Member Election Decision Support System South Sumatera Paskibraka Using Topsis-Promethee Method

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ABSTRACT

Paskibraka is the best young generation selected through various selections to raise and lower the Heritage Flag on Indonesian Independence Day. However, in the enthusiasm of the students to take part, the Dispora of South Sumatra Province still uses a manual assessment system so that several obstacles were found in its implementation. done with Microsoft Excel, as well as a calculation system that can only be used for one period, while this selection is an annual event that is held every time to celebrate Indonesian Independence Day. Therefore, we need a way that can help the Dispora of South Sumatra Province in determining the best alternative for paskibraka members. One algorithm that is useful in decision support is Topsis. Topsis is used in the application of values for each criterion and a different range of values. Then using the Promethee method can improve the Topsis method because the Promethee method is used to determine the order of priority in multi-criteria analysis. The data taken by 60 participants were then researched according to predetermined criteria including written test scores, interview tests, health tests, physical fitness, and posture. Produced the best participants according to the system as many as 15 data. The results of the research test have an accuracy of 80%.

1. Introduction

The Pusaka Flag Raising Troop (Paskibraka) is a group of the best young people selected through various stages of selection to raise and lower the Heritage Flag on Indonesian Independence Day. Becoming Paskribraka is the desire of every youth, so it's no wonder that the Paskibraka selection is the thing that high school, vocational and public high school, vocational and MA students look forward to the most. The selection process for prospective Paskibraka members is not easy, participants have to compete closely with hundreds of other participants through several stages starting from the school, district/city level, until the selected tens of the best participants who will represent their respective districts/cities to take part in the selection at the local level. province.

At the provincial level, the Dispora of South Sumatra Province still uses a manual assessment system so that several obstacles were found in the implementation of its activities. These obstacles include the high number of participants who will be compared, the many different criteria, the value processing process that takes a long time because it is done with Microsoft Excel, and the calculation system that can only be used for one period, while this selection is an annual event held the government celebrates Indonesian Independence Day every year. Based on the problems above, it is necessary to find a way that can help the Dispora of South Sumatra Province in determining the best alternative for paskibraka members

Decision support system (DSS) is a system designed to support all stages of decision making, from identifying problems, determining the approach used in the decision-making process, to evaluating alternative choices. The decision support system was chosen as a solution for this case because of its advantages, namely it is a solution to unstructured management problems in order to improve the quality of decision making, besides that DSS uses criteria as the basis for the calculation process, so that the results issued will be according to the needs of decision makers.

There are several methods that have been used for support systems decisions such as Simple Additive Weighing (SAW), The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Promethee. The Simple Additive Weighting (SAW) method is a DSS method with the basic concept of finding the weighted addition. However, the SAW method has a drawback, namely that it is basically local which causes the weighting system to tend to be static, namely according to the initial weighting input used, so this method is not suitable to be applied to the selection of paskibraka members because it can produce a system which is not so accurate and as needed. While the TOPSIS method is a method that 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.

TOPSIS method has a solution for the shortcomings of the SAW method, namely by applying a weighted value to each criterion and a different range of values. Thus, the TOPSIS method can be chosen because it has advantages in the form of the ability to overcome alternative differences even though the differences are quite small, besides that the TOPSIS method is also suitable to be used to solve a problem with various criteria as happened in the election of paskibraka members. However, among the advantages above, the constraint of this method is that there must be a predetermined and calculated weight.

The Promethee method is a method of determining the order or priority in multi-criteria analysis. The Promethee method can improve the TOPSIS method with the strength of preference from one alternative to another.

Based on the explanation above, this research will build a decision support system that uses the TOPSIS and Promethee methods in the selection of Paskibraka members in South Sumatra Province.

a. Literature Study / Hypotheses Development

Decision Support System

Decision support system (DSS) is a system designed to support all stages of decision making, from identifying problems, determining the approach used in the decision-making process, to evaluating alternative choices. The decision support system was chosen as a solution for this case because of its advantages, namely it is a solution to unstructured management problems in order to improve the quality of decision making, besides that DSS uses criteria as the basis for the calculation process, so that the results issued will be according to the needs of decision makers

Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method has a solution for a static weighting system, namely by applying a weighted value to each criterion and a different range of values. Thus, the TOPSIS method can be chosen because it has advantages in the form of the ability to overcome alternative differences even though the differences are quite small, besides that the TOPSIS method is also suitable to be used to solve a problem with various criteria as happened in the election of paskibraka members. However, among the advantages above, the constraint of this method is that there must be a predetermined and calculated weight.

