Decision Support System on Selection of Lecturer Research Grant Proposals using Preferences Selection Index

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Abstract. The Institute for Research and Community Service is a forum for lecturers at every university/institution to develop their knowledge according to their respective disciplines through research fields. This study aims to determine the recipient of the best research grant at STIKOM Tunas Bangsa Pematangsiantar. Research data comes from relevant agencies. There are 9 names of lecturers that are used as alternatives and 5 criteria as the assessment of grantees, namely type of problem formulation (C1), research output opportunities (C2), research method (C3), literature review (C4) and research feasibility (C5). This study uses the Preference selection index (PSI) method. In this method does not require relative determination of attributes, so the researcher does not need to determine the weight criteria. Based on the results of the study obtained several alternatives with the highest preference value, A8 (index selection value 0.8819), A9 (index selection value 0.8627), A4 (index selection value 0.8447), A3 (index selection value 0.83123) and A5 (Index selection value 0.8184) are entitled to get an internal research grant at STIKOM Tunas Bangsa. With this system, it can be used as a comparison between reviewer evaluators and the PSI system so as to maintain the quality of assessment in determining the recipients of internal research grants objectively. It is hoped that this research can provide recommendations to the Institute for Research and Community Services in determining internal lecturer research proposal grants so that the results obtained are more objective.

1. Introduction

Institute for Research and Community Service is an institution that handles the activities of the field of research and community service which is a forum for lecturers in every university/institution to develop their knowledge according to their respective disciplines through research fields. The internal grant research program is intended as a research activity to foster and direct beginner researchers to improve their ability to carry out research in universities. This study aims to stimulate the interest of lecturers in conducting publications that have outcomes that can be used to increase the value of institutional accreditation. Over time, the evaluation of proposals made by competent reviewers through the related Research and Community Service Institutions must always be improved considering the number of internal lecturers research proposals has increased every year.

Recognizing the importance of proposal evaluation, it is necessary to have a decision support system that can assist the Research and Community Service section in comparing the assessment
results of reviewers to determine the choices that are entitled to receive internal lecturer research grants. Many branches of computer science can solve complex problems. This is evidenced by several studies in the field of data mining [1]–[8], artificial neural network field [9]–[13], and in the field of decision support systems [14]–[18]. Based on the existing problems, the analysis is needed using the Preference Selection Index (PSI) algorithm to produce an appropriate comparison in the selection of internal lecturer research proposals that match the criteria. Based on previous research [19] discuss The decision taken in the selection of scholarship recipients for students is one of the responsibilities held by the stakeholders at the high school leadership level. Subsequent research by [20] which discusses how to present a logical procedure for selecting automatic guided vehicles in the field of environmental manufacturing for a given application. Next with research [21] which concludes that this method is simple, logical, and more appropriate for the facility of problem layout design selection compared to the method presented by the previous researchers.

In this case, the researcher uses the Preference Selection Index Method in which conflicts in resolving the relative importance of attributes [22]. In determining the weight of the Preference Selection Index method by determining by the information contained in the decision matrix, the standard deviation or entropy method can be identified from the criteria object weight [19]. It is expected that this research can provide recommendations to the Institute for Research and Community Service in determining internal lecturer research proposal grants so that the results obtained are more objective.

2. Methodology

2.1. Decision Support System

Decision Support System (DSS) is a computerised information system which contains domain-specific knowledge and analytical decision models to assist the decision maker by presenting information and the interpretation of various alternatives [23].

2.2. The Preference Selection Index (PSI)

Preference selection index method was developed by Maniya and Bhatt (2010) [24][25] for solving the multi-criteria decision making (MCDM) problems. In the proposed method it is not necessary to assign a relative importance between attributes[24]. Moreover, there is no requirement of computing the weights of attributes involved in decision making problems in this method. This method is useful when there is a conflict in deciding the relative importance among attributes [26].

2.3. Data used

This research was conducted at STIKOM Tunas Bangsa Pematangsiantar. The process of collecting data by taking data in the 2017 archives in related institutions and doing interviews with the LPPM STIKOM Tunas Bangsa Pematangsiantar section. The total data sample used was 9 lecturers (A1-A9). Some criteria used in the assessment of internal lecturer research proposals:

