Development of Decision Support System for Selection Paskibraka Members of South Sumatera Province Using TOPSIS Method

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ABSTRACT
Paskibraka is an organization of flag hoisting troops in Indonesia. This group will lead the flag-raising on Indonesia big day, such as Independence Day. This organization opens selection every year for high school students only with several requirements needed. For becoming this member, they also have to pass various selection with their criteria. In obtaining a more accurate assessment of Paskibraka members, a decision support system will be providing recommendations on the results of the system to decision-makers in determining the final results. By this recommendation system, can support the decision for choosing delegates from the south Sumatera to the national level. In implementing a decision support system, it can apply the Technique For Others Reference by Similarity to Ideal Solution (TOPSIS) method that appropriate for multi-criteria decision-making cases.

Keywords: decision support system, TOPSIS method, flag hoisting troops, Paskibraka

INTRODUCTION
Processes leading to opposite poles in cultural, political, and economic, even the relationship between them has been far more complex, it builds up the nationalism and globalization.[2] Flag Hoisting Troops (PASKIBRAKA) are the best youth of the nation, candidate of nation leaders who are recruited and selected in every level of stages, through systems and mechanisms of education and training that increase and triggered national values and strengthen mental and physical aspects in order to have prime ability in carry out his duties as an flag hoisting troops. [4] The government held a selection at every level, starting from the district/city level, provincial level, and national level. At the provincial level, especially in the province of South Sumatra, selected students are students who have first been passed from each district/city selection that consists of male and female students. In 2018 enrolled students were 68 students and in 2019 increased became 102 students due to the high demand, while the number chosen to become a member of the South Sumatra Paskibraka is 50 students (25 male and 25 female) for South Sumatra Province and 2 best students (1 male and 1 female) will be delegated to National level from South Sumatera. it consists of 4 types of tests, such as health, psychological testing, physical fitness, and body posture. Paskibraka in South Sumatera is held and responsible by Dinas Pemuda dan Olahraga Sumatera Selatan.

A decision support system is subsystems intended to help decision-makers with interactive computer-based systems and use communications technologies, data, documents, knowledge and/or models to identify and solve problems and make decisions [1].

LITERATURE REVIEW
In research about decision support systems for supplier selection in the automotive industry using AHP, the AHP method is making the problem is divided into two hierarchies (main criteria and sub-criteria). 3 alternatives tested to this case because in AHP can't proceed in many alternatives because AHP will make the structure and compare every criteria and alternative that exist. And also each criterion having importance scale in pair-wise comparison to choosing the criteria of supplier selection. [4] In research about the decision support system for selecting the best employees using TOPSIS, TOPSIS is used because the recommendation system has results based on comparison from the shortest ideal solution and farthest ideal solution.[3] Decision Support System Decision Support System (DSS) is proposed for semi-structured buying decisions. The DSS has been designed considering, on one hand, the main features of a semi-structured decision problem. The decision process is not a linear one; the DSS is designed to allow the DM to come back to earlier phases in the course of the learning process.[7]

According to Simon, the process of making a decision is divided into 4 phases, such as [8]:

Intelligence phase. This stage is the identification process carried out by decision-makers for all problems that must be resolved. At this stage, the decision-maker is required to understand the problem.

Design phase.
This stage is the process of modeling the problem that has been previously defined by outlining the decision elements, alternative decision variables, and evaluation criteria were chosen.

Selection phase.
This stage is the stage of choosing a solution produced by a model. If the solution can be accepted at this phase, then proceed with the implementation phase of the decision solution.

Implementation phase
At this stage is a solution that has been proposed in the problem is an initiation or introduction to changes which are then managed.

TOPSIS
TOPSIS is a method found by Yoon and Hwang for solving multi-criteria decision making cases. [9]

Make a decision matrix.
This matrix will be evaluated based on the criteria of alternatives.

Make a decision matrix is normalized.
\[ r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \]

Make a decision matrix is normalized weighted.
\[ y_{ij} = w_i r_{ij} \]

Prescribing the positive and negative ideal solution with the ideal solution matrix.