Steps to solve problems using the TOPSIS method:

1. Create a normalized decision matrix. The TOPSIS method requires a performance rating of each alternative Ai on each of the normalized Ci criteria.

$$rij = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} X_{ij}^2}} \qquad (1)$$

With i = 1, 2, ..., m; and j=1,2, …, n.

rij = normalized decision matrix.

X_{ij} = weight of criteria to j on alternative i.

i = alternative to i.

j = criterion to j.

2. Create a weighted normalized decision matrix

$$Y = \left(y_{11}\, y_{12}\, y_{1j}\, y_{21}\, y_{22}\, y_{2j}\, y_{i1}\, y_{i2}\, y_{ij}\right)_{for\ yij = wj\ .\ rij} \quad (2)$$

Description:

Wj is the weight of the j criteria

Yij is an element of a normalized decision matrix.

3. Determine the positive ideal solution matrix and the negative ideal solution matrix

$$A^{+} = (y_1^{+}, y_2^{+}, ..., y_i^{+})$$

$$A^{-} = (y_1^{-}, y_2^{-}, ..., y_i^{-}) \quad (3)$$

Where:

y_j^{+} = max yij, if j is profit attribute min yij, if j is cost attribute.

y_j^{-} = min yij, if j is profit attribute max yij, if j is cost attribute.

4. Determine the distance between the value of each alternative with the positive ideal solution matrix (D+) and (D-) negative ideal solution matrix.

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

$$D_i^{-} = \sqrt{\sum_{i=1}^{n} (y_{ij} - y_i^{-})^2}\ ;\ i = 1,2,.., m \quad (4)$$

Description:

y_j^{+} is a positive ideal solution matrix element

y_j^{-} is a negative ideal solution matrix element

5. Determine the preference value for each alternative. Preference value is the proximity of an alternative to the ideal solution

$$Vi = \frac{D_i^{-}}{D_i^{-} + D_i^{+}}\ ;\ i = 1,2,...,m \quad (5)$$

Where:

A larger Vi value indicates an alternative priority.

Preference Ranking Organization Method for Enrichment Evaluation (Promethee)

The Promethee method is a method of determining the order or priority in multi-criteria analysis. The Promethee method can improve the TOPSIS method with the strength of preference from one alternative to another.

b. Methodology

Data Collection Method

The data used in this study were obtained by documentation. Data obtained from the Youth and Sports Office of South Sumatra Province in 2018. The data collected is in the form of prospective Paskibraka members of South Sumatra Province who have criteria, namely written test scores, interview tests, health tests, physical fitness, and posture.

Framework

1. Input the data of prospective Paskibraka members at this stage, enter research data, namely data for prospective members of Paskibraka, South Sumatra Province which has criteria, namely written test scores, interview tests, health tests, physical fitness, and posture. The data was obtained from the Department of Youth and Sports of South Sumatra Province.
2. TOPSIS and Promethee Method Process At this stage, the process of calculating the TOPSIS and Promethee methods is carried out using data on prospective members of Paskibraka, South Sumatra Province. The weighting is done by TOPSIS and the ranking is done by Promethee. The calculation process with TOPSIS is normalizing the decision matrix and then weighting the normalized matrix. After that, the Promethee calculation process is carried out, namely the predetermined criteria, adjusted to the type of preference function criteria. Then determine the degree of preference by looking for a comparison of values between alternatives and the value of h(d) or index of preference is obtained. Then look for the values of leaving flow, entering flow, and net flow so that the ranking of prospective members of Paskibraka South Sumatra Province is obtained.
3. Ranking results After the TOPSIS and Promethee methods were carried out, the ranking results were obtained.
4. Calculate accuracy at this stage, the ranking results obtained from the TOPSIS and Promethee methods are calculated for accuracy.
5. Accuracy results After calculating the accuracy, the accuracy results obtained from manual calculations with test data carried out by the system.

