

Implementation of Simple Additive Weighting (SAW) in Decision Support Systems as a Recommendation for Student Creativity Program Proposals

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ABSTRACT

This study aims to develop a decision support system that can facilitate the proposal selection process and provide an alternative ranking for the selection results of student creativity program proposal selection. This decision support system uses the simple additive weighting method calculation. The criteria used in this assessment refer to the 2020 Student Creativity Program Guidebook. The data used in this decision support system uses proposal selection data at the Student Creativity Development Unit at the Muhammadiyah University of North Sumatra in 2019 for 2020. This system was developed by determining criteria and weight determination using the Simple Additive Weighting method and determining the preference value of the predetermined criteria. Calculations using the Simple Additive Weighting Method certainly have advantages and disadvantages. The advantages of SAW with a simple and simple ranking process that can be applied to decision-making cases such as in the recommendation of selecting proposals with various attributes. By utilizing the advantages and disadvantages of the SAW method, this Decision Support System is able to produce an accuracy of 97%. This decision support system using the SAW method can help simplify the process of selecting proposals and provide alternative choices from the ranking results. Further research is suggested for the development of a decision support system for proposal selection using a combination of different methods between SAW and other methods.

Keywords: Decision Support System, Simple Additive Weighting, Student Proposals

INTRODUCTION

Recipients of Student Creativity Program research funds are selected based on the best proposals with criteria determined by the grant-giving institution, in this case the Government through the Ministry of Research and Technology / National Research and Innovation Agency of the Republic of Indonesia (Kemenristek / BRIN). The number of Student Creativity Program schemes offered requires the University to be more selective in selecting student proposals that match the assessment criteria. One of the many schemes offered is the Entrepreneurship Student Creativity Program scheme (Program et al., Nd) In the selection of proposals, a method is needed that can provide the best and right recommendation for proposals based on predetermined criteria. The process of selecting alternatives in overcoming these problems can be done by utilizing computer technology such as Decision Support Systems. Decision Support System is a computer-based information system that produces an alternative decision from both

structured and unstructured problems. The concept of a decision support system that was first discovered by Michael Scoot Marton in 1971 is called the Management Decision System.(Luthfi, 2009)

The SAW method certainly has advantages and disadvantages. The advantages of SAW with a simple and simple ranking process, can be applied to decision-making cases such as in the recommendation of selecting proposals with various attributes. This SAW method can also be used in assisting in recommendation of proposal selection based on what is needed by the University. The system that will be used in the recommendation of the Entrepreneurship Student Creativity Program proposal uses the Simple Additive Weighting (SAW) method decision support system. The reasons for using this method include being able to produce appropriate recommendations in determining the selection of proposals based on the criteria determined by the research grant funding institution.n In determining the criteria for the recommendation system, there are several attributes that are used to determine the feasibility of the proposal for the Entrepreneurship Student Creativity Program to be funded, namely creativity, market opportunities, program potential, activity scheduling and personnel and budgeting. Several previous studies that have been carried out using the Simple Additive Weighting method include the use of the Simple Additive Weighting (SAW) method in the recommendation system for selecting lecturers' research proposals using 4 criteria scenarios compared to manual testing. In this study, the weighting of the assessment criteria was carried out to determine the suitability rating of each alternative. The results of the research carried out have an accuracy value of up to 99% using 40 test data from a total of 50 data. The prototype system created can help rank the results of the review of proposals submitted by research lecturers(Mubarak et al., 2018)

Muhammadiyah University of North Sumatra (UMSU) which is the location of the research is one of the Private Higher Education Institutions (PTS) located in the LLDIKTI Region I North Sumatra which consistently implements the Tri Dharma of Higher Education. To improve student abilities both in terms of academic quality and creativity, UMSU strives to do various things in fostering student innovation and creativity in all fields. Efforts to foster student creativity and innovation are an integral part of shaping the character and thinking and acting skills of students. The Student Creativity Program is an implementation of the Tridharma of Higher Education. Since its launch, the Student Creativity Program has received positive responses. Both among students and university leaders. This is reflected in the increasing number of participating universities and the proposals uploaded by students. The proposal-based Student Creativity Program scheme consists of the Research Student Creativity Program, the Entrepreneurship Student Creativity Program, the Technology Application Student Creativity Program, the Written Ideas Student Creativity Program, the Scientific Article Student Creativity Program, the Community Service Student Creativity Program, Student Creativity Program in the Field of Cipta Karsa and Student Creativity Program for Constructive Futuristic Ideas.(Belmawa, 2021)

