Decision Support System Museum Ambassadors Using TOPSIS Method

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Abstract. Generally, museum ambassador is based on various criteria from several assessment stages. The evaluation criteria for the audition stage are: interview, communication, appearance. The assessment criteria for the quarantine stage are: creativity, ability, liveliness, loyalty, responsibility, and written test. The final stage assessment criteria are: ideas, communication, and appearance. In the selection process, the committee used manual method so it was prone to errors. The decision support system used TOPSIS method. SDLC (System Development Life Cycle) was used as a design method. The research showed a score of 100 which means that the system is accepted by users. Meanwhile the user testing to four respondents obtained a percentage of 89.24% which means that the system is worth using. The system was developed in the web. So that is need more research to be developed in mobile.

1. Introduction
A museum ambassador is a person who represents or becomes an icon, and his/her task is to educate the general public to be familiar with the museum. The presence of museum ambassador aims to help improve museum marketing, invite people to be willing to visit museum, make people aware of the importance of museum as a source of knowledge, a source of inspiration, a recreation place, and as a place of national character education [1]. The word “Museum” is derived from the word Muze, which in the Ancient Greek language is defined as a group of nine goddesses, a symbol of arts [2]. To date, the audition of museum ambassadors in Ranggawarsita Museum in Semarang City still uses paper-based conventional or manual selection processes. However in practice, there are many weaknesses of such paper-based system, for examples: paper-based data are damaged or lost, data processing is difficult or takes a long time, the tabulation process is error-prone, and the process of report writing takes a relatively long time. Therefore, the authors wanted to minimize the use of paper-based manual system by introducing a computer-based decision support system in the selection of the ambassadors of Central Java Museum.

2. Methods
2.1. Decision Support System
The concept of Decision Support System (DSS) was first introduced in the early 1970s by Michael S. Scott Morton using the term Management Decision System [3]. Decision Support System (DSS) is an information-producing system [4] which aims to solve various problems [5] with the help of computer technology in decision making process [6].
2.2. TOPSIS Method

TOPSIS method, which stands for Technique for Order Preference by Similarity to Ideal Solution, is one of decision making methods which can be applied in this problem. This method searches for the best alternative with the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution, with certain criteria and weight of each of these criteria determined by a company. Based on the test results obtained in this study, the decision support system being developed could help or support the museum in selecting the best museum ambassadors [1].

TOPSIS is one of the multi-criteria decision-making methods which was first introduced by Yoon and Hwang (1981) [3]. TOPSIS has the principle that the selected alternatives must have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution from a geometrical point by using the Euclidean distance between two points to determine the relative proximity of an alternative [7].

In general, TOPSIS procedures are as follows [8]:

a) Making a normalized decision matrix
b) Making a weighted normalized decision matrix
c) Determining a matrix of positive ideal solution and negative ideal solution
d) Determining the distance between the values of each alternative with a matrix of positive and negative ideal solutions
e) Determining the preferred value for each alternative

3. Results and discussion

TOPSIS algorithms were used in the three stages of selection, i.e. the audition stage, the quarantine stage, and the final stage. TOPSIS calculation resulted in the ranking of each alternative (candidate) and the winner or the best alternative was determined based on such ranking. The number of shortlisted candidates of each of the selection stages was determined as needed. The assessment criteria for each of the selection stages were different and shown in Table 1 – Table 3.

| Criteria             | Descriptions                                                                 |
|----------------------|-----------------------------------------------------------------------------|
| Questions and Answers| Questions about the program that will be held, being creative in answering  |
| Communication        | Speaking fluently and focusing on the materials                             |
| Appearance           | Tall, beautiful, expressive speech                                          |

| Criteria             | Descriptions                                                                 |
|----------------------|-----------------------------------------------------------------------------|
| Creativity           | Being creative in describing the socialization programs of the museum       |
| Ability              | Ability to offer solutions to museum development and how to promote the museum |
| Liveliness           | Being active in groups during quarantine/training                            |
| Loyalty              | Being loyal, i.e. being serious in being an ambassador and loyal to the museum |
| Responsibility       | Being responsible for any tasks given by the judges                         |
| Written test         | Each judge was required to make questions, then the questions were put together to be given to each candidate |

| Criteria             | Descriptions                                                                 |
|----------------------|-----------------------------------------------------------------------------|
| Ideas                | Ideas in promoting the museum to the general public without spending money  |
| Communication        | Fluently communicating and focusing on the materials                          |
| Appearance           | Tall, beautiful, expressive speech                                          |
The scores that the judges could give to the candidates ranged from 2, 3, 4, and 5 or using a description, i.e. poor, fair, good, and very good.