Topsis – Promethee

1. Create a Decision Matrix. An example of using 5 data in this calculation, can be seen in the table

Table 1. Alternative Data

Alternative	C1	C2	C3	C4	C5
A1	80	80	80	60	60
A2	40	100	90	80	80
A3	100	80	80	60	100
A4	80	60	80	80	100
A5	100	40	90	60	40

After making the table above so that the decision matrix can be described as follows:

$C = \{80\ 80\ \ 80\ 60\ 60\ \ 40\ 100\ 80\ 100\ \ \ 100\ 80\ 60\ 40\ \ \ 90\ 80\ 80\ 90\ \ 80\ 60\ 80\ 60\ \ 80\ 100\ 100\ 40\ \ \}$

2. Calculate the normalized decision matrix. Using eq. (1) and can be seen in table below and there is an explanation.

Table 2. Normalized Matrix

R	*C*1	*C*2	*C*3	*C*4	C5
*R*1	0,4313	0,478091444	0,425195203	0,390566733	0,33752637
*R*2	0,2157	0,597614305	0,478344603	0,520755644	0,45003516
*R*3	0,5392	0,478091444	0,425195203	0,390566733	0,56254395
*R*4	0,4313	0,358568583	0,425195203	0,520755644	0,56254395
*R*5	0,5392	0,239045722	0,478344603	0,390566733	0,22501758

The following is an explanation in the calculation:

$$R^{11} = \frac{80}{\sqrt{80^2+40^2+100^2+80^2+100^2}} = 0{,}4313$$

3. Calculating the weighted normalization decision matrix

Table 3. Weighted Normalization Decision Matrix

R	C1	C2	C3	C4	C5
W (weight)	0,1	0,2	0,2	0,25	0,25
*R*1	0,04313	0,095618289	0,085039041	0,097641683	0,084381593
*R*2	0,02157	0,119522861	0,095668921	0,130188911	0,11250879
*R*3	0,05392	0,095618289	0,085039041	0,097641683	0,140635988
*R*4	0,04313	0,071713717	0,085039041	0,130188911	0,140635988
*R*5	0,05392	0,047809144	0,095668921	0,097641683	0,056254395
Sum	0,21567	0,430282299	0,446454963	0,553302872	0,534416753

4. Normalize the decision matrix using promethee

Table 4. Normalization of the promethee decision matrix

Criteria	Min/Max	Alternative					Preference type	Parameters	
		A1	A2	A3	A4	A5		P	Q
C1	Max	80	40	100	80	100	II	16	-
C2	Max	80	100	80	60	40	II	32	-
C3	Max	80	90	80	80	90	II	0	-
C4	Max	60	80	60	80	60	II	0	-
C5	Max	60	80	100	100	40	II	32	-

5. Determine the type of preference for each of the most suitable criteria based on the data and considerations of the decision maker.

Table 5. Alternative (A1) comparison process

(A1,A2)	(A2,A3)
d = 80 - 40 = 40	d = 40 - 100 = -60
By taking into account the provisions of the 2nd preference type;	By taking into account the provisions of the 2nd preference type;
Cause' 40 > 16	Cause' -60 < -16
P (A1,A2) = 1 meanwhile P(A2,A1) = 0	P (A2,A3) = 1 meanwhile P(A3,A2) = 0

6. Calculating the multi-criteria preference index between alternatives

Table 6. Preference index

(A1,A2) = 1/5 *(0,21567 + 0 + 0,446454963 + 0,553302872 + 0) = 0,243085567
(A1,A3) = 1/5 *(0,21567 + 0 + 0 + 0 + 0,534416753) = 0,150017351
(A1,A4) = 1/5 *(0 + 0 + 0 + 0,553302872+ 0,534416753) = 0,217543925
(A1,A5) = 1/5 *(0,21567+ 0,430282299 + 0,446454963 + 0 + 0) = 0,218481452

7. Calculating alternative multi-criteria preferences

Table 7. Multi-Criteria Preferences

	A1	**A2**	**A3**	**A4**	**A5**
A1	0	0,243085567	0,150017351	0,217543925	0,218481452
A2	0,19293981	0	0,243085567	0,218481452	0,346734385
A3	0,286008027	0,19293981	0	0,153794574	0,282230803
A4	0,218481452	0,217543925	0,282230803	0	0,349968918
A5	0,217543925	0,089290993	0,153794574	0,08605646	0