| No | Assessment criteria                                           | Type    | Weight (%) |
|----|----------------------------------------------------------------|---------|------------|
| 1  | Formulation of the problem                                    | Benefit | 25         |
|    | a. The sharpness of problem formulation                       |         |            |
|    | b. Research purposes                                          |         |            |
|    | Opportunities for research outcomes                           |         |            |
|    | a. Scientific publication                                    |         |            |
|    | b. Socio-science and technology development                   |         |            |
|    | c. Enrichment of teaching materials                           |         |            |
| 2  | Research methods                                              | Cost    | 25         |
|    | The accuracy and suitability of the method used                |         |            |
| 3  | Literature review                                             | Benefit | 25         |
| 4  |                                                               | Benefit | 15         |
| No | Assessment criteria                  | Type   | Weight (%) |
|----|-------------------------------------|--------|------------|
| 4  | a. Relevance                         |        |            |
|    | b. Update                            |        |            |
|    | c. Compilation of library lists      |        |            |
| 5  | Research feasibility                 |        |            |
|    | a. Timeliness                        | Benefit| 10         |
|    | b. Cost compatibility                |        |            |
|    | c. Personnel suitability             |        |            |

Amount 100

The Preference selection index method is used where the conflict in resolving the relative importance of attributes. In determining the weight of the Preference selection index method by determining the information contained in the decision matrix, the standard deviation or entropy method can be identified from the object weight criteria. This study uses 5 criteria, namely problem formulation (C1), research outcome opportunities (C2), research method (C3), literature review (C4), and research feasibility (C5). Several steps to develop the PSI method [19][20][26]:

1. Identify the problem.
   Determine alternatives along with related attributes in decision making.

2. Identify the decision matrix.
   m in the Xij matrix is the number of alternatives for selection and n is the number of attributes. While Xij is the decision matrix of i-th alternative with j-th criterion.

\[ X_{ij} = \begin{bmatrix} x_{1i} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \]  

(1)

3. Normalize the decision matrix.
   The normalized decision matrix is constructed using equations (2) and (3)

\[ R_{ij} = \frac{x_{ij}}{x_{j,max}}, \]  

(2)

If the smaller value is better than the other value then use the cost attribute

\[ R_{ij} = \frac{x_{j,min}}{x_{ij}}, \]  

(3)

4. Determination of the mean value of the normalized matrix
   \[ N = \frac{1}{N} \sum_{i=1}^{m} R_{ij} \]  

(4)

5. Calculates the value of preference variation in this step
   The value of preference variation (\( \phi_j \)) or each attribute is determined using the following equation

\[ \phi_j = \sum_{i=1}^{m} (R_{ij} - N)^2 \]  

(5)

6. Determine the deviation of preference value
   \[ \Omega_j = 1 - \phi_j \]  

(6)

7. Determine the criteria weight
   \[ w_j = \frac{\Omega_j}{\sum_{j=1}^{n} \Omega_j} \]  

(7)

8. Determination the preference selection index
   \[ \theta_j = \sum_{i=1}^{m} R_{ij} w_j \]  

(8)

3. Result and Discussion
   To determine alternatives and criteria, the author has conducted interviews directly with the resource person. In this study, there were nine lecturers as an alternative and five criteria, namely the type of problem formulation (C1), research outcome opportunities (C2), research method (C3), literature review (C4), research feasibility (C5). Normalization of the decision matrix based on the attributes of the benefits and the cost attributes. Advantage attributes C1, C3, C4, and C5 while attribute costs C2.
Table 2. Alternatives and criteria

| Alternatives | Criteria |
|--------------|----------|
|              | C1 | C2 | C3 | C4 | C5 |
| A1           | 150| 150| 75 | 90 | 60 |
| A2           | 125| 125| 125| 45 | 30 |
| A3           | 150| 150| 150| 105| 30 |
| A4           | 175| 150| 150| 105| 20 |
| A5           | 150| 150| 150| 90 | 30 |
| A6           | 125| 125| 75 | 45 | 50 |
| A7           | 125| 125| 125| 30 | 50 |
| A8           | 150| 125| 150| 45 | 50 |
| A9           | 175| 150| 75 | 45 | 50 |

Before determining the normalization of the decision matrix, first look for maximum and minimum values. The maximum value is used for benefit attributes with equation 2 while attribute cost uses the minimum value with equation 3. The results of normalizing the decision matrix can be seen in Table 3.

Table 3. Results of the normalization decision matrix

| C1   | C2  | C3   | C4  | C5   |
|------|-----|------|-----|------|
| 0.8571 | 0.8333 | 0.5  | 0.8571 | 1    |
| 0.7143 | 1   | 0.8333 | 0.4286 | 0.5  |
| 0.8571 | 0.8333 | 1   | 1   | 0.5  |
| 1     | 0.8333 | 1   | 1   | 0.3333 |
| 0.8571 | 0.8333 | 1   | 0.8571 | 0.5  |
| 0.7143 | 1   | 0.5  | 0.4286 | 0.8333 |
| 0.7143 | 1   | 0.8333 | 0.2857 | 0.8333 |
| 0.8571 | 1   | 0.8571 | 0.4286 | 0.8333 |
| 1     | 0.8333 | 0.5  | 1   | 1    |

