Analysis of PROMETHEE II Method on Selection of Lecturer Community Service Grant Proposals

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Abstract. This study aims to determine the recipient lecturers of the service to the internal community at STIKOM Tunas Bangsa. The data were obtained from the archive of the Institute for Research and Service to the Tunas Bangsa STIKOM Community in 2017 and conducted interviews with the Chairperson of the Institute. The alternatives used are 6, namely Situation Analysis (C1), Partner prioritization problems and solutions offered (C2), output targets (C3), accuracy of approach methods to overcome problems, activity plans, partner participation contributions (C4), college feasibility (C5), the cost of work for the feasibility of the proposed cost (C6). The method used in the research of the PROMETHEE II Method. From the results of the study obtained 5 alternatives selected lecturers who received internal service grants, namely: A1 (Net flow 13.79), A5 (Net flow 7.23), A2 (Net flow 7.16), A6 (Net flow 6.29), A3 (Net flow 2.08) of 9 Alternatives. The implementation of the PROMETHEE II method is expected to provide an objective assessment and to compare the results of the reviewer's assessment in determining the recipients of internal service grants. So that it is expected that the decisions given can maintain the quality and quality of the assessment.

1. Introduction

Community service is one form of lecturer activity in the form of seminars, counseling, guidance, and others. Community service for the lecturers is one of the dharma from the tri dharma of higher education that must be carried out. Institute for Research and Community Service STIKOM Tunas Bangsa is an institution that handles research and community service activities which is a forum for STIKOM Tunas Bangsa lecturers to develop their knowledge according to their respective disciplines through the field of community service. In the implementation of higher education, research and community service are the obligations of a lecturer in addition to teaching. One of them is an internal lecturer service grant program. This program is intended as a service activity to foster and direct the lecturers in improving their abilities. This internal lecturer service grant is intended for all lecturers in the Tunas Bangsa STIKOM with university funding. The amount of funds allocated for internal lecturer service grants is Rp. 4.000.000, - up to Rp. 5.000.000, - each title per semester. It is expected that the results of the dedication of the lecturers can be used as teaching materials for enrichment in learning activities and increase the value of institutional accreditation. Many branches of computer science can solve complex problems. This is evidenced by several studies in the field of data mining [1]–[8], field of artificial neural networks [9]–[13] and in the field of decision support systems [14]–[18]. Based on this explanation, researchers used a decision support system to solve the problem above. The PROMETHEE II method is a reasonably simple ranking in concepts and applications...
compared to other methods for multi-criteria analysis. This method will later take decisions with several different and alternative criteria and will produce the highest value that will then be chosen as the best alternative. Based on the above background, it is hoped that the PROMETHEE II algorithm can be a comparison in determining the recipients of internal service grants that are by assessment results from the reviewer.

2. Methodology

2.1. Decision Support System
Decision support system is an information system at the management level of an organization that combines data and sophisticated analytical models to support decision-making in the condition of semi-structured and unstructured. Decision support system can be interpreted as a model-based system consisting of procedures in processing the data and the results of the data processing are used to assist managers in making decisions[19].

2.2. PROMETHEE II Method
Preference function based outranking method is a special type of MCDM tool that can provide a ranking ordering of the decision options. The PROMETHEE (preference ranking organization method for enrichment evaluation) method was developed by Brans and Vincke in 1985. The PROMETHEE I method can provide the partial ordering of the decision alternatives, whereas, PROMETHEE II method can derive the full ranking of the alternatives[20].

2.3. Data Used
This research was conducted at STIKOM Tunas Pemutangsiantar, especially the part of the Institute for Research and Community Service. The data were obtained from the archive of the Institute for Research and Community Service to the STIKOM Tunas Bangsa Community in 2017 and conducted interviews with the Research and Community Service Institutions section. The total data sample used is 9 lecturers (initials A1-A9) and PROMETHEE II used to get the rank of lecturers who are candidates for the recipient of internal service grants. The grantee lecturer assessment criteria are as follows:

| Criteria                                                                 | (Cj) | Type | Weight |
|-------------------------------------------------------------------------|------|------|--------|
| Situation Analysis (Current Partner Conditions, Common Problems faced by partners) | C1   | Benefit | 20     |
| Partner prioritization issues and solutions offered (suitability of problems, solutions and team competitions) | C2   | Benefit | 15     |
| Output Target (Output type and specifications according to proposed activities) | C3   | Benefit | 15     |
| Accuracy of Approach Methods to overcome problems, Plan activities, contribution of partner participation | C4   | Benefit | 20     |
| Company Feasibility (Qualification of Executing Team, Relevance of Team Skill, Team Synergism, Community Experience, Team Organization, Activity Schedule, Attachment Completeness) | C5   | Benefit | 10     |
| Cost of Work Feasibility Proposed Costs (Honorarium (maximum 30%). Materials used up, equipment, travel, other expenses) | C6   | Cost | 20     |

In Table 1 it can be explained that the criteria that will be used as a reference in decision making, namely C1 to C6. The criteria determined based on the Internal Grants assessment form from the Institute for Research and Community Service.