| Table 4. Score of Criteria | Score | Descriptions |
|-----------------------------|-------|--------------|
| 2                           | Poor  |
| 3                           | Fair  |
| 4                           | Good  |
| 5                           | Very Good |

The steps in Topsis calculation are as follows:

a) Making decision matrix (X)
Decision matrix contains data of alternatives and criteria listed in the form of table or matrix. The decision matrix of the final stage of Central Java museum ambassador selection can be seen in Table 5.

| Alternatives                  | Criteria 1 | Criteria 2 | Criteria 3 |
|-------------------------------|------------|------------|------------|
| Abdurrouf Khodamul Umam       | 5          | 5          | 5          |
| Anita Sholikha                | 5          | 4          | 3          |
| Aulia Azzumardila Adzra       | 5          | 4          | 5          |
| Michael Rivaldy Mewengkang    | 5          | 5          | 4          |
| Ika Audiyah Andriyani         | 5          | 4          | 4          |
| Jacika Pifi Nugraheni          | 4          | 3          | 3          |
| Ayu Sabrina                   | 4          | 2          | 2          |
| Mega Purnomo                  | 3          | 3          | 2          |
| Rio Awang Maulana             | 3          | 3          | 2          |
| Riki Supriyadi                | 4          | 4          | 3          |

b) Making weighted criteria matrix (W)
Weighted criteria matrix contains the data of criteria weights listed in the form of table or matrix. The weighted criteria matrix of the final stage of Central Java museum ambassador selection can be seen in Table 6.

| Code | Criteria    | Type   | Weight |
|------|-------------|--------|--------|
| K_1  | Ideas       | Benefit| 0.5    |
| K_2  | Communication| Benefit| 0.3   |
| K_3  | Appearance  | Benefit| 0.2    |

The steps in Topsis calculation are as follows:

c) Making normalized decision matrix (R)
Normalized decision matrix contains the data of the result of normalized calculation listed in the form of table or matrix.

| Alternatives                  | Criteria 1 | Criteria 2 | Criteria 3 |
|-------------------------------|------------|------------|------------|
| Abdurrouf Khodamul Umam       | 0.362      | 0.415      | 0.455      |
| Anita Sholikha                | 0.362      | 0.332      | 0.273      |
| Aulia Azzumardila Adzra       | 0.362      | 0.332      | 0.455      |
| Michael Rivaldy Mewengkang    | 0.362      | 0.415      | 0.364      |
| Ika Audiyah Andriyani         | 0.362      | 0.332      | 0.364      |
d) Making weighted normalized decision matrix (\(Y\))

Normalized decision matrix contains the calculation result of normalized matrix and weighted matrix listed in the form of table or matrix.

**Table 7 Weighted Normalized Decision Matrix**

| Alternatives                  | Criteria |
|-------------------------------|----------|
|                               | \(K_1\) | \(K_2\) | \(K_3\) |
| Jacika Pifi Nugraheni         | 0.289    | 0.249    | 0.273    |
| Ayu Sabrina                   | 0.289    | 0.166    | 0.182    |
| Mega Purnomo                  | 0.217    | 0.249    | 0.182    |
| Rio Awang Maulana             | 0.217    | 0.249    | 0.182    |
| Riki Supriyadi                | 0.289    | 0.332    | 0.273    |

e) Determining the matrix of positive ideal solution and negative ideal solution (\(A^+\) and \(A^-\))

Matrix of positive ideal solution and negative ideal solution (\(A^+\) and \(A^-\)) is the calculation result of positive ideal solution and negative ideal solution listed in the form of table or matrix. Benefit attribute is an attribute given the highest score to obtain the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. On the other hand, cost attribute is an attribute given the lowest score to obtain the farthest distance from the positive ideal solution and the shortest distance from the negative ideal solution.