Positive ideal solution :
\[ Y_1^+ = \left\{ \begin{array}{ll}
\max \{ Y_{ij} \} & \text{if } j \text{ is benefit attribute} \\
\min \{ Y_{ij} \} & \text{if } j \text{ is cost attribute}
\end{array} \right\} \]

Negative Ideal solution :
\[ Y_1^- = \left\{ \begin{array}{ll}
\min \{ Y_{ij} \} & \text{if } j \text{ is benefit attribute} \\
\max \{ Y_{ij} \} & \text{if } j \text{ is cost attribute}
\end{array} \right\} \]

5. Calculating separation
Positive Ideal Solution :
\[ D_i^+ = \sqrt{\sum_{i=1}^{m} (Y_{ij} - Y_{ij}^+)^2} \]

Negative Ideal Solution :
\[ D_i^- = \sqrt{\sum_{i=1}^{m} (Y_{ij} - Y_{ij}^-)^2} \]

6. Calculating the relative proximity to the positive ideal solution.
\[ D_i = \frac{D_i^-}{D_i^+ + D_i^-} \]

7. Alternative rank.

RESEARCH METHODS
According to Simon, the process of making a decision is divided into 4 phases, such as [8]:

Intelligence phase.
This stage is the identification process carried out by decision-makers for all problems that must be resolved. There are primary data and secondary data. Primary data is collected by interview with Dinas Pemuda dan Olahraga Sumsel as an institute that held the program. And Secondary data is collected by literature review with previous research. And then, in this stage should be analyzing the problem or opportunity that likely happens under the old decision-making system, such as inaccuracy entry data, longer time to process and how to manage the data.

Design phase.
This stage is the process of modeling the problem that has been previously defined by outlining the decision elements, alternative decision variables, and evaluation criteria were chosen. The model will be validated by the criteria set out to conduct an alternative evaluation of the selected decision.

The process of determining a solution is a process for designing or developing alternatives, determining decisions and assigning values and weights given to each alternative that exists.

Selection phase.
This stage is the stage of choosing a solution produced by a model.

Implementation phase
This stage is the implementation of a system that already designs in the design phase.

RESULTS AND DISCUSSION
This research is needed to determine:

Criteria
Table 1. Criteria

| Criteria                  | Weight (%) | Type  |
|---------------------------|------------|-------|
| Writing Test (C1)         | 10         | Benefit |
| Interview (C2)            | 20         | Benefit |
| Health (C3)               | 20         | Benefit |
| Physical Fitness (C4)     | 25         | Benefit |
| Body Posture (C5)         | 25         | Benefit |

Subcriteria

Table 2. Subcriteria of Writing Test

| Range of Writing Test | Value |
|-----------------------|-------|
| 76-100                | 100   |
| 51-75                 | 80    |
| 26-50                 | 60    |
| 0-25                  | 40    |

Table 3. Subcriteria of Interview

| Description                                           | Value |
|-------------------------------------------------------|-------|
| Good Attitude, communicate well and have other skill  | 100   |
| Good attitude and communicate well                    | 80    |
| Less polite and not good enough in communicating       | 60    |
| Not polite and can’t communicate well                  | 40    |

Table 4. Subcriteria of Health

| Health | Description            | Value |
|--------|------------------------|-------|
| A      | All Health Aspects Well| 100   |
| A’     | 9 Health Aspects Well  | 90    |
| A’     | 8 Health Aspects Well  | 80    |
| B’     | 7 Health Aspects Well  | 70    |
| B’     | 6 Health Aspects Well  | 60    |
| B’     | 5 Health Aspects Well  | 50    |
| C’     | 4 Health Aspects Well  | 40    |
| C’     | 3 Health Aspects Well  | 30    |
| C’     | 2 Health Aspects Well  | 20    |
| D      | 1 Health Aspects Well  | 10    |

Subcriteria of health based on medical checkup in 10 aspects (liver, heart, lungs, kidney, eyes, ears, nose, throat and body).
Table 5. Subcriteria of Physical Fitness

| Description                           | Value |
|---------------------------------------|-------|
| Physical Fitness above standard       | 100   |
| Physical Fitness fulfill the standard | 80    |
| Physical Fitness only enough in standard | 60    |
| Physical Fitness below standard       | 40    |

Assessment of physical fitness is count by amount of Sit Up, Push Up and Shuttle Run with a predetermined standard.

Table 6. Subcriteria of Posture

| Description                | Value |
|----------------------------|-------|
| Very Good Posture          | 100   |
| Good Posture               | 80    |
| Good Enough Posture        | 60    |
| Bad Posture                | 40    |

Table 7. Alternative Data

| Gender | Name | C1 | C2 | C3 | C4 | C5 |
|--------|------|----|----|----|----|----|
| Male   | L1   | 80 | 80 | 80 | 60 | 60 |
| Male   | L2   | 40 | 100| 90 | 80 | 80 |
| Male   | L3   | 100| 80 | 80 | 60 | 100|
| Male   | L4   | 80 | 60 | 90 | 80 | 80 |
| Male   | L5   | 80 | 80 | 70 | 40 | 60 |