2.4. Weighting Value
The weighting results of each criterion are given a score of 1 (Bad), 2 (Very Less), 3 (Poor), 5 (Fair), 6 (Good) and 7 (Very Good). To provide alternative values for each criterion, the weight of each criterion is determined in advance. Weight 7 is the highest value, and weight of 1 is the lowest value. The granting of a weight value is a provision that is applied by the Standard Operating Procedure and Guidebook for Research and Community Service. The results of the reviewer's assessment of the internal lecturer service grant proposal are as follows:
Table 2. Assessment data from reviewers

| Alternatif | C1 | C2 | C3 | C4 | C5 | C6 |
|------------|----|----|----|----|----|----|
| Lecturer 1 | 3  | 7  | 6  | 5  | 5  | 5  |
| Lecturer 2 | 5  | 3  | 5  | 6  | 6  | 6  |
| Lecturer 3 | 6  | 6  | 3  | 5  | 5  | 5  |
| Lecturer 4 | 3  | 3  | 6  | 5  | 5  | 5  |
| Lecturer 5 | 5  | 5  | 5  | 5  | 3  | 5  |
| Lecturer 6 | 6  | 3  | 5  | 5  | 3  | 5  |
| Lecturer 7 | 5  | 3  | 5  | 3  | 5  | 5  |
| Lecturer 8 | 5  | 3  | 5  | 3  | 5  | 5  |
| Lecturer 9 | 6  | 3  | 5  | 3  | 3  | 3  |

Table 2 is an assessment given by a reviewer, which is then recapitulated from the results of the evaluation by the Research and Community Service Agency section based on the weight of the criteria specified above.

3. Result and Discussion

The following is the calculation process using the PROMETHEE II method to determine which alternative will receive the service grant, here are the steps in the calculation process:

a. Alternative Value of Each Criteria

Table 3. Alternative Value of Each criterion

| Alternative | C1 | C2 | C3 | C4 | C5 | C6 |
|-------------|----|----|----|----|----|----|
| Lecturer 1  | 60 | 105| 90 | 100| 50 | 100|
| Lecturer 2  | 100| 75 | 45 | 100| 60 | 100|
| Lecturer 3  | 100| 90 | 90 | 100| 50 | 100|
| Lecturer 4  | 60 | 45 | 90 | 100| 50 | 100|
| Lecturer 5  | 100| 75 | 75 | 100| 30 | 100|
| Lecturer 6  | 120| 45 | 75 | 100| 30 | 100|
| Lecturer 7  | 100| 45 | 75 | 60 | 50 | 100|
| Lecturer 8  | 100| 45 | 75 | 100| 30 | 100|
| Lecturer 9  | 120| 45 | 75 | 60 | 30 | 60 |

b. Normalization of the decision matrix

Table 4. Normalization Matrix

| Alternative | C1     | C2     | C3     | C4     | C5     | C6     |
|-------------|--------|--------|--------|--------|--------|--------|
| A1          | 0      | 1      | 1      | 1      | 0,67   | 0,33   |
| A2          | 0,67   | 0,5    | 0      | 1      | 1      | 0      |
| A3          | 0,67   | 0,75   | 1      | 0      | 0,67   | 0,33   |
| A4          | 0      | 0      | 1      | 1      | 0,67   | 0,33   |
| A5          | 0,67   | 0,5    | 0,67   | 1      | 0      | 0,33   |
| A6          | 1      | 0      | 0,67   | 1      | 0      | 0,33   |
| A7          | 0,67   | 0      | 0,67   | 0      | 0,67   | 0,33   |
| A8          | 0,67   | 0      | 0,67   | 1      | 0      | 0,33   |
| A9          | 1      | 0      | 0,67   | 0      | 0      | 1      |

Calculate evaluative differences from the alternatives concerning other alternatives. This step involves calculating differences in criteria values between various partner-wise alternatives.