8. Determine the values of leaving flow, entering flow, and net flow as well as the order of alternative priorities

Table 8. The value of Entering Flow

	A1	**A2**	**A3**	**A4**	**A5**	**Entering Flow**
A1	0	0,243085567	0,150017351	0,217543925	0,218481452	0,207282074
A2	0,19293981	0	0,243085567	0,218481452	0,346734385	0,250310304
A3	0,286008027	0,19293981	0	0,153794574	0,282230803	0,228743304
A4	0,218481452	0,217543925	0,282230803	0	0,349968918	0,267056274
A5	0,217543925	0,089290993	0,153794574	0,08605646	0	0,136671488

Table 9. The value of Leaving Flow

	A1	A2	A3	A4	A5	Leaving Flow
A1	0	0,243085567	0,150017351	0,217543925	0,218481452	0,228743304
A2	0,19293981	0	0,243085567	0,218481452	0,346734385	0,185715074
A3	0,286008027	0,19293981	0	0,153794574	0,282230803	0,207282074
A4	0,218481452	0,217543925	0,282230803	0	0,349968918	0,168969103
A5	0,217543925	0,089290993	0,153794574	0,08605646	0	0,299353889

Table 10. The value of Net Flow

Alternative	Leaving Flow	Entering Flow	Net Flow	Rank
A1	0,207282074	0,228743304	-0,02146123	4
A2	0,250310304	0,185715074	0,06459523	2
A3	0,228743304	0,207282074	0,02146123	3
A4	0,267056274	0,168969103	0,098087172	1
A5	0,136671488	0,299353889	-0,162682402	5

c. Result and Discussion

A. Experimental Result

In this section, the results of the rankings that have been tested will be displayed, where the results of the member election data are in .csv format. The results were obtained from the Topsis-Promethee method. In Table 11 can be seen the results of the research tests carried out.

Table 11. Experimental Result

Name	System Rank	Actual Dispora Rank	Conclussion
Apriansyah	9 (Accepted)	1 (Accepted)	Match, system and actual data <= 15
Jonathan	6 (Accepted)	2 (Accepted)	Match, system and actual data <= 15
Novianti Syofira	1 (Accepted)	3 (Accepted)	Match, system and actual data <= 15
Riko Prasetya	3 (Accepted)	4 (Accepted)	Match, system and actual data <= 15
M. Bintang Nata Alam	10 (Accepted)	5 (Accepted)	Match, system and actual data <= 15
Nyoman Puspa Werdi. P	5 (Accepted)	6 (Accepted)	Match, system and actual data <= 15
Rizky Andrean S	2 (Accepted)	7 (Accepted)	Match, system and actual data <= 15
Egga Shaputri	15 (Accepted)	8 (Accepted)	Match, system and actual data <= 15

Mutiara Cahya Pertiwi	4 (Accepted)	9 (Accepted)	Match, system and actual data <= 15
M. Ale Al Abiyyu	11 (Accepted)	11 (Accepted)	Match, system and actual data <= 15
Riska Putri	13 (Accepted)	12 (Accepted)	Match, system and actual data <= 15
Natasha Putri Devara	8 (Accepted)	13 (Accepted)	Match, system and actual data <= 15
Wahyu Akhasa	7 (Accepted)	16 (Rejected)	Not Match, system and actual data > 15
Bima Anggara Putra	12 (Accepted)	17 (Rejected)	Not Match, system and actual data > 15
Galih Prakasiwi	14 (Accepted)	18 (Rejected)	Not Match, system and actual data > 15

B. Discussion

A research experiment using the Topsis-Promethee method has been carried out, from the 60 data tested, the 15 highest rankings were taken from the system ranking results. There are 12 data that are equal to the ranking of the system and 3 data that are not the same for comparisons between rankings from the system and from DISPORA data, so this system has an accuracy of 80%. The results of testing this system indicate that the system can be used for the election of Paskibraka members by the Youth and Sports Office of South Sumatra Province

d. Conclusion

Based on the research that has been done in this research, the conclusions obtained are as follows:

1. Decision support system software for the selection of the South Sumatran Paskibraka members using the Topsis-Promethee method with 15 data. Topsis is used to determine the weights and promethee is used to determine the order or priority in multi-criteria analysis.
2. The accuracy of this method reaches 80% by testing 15 data, 12 data are similar to the original data and 3 data are not similar.

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