Phi$	magnetic flux	1 Mx $\rightarrow$ $10^{-8}$ Wb = $10^{-8}$ V·s
B	Magnetic flux density, magnetic induction	1 G $\rightarrow$ $10^{-4}$ T = $10^{-4}$ Wb/m <sup>2</sup>
H	magnetic field strength	1 Oe $\rightarrow$ $103/(4\pi)$ A/m
m	magnetic moment	1 erg/G = 1 emu $\rightarrow$ $10^{-3}$ A·m <sup>2</sup> = $10^{-3}$ J/T
M	magnetization	1 erg/(G·cm <sup>3</sup> ) = 1 emu/cm <sup>3</sup> $\rightarrow$ 103 A/m

#### 4. Conclusion

The conclusions from the results of this study are as follows. The election process for the Governor of BEM is due to the large number of alternatives that become candidates, so before reaching the selection stage, students need to be selected to determine the best alternatives. The Technique for Order Performance of Similarity to Ideal Solution (TOPSIS) method is very appropriate to use for the purpose of selecting the best alternatives from a number of alternatives based on the principle that the chosen alternative must have the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

TOPSIS method based on research results can be used to assist the selection process for the Governor of BEM.

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