Equation 4 to determine the average value of the normalization of the decision matrix.

\[ N1 = \frac{1}{9}(0.8571 + 0.7143 + 0.8571 + 1 + 0.85 + 0.7143 + 0.8571 + 1) = 0.8413 \]
\[ N2 = \frac{1}{9}(0.8333 + 1 + 0.8333 + 0.8333 + 0.8333 + 1 + 1 + 1 + 0.8333) = 0.9074 \]
\[ N3 = \frac{1}{9}(0.5 + 0.8333 + 1 + 1 + 1 + 0.5 + 0.8333 + 1 + 0.5) = 0.7963 \]
\[ N4 = \frac{1}{9}(0.8571 + 0.4286 + 1 + 1 + 0.8571 + 0.4286 + 0.2857 + 0.4286 + 1) = 0.6984 \]
\[ N5 = \frac{1}{9}(1 + 0.5 + 0.5 + 0.3333 + 0.5 + 0.8333 + 0.8333 + 0.8333 + 0.8333 + 1) = 0.7037 \]

Equation 5 to determine the value of preference variations. Results can be seen in Table 4.

Table 4. Results of variation preference values

| C1   | C2  | C3   | C4  | C5   |
|------|-----|------|-----|------|
| 0.0003 | 0.0055 | 0.08779 | 0.0252 | 0.0878 |
| 0.0161 | 0.0086 | 0.00137 | 0.0728 | 0.0415 |
| 0.0003 | 0.0055 | 0.0415 | 0.091 | 0.0415 |
| 0.0252 | 0.0055 | 0.0415 | 0.091 | 0.1372 |
| 0.0003 | 0.0055 | 0.0415 | 0.0252 | 0.0415 |
| 0.0161 | 0.0086 | 0.08779 | 0.0728 | 0.0168 |
| 0.0161 | 0.0086 | 0.00137 | 0.1703 | 0.0168 |
| 0.0003 | 0.0086 | 0.0415 | 0.0728 | 0.0168 |
| 0.0252 | 0.0055 | 0.08779 | 0.091 | 0.0878 |

Table 3 is the result of variation preferences, then looks for the value of the overall preference variations based on the criteria with equation 5. So that \( \emptyset_j \) is obtained as follows:

Table 5. Average value of preference variation

| C1   | C2  | C3   | C4  | C5   |
|------|-----|------|-----|------|
| 0.0998 | 0.0617 | 0.4321 | 0.712 | 0.4877 |
The next step determines the deviation in the preference value using equation 6.

\[
\Omega_1 = 1 - 0.0998 = 0.9002 \\
\Omega_2 = 1 - 0.0617 = 0.9383 \\
\Omega_3 = 1 - 0.4321 = 0.5679 \\
\Omega_4 = 1 - 0.712 = 0.288 \\
\Omega_5 = 1 - 0.4877 = 0.5123
\]

After the total deviation value is known, then look for the weight of each criterion using equation 7.

\[
W_j = 0.2807; 0.2926; 0.1771; 0.0898; 0.1598
\]

The last step then calculates the selection index preference value using equation 8.

**Table 6. Ranking results**

| Alternatives | Nilai selection index | Rank |
|--------------|-----------------------|------|
| A1           | 0.8098                | 6    |
| A2           | 0.7591                | 8    |
| A3           | 0.8312                | 4    |
| A4           | 0.8447                | 3    |
| A5           | 0.8184                | 5    |
| A6           | 0.7533                | 9    |
| A7           | 0.7995                | 7    |
| A8           | 0.8819                | 1    |
| A9           | 0.8627                | 2    |

Table 6 can be seen the ranking results with the highest index selection value that has been obtained from the Preference Selection Index calculation. Of the nine alternatives obtained, A8 is an alternative that gets the highest score followed by A9, A4, A3, and A5.

4. Conclusion

Based on the results of the discussion above, it can be concluded that the decision support system with the Preference Selection Index algorithm can be used as a solution in recommending internal research grant recipients. Based on the results of the study, there were several alternatives with the highest preference values, namely A8 (index selection value 0.8819), A9 (index selection value 0.8627), A4 (index selection value 0.8447), A3 (index selection value 0.8312) and A5 (Index selection value 0.8184) are entitled to get an internal lecturer research grant at STIKOM Tunas Bangsa Pematangsiantar. With this system, it can help the Research Institute to the Community in determining internal lecturer research grant proposals and can be used as a comparison between reviewer evaluators and the Preference Selection Index system so as to maintain the quality of the assessment in determining objectively internal research grant recipients.

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