**Table 8 Weighted Normalized Decision Matrix**

| Alternatives                  | Criteria |
|-------------------------------|----------|
|                               | \(K_1\) | \(K_2\) | \(K_3\) |
| Abdurrouf Khodamul Umam       | 0.1809   | 0.1246   | 0.0909   |
| Anita Sholikha                | 0.1809   | 0.0997   | 0.0545   |
| Aulia Azzumardila Adzra       | 0.1809   | 0.0997   | 0.0909   |
| Michael Rivaldy Mewengkang    | 0.1809   | 0.1246   | 0.0727   |
| Ika Audiyah Andriyani         | 0.1809   | 0.0997   | 0.0727   |
| Jacika Pifi Nugraheni         | 0.1447   | 0.0747   | 0.0545   |
| Ayu Sabrina                   | 0.1447   | 0.0498   | 0.0364   |
| Mega Purnomo                  | 0.1085   | 0.0747   | 0.0364   |
| Rio Awang Maulana             | 0.1085   | 0.0747   | 0.0364   |
| Riki Supriyadi                | 0.1447   | 0.0997   | 0.0545   |

f) Determining the distance between the scores of each alternative with the matrix of positive ideal solution and negative ideal solution (\(D^+\) and \(D^-\))

Matrix of distance from positive ideal solution and distance from negative ideal solution (\(D^+\) and \(D^-\)) is the calculation result of distance from positive ideal solution and distance from negative ideal solution listed in the form of table or matrix.

**Table 9 Matrix of Distance from Positive Ideal Solution and Negative Ideal Solution**

| Alternatives                  | \(D^+\) | \(D^-\) |
|-------------------------------|----------|----------|
| Abdurrouf Khodamul Umam       | 0.0000   | 0.1175   |
| Anita Sholikha                | 0.0441   | 0.0897   |
| Aulia Azzumardila Adzra       | 0.0249   | 0.1034   |
| Michael Rivaldy Mewengkang    | 0.0182   | 0.1102   |
| Ika Audiyah Andriyani         | 0.0308   | 0.0951   |
Alternatives | $D^+$ | $D^-$
---|---|---
Jacika Pifi Nugraheni | 0.0715 | 0.0475
Ayu Sabrina | 0.0993 | 0.0362
Mega Purnomo | 0.1034 | 0.0249
Rio Awang Maulana | 0.1034 | 0.0249
Riki Supriyadi | 0.0570 | 0.0642

Determining preferred value ($V$) of each alternative

Preferred value ($V$) of each alternative. The highest preferred value ($V_i$) shows that the $i$-th alternative deserves to be selected as the best solution.

Table 10 Preferred Value

| Alternatives                  | Vector ($v$)  |
|-------------------------------|--------------|
| Abdurrouf Khodamul Umam      | 1.0000       |
| Anita Sholikha                | 0.6705       |
| Aulia Azzumardila Adzra       | 0.8059       |
| Michael Rivaldy Mewengkang    | 0.8584       |
| Ika Audiyah Andriyani         | 0.7551       |
| Jacika Pifi Nugraheni         | 0.3993       |
| Ayu Sabrina                   | 0.2669       |
| Mega Purnomo                  | 0.1941       |
| Rio Awang Maulana             | 0.1941       |
| Riki Supriyadi                | 0.5296       |

Table 12 Conclusions of Winners of Museum Ambassador

| Alternatives | Winner                                    |
|--------------|-------------------------------------------|
| 1st Runner-up| Abdurrouf Khodamul Umam                   |
| 2nd Runner-up| Michael Rivaldy M                         |
| 3rd Runner-up| Aulia Azzumardila Adzra                   |
| 4th Runner-up| Ika Audiyah Andriyani                     |
| 5th Runner-up| Riki Supriyadi                            |

4. Conclusion

a. Topsis method which is a decision support system which is able to solve various multi-criteria decision making problems can also be used to solve the problems in selecting a Museum Ambassador.

b. An application has been successfully created using the SDLC (System Development Life Cycle) method and a system using a decision support system with Topsis method.

c. Manual Topsis calculation results are the same as computer-based calculation results.

d. User acceptance testing (UAT) uses questionnaires filled out or evaluated by museum staffs and by experts (lecturers). The results of this test show that the software has a percentage of 89.24% thus receiving a predicate of "The system is feasible to use"

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