c. Calculating the preference function for all alternative pairs

Table 5. Preferences For All Alternative Pairs

| A1,A2 | 0 | 0,5 | 1 | 0 | 0 | 0,33 | A1,A7 | 0 | 1 | 0,33 | 1 | 0 | 0 |
|-------|---|-----|---|---|---|------|-------|---|---|-----|---|---|---|
| A1,A3 | 0 | 0,25| 0 | 1 | 0 | 0    | A1,A8 | 0 | 1 | 0,33 | 0 | 0,67 | 0 |
| A1,A4 | 0 | 1   | 0 | 0 | 0 | 0    | A1,A9 | 0 | 1 | 0,33 | 1 | 0,67 | 0 |
| A1,A5 | 0 | 0,5 | 0,33| 0 | 0,67| 0    | A2,A1 | 0,67| 0 | 0 | 0 | 0,33 | 0 |
| A1,A6 | 0 | 1 | 0,33| 0 | 0,67| 0    | A2,A3 | 0 | 0 | 0 | 1 | 0,33 | 0 |
d. Calculating the aggregate preference function by considering the criteria weight

Table 6. The Result of Combined Preference Function

| Alternative | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 |
|-------------|----|----|----|----|----|----|----|----|----|
| A1          | 16.67 | 22.57 | 23.75 | 15 | 19.17 | 26.67 | 40 | 26.67 | 46.67 |
| A2          | 10 | 17.5 | 30.83 | 17.5 | 37.5 | 20.13 | 6.8 | 6.8 | 6.8 |
| A3          | 13.33 | 18.82 | 24.58 | 15.42 | 22.92 | 16.25 | 22.92 | 22.92 | 22.92 |
| A4          | 0 | 15.07 | 20 | 11.67 | 11.67 | 25 | 11.67 | 31.67 |
| A5          | 7.5 | 27.5 | 7.5 | 27.5 | 7.5 | 27.5 | 7.5 | 27.5 |
| A6          | 10 | 16.73 | 26.67 | 20 | 6.67 | 26.67 | 6.67 | 6.67 |
| A7          | 13.33 | 10.07 | 0 | 13.33 | 6.67 | 6.67 | 6.67 | 6.67 |
| A8          | 13.33 | 10.07 | 20 | 13.33 | 0 | 20 | 20 | 20 |
| A9          | 20.13 | 16.87 | 6.8 | 20.13 | 6.8 | 0 | 6.8 | 6.8 |

e. Determine the leaving and entering outranking flows

Table 7. Outflow Results and Inrush Current for Different Alternatives

| Alternative | Leaving flow | Entering flow |
|-------------|-------------|---------------|
| A1          | 27.56 | 13.77 |
| A2          | 22.19 | 15.03 |
| A3          | 19.64 | 17.57 |
| A4          | 15.84 | 18.92 |
| A5          | 16.78 | 9.55 |
| A6          | 17.93 | 11.63 |
| A7          | 7.93 | 24.13 |
| A8          | 12.09 | 13.30 |
| A9          | 10.56 | 26.61 |
f. Calculating the flow outperforming the net for each alternative by subtracting leaving flows with entering flows

| Alternative | Net flow |
|-------------|----------|
| A1          | 13.79    |
| A2          | 7.16     |
| A3          | 2.08     |
| A4          | -3.08    |
| A5          | 7.23     |
| A6          | 6.29     |
| A7          | -16.21   |
| A8          | -1.21    |
| A9          | -16.06   |

Table 8. Net Flow Value

| Alternative | Net flow |
|-------------|----------|
| A1          | 13.79    |
| A2          | 7.16     |
| A3          | 2.08     |
| A4          | -3.08    |
| A5          | 7.23     |
| A6          | 6.29     |
| A7          | -16.21   |
| A8          | -1.21    |
| A9          | -16.06   |

g. Determine Alternative Rankings

| Alternative | Net flow | Ranking |
|-------------|----------|---------|
| A1          | 13.79    | 1       |
| A2          | 7.16     | 3       |
| A3          | 2.08     | 5       |
| A4          | -3.08    | 7       |
| A5          | 7.23     | 2       |
| A6          | 6.29     | 4       |
| A7          | -16.21   | 9       |
| A8          | -1.21    | 6       |
| A9          | -16.06   | 8       |

Table 9. Determine alternative rankings

4. Conclusion

Based on the results of the discussion it can be concluded that the PROMETHEE II algorithm can be used as a solution to the problem of determining the lecturer who receives the internal service grant at STIKOM Tunas Bangsa. Of the 9 alternatives used, 5 alternative lecturers obtained internal service grants: A1 (Net flow 13.79), A5 (Net flow 7.23), A2 (Net flow 7.16), A6 (Net flow 6.29), A3 (Net flow 2.08). The results obtained are a comparison to the reviewer’s assessment before the institution announced the results of the proposal selection so that it can maintain the quality of the assessment in determining the objective winner of the grant for internal lecturers.

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