Steps in TOPSIS:

1. Make a decision matrix.

\[
L = \begin{bmatrix}
80 & 80 & 80 & 60 & 60 \\
40 & 100 & 90 & 80 & 80 \\
100 & 80 & 80 & 60 & 100 \\
80 & 80 & 90 & 80 & 80 \\
80 & 80 & 70 & 40 & 60
\end{bmatrix}

P = \begin{bmatrix}
80 & 60 & 80 & 80 & 100 \\
100 & 40 & 90 & 60 & 40 \\
60 & 80 & 70 & 80 & 60 \\
80 & 60 & 100 & 40 & 80 \\
40 & 100 & 60 & 60 & 60
\end{bmatrix}

2. Make a decision matrix is normalized.

Table 8. Normalized Matrix

| R  | C1       | C2       | C3       | C4       | C5       |
|----|----------|----------|----------|----------|----------|
| R1 | 0.455842306 | 0.441726104 | 0.434500357 | 0.40824829 | 0.346410162 |
| R2 | 0.227921153 | 0.55215763 | 0.488812902 | 0.544331054 | 0.461880215 |
| R3 | 0.569802882 | 0.441726104 | 0.434500357 | 0.40824829 | 0.577350269 |
| R4 | 0.455842306 | 0.331294578 | 0.488812902 | 0.544331054 | 0.461880215 |
| R5 | 0.455842306 | 0.441726104 | 0.380187813 | 0.272165527 | 0.346410162 |
3. Make a decision matrix is normalized weighted.

Table 9. Weighted Normalized Matrix

| R   | Y_1      | Y_2      | Y_3      | Y_4      | Y_5      |
|-----|----------|----------|----------|----------|----------|
| W   | 0.1      | 0.2      | 0.2      | 0.25     | 0.25     |
| R_1 | 0.045584231 | 0.088345221 | 0.086900071 | 0.102062073 | 0.08660254 |
| R_2 | 0.022792115 | 0.110431526 | 0.09776258  | 0.136082763 | 0.115470054 |
| R_3 | 0.056980288 | 0.088345221 | 0.086900071 | 0.102062073 | 0.144337567 |
| R_4 | 0.045584231 | 0.066258916 | 0.09776258  | 0.136082763 | 0.115470054 |
| R_5 | 0.045584231 | 0.088345221 | 0.076037563 | 0.068041382 | 0.08660254 |

4. Prescribing the positive and negative ideal solution with the ideal solution matrix.

Table 10. Positive ideal solution

| Y_1       | Y_2       | Y_3       | Y_4       | Y_5       |
|-----------|-----------|-----------|-----------|-----------|
| 0.056980288 | 0.110431526 | 0.09776258 | 0.136082763 | 0.144337567 |

Table 11. Negative Ideal Solution

| Y_1       | Y_2       | Y_3       | Y_4       | Y_5       |
|-----------|-----------|-----------|-----------|-----------|
| 0.022792115 | 0.066258916 | 0.076037563 | 0.068041382 | 0.08660254 |

5. Calculating separation

Table 12. Positive ideal

| D+          |           |           |           |           |
|-------------|-----------|-----------|-----------|-----------|
| D1+         | 0.072293913 | 0.044745553 | 0.041990551 | 0.053985396 |
| D2+         | 0.041990551 |           |           |           |
| D3+         | 0.053985396 |           |           |           |
| D4+         | 0.095145228 |           |           |           |

Table 13. Negative ideal

| D-          |           |           |           |           |
|-------------|-----------|-----------|-----------|-----------|
| D1-         | 0.047777473 |           |           |           |
| D2-         | 0.088804048 |           |           |           |
| D3-         | 0.077000289 |           |           |           |
| D4-         | 0.080339404 |           |           |           |
| D5-         | 0.03173776 |           |           |           |

6. Relative proximity. for example:

\[ V^1 = \frac{0.047777473 + 0.072293913}{0.397908898} = 0.397908898 \]

7. Alternative Rank

| No. | Name | Value      |
|-----|------|------------|
| 1.  | L2   | 0.664951803 |
| 2.  | L3   | 0.647111062 |
| 3.  | L4   | 0.598098074 |
| 4.  | L1   | 0.397908898 |
| 5.  | L5   | 0.250134083 |
CONCLUSION

The implementation of the TOPSIS method can give a recommendation system to help the decision-maker to take the final decision. The result is taken by sorting the alternatives that have comparison results between the farthest ideal solution and the shortest ideal solution from negative and positive solutions. The result is used to support a decision for being Paskibraka members in South Sumatera Province and delegates for goes to National.

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