In supporting student creativity programs in the field of entrepreneurship, Muhammadiyah University of North Sumatra through the Student Scientific Creativity Development Unit or structurally an internal institution of Muhammadiyah University of North Sumatra called the Student's Research & Creativity Center (SRCC) accommodates and organizes scientific work creativity programs for students with management and assessment

carried out professionally and proportionally. For every proposal submitted by students, the research proposal assessment process is carried out by considering several criteria that must go through the selection stages, both administrative selection and substance selection by the SRCC team. After all the files are collected, the SRCC will submit the proposal to selected reviewers from each faculty and from various fields of scientific development. The purpose of this selection process is to ensure that each proposal submitted is able to meet the predetermined standards, so that the best proposal and according to the criteria qualify for research funding. The problems in the administrative selection are related to the efficiency and effectiveness of the management of proposals by the SRCC. Meanwhile, determining the value and passing of the proposal is fully the right of the appointed reviewer with various predetermined criteria. This may happen because it is only based on the reviewers' perceptions and perspectives on the proposal being assessed. The purpose of this selection process is to ensure that each proposal submitted is able to meet the predetermined standards, so that the best proposal and according to the criteria qualify for research funding. The problems in the administrative selection are related to the efficiency and effectiveness of the management of proposals by the SRCC. Meanwhile, determining the value and passing of the proposal is fully the right of the appointed reviewer with various predetermined criteria.

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LITERATURE REVIEW

Simple Additive Weigthing (SAW)

The source of the complexity of the decision problem is only due to uncertainty or imperfect information. However, there are still other causes, such as factors that influence the choices that exist, with the variety of selection criteria and also the weight value of each criterion, which is a form of problem solving that is very complex. In this day and age, multi-criteria problem solving methods have been used widely in various fields. After determining the objectives of the problem, the criteria against which to measure and possible alternatives, decision makers can use one or more methods to solve their problems. The method that can be

used to solve multi-criteria problems is the Simple Additive Weighting (SAW) method. SAW was introduced by (Fishburn, 1967) (MacCrimmon, 1968). to be used as a method in solving multi-criteria problems.(Ambika et al., 2019)

Understanding the SAW Method

The Simple Additive Weighting (SAW) method is often also known as the weighted addition method. The basic concept of the SAW method is to find a weighted sum of the performance ratings for each alternative on all attributes (Fishburn, 1967) (MacCrimmon, 1968). The SAW method requires a decision matrix normalization process (X) to a scale that can be compared with all available alternative ratings. This method is the most well-known and most widely used method in dealing with Multiple Attribute Decision Making (MADM) situations. MADM itself is a method used to find optimal alternatives from a number of alternatives with certain criteria. This SAW method requires the decision maker to determine the weight for each attribute. The total score for the alternatives is obtained by adding up all the multiplication results between the rating (which can be compared across attributes) and the weight of each attribute. The rating of each attribute must be dimension-free in the sense that it has passed the previous matrix normalization process(Sundari et al., 2019)

SAW Method Steps

Here are the SAW method steps:

1. Determine the criteria that will be used as a reference in making decisions, namely C_i .
2. Determine the suitability rating of each alternative on each criterion.
3. Making a decision matrix based on the criteria (C_i), then normalizing the matrix based on the equation adjusted for the type of attribute (profit attribute or cost attribute) in order to obtain a normalized matrix R.
4. The final result is obtained from the ranking process, namely the sum of the normalized matrix multiplication R with the weight vector so that the largest value is chosen as the best alternative (A_i) as a solution. (Journal et al., 2019)

The formula for carrying out the normalization is:

$$r_{ij} = \left\{ \frac{x_{ij}}{\max x_{ij}} \right. \quad (1)$$

The formula for the Cost attribute:

$$r_{ij} = \left\{ \frac{\min x_{ij}}{x_{ij}} \right. \quad (2)$$

Where :

r_{ij} = normalized performance rating

\max_{ij} = maximum value of each row and column

\min_{ij} = minimum value of each row and column

X_{ij} = rows and columns of the matrix

Where r_{ij} is the normalized performance rating of the alternative A_i on the attribute

C_j ; $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$

The preference value for each alternative (V_i) is given as:

$$V_i = \sum_j^n = 1^{w_j} r_{ij} \quad (3)$$

Where :

V_i = The final value of the alternatives

w_j = Weight has been determined

r_{ij} = Normalized matrix

A larger V_i value indicates that the alternative A_i is preferred

METHODS

Data collection

One of the important components in research is the researcher's process of collecting data. Mistakes made in the data collection process will make the analysis process difficult. In addition, the results and conclusions obtained will be confused if the data collection is done incorrectly. This step is the stage of how the data collection process is carried out and what is the reference in collecting the required data. The data needed in this study is the proposal data received by SRCC for the 2019 National Student Creativity Week which is used as training data and test data. The process of collecting proposal data is done manually by visiting the student's scientific creativity development unit (SRCC) at the Muhammadiyah University of North Sumatra which will be the object of research. Then the data will be copied and compiled into Microsoft Excel and will be labeled manually. In addition, several data collection methods used in this study include:

a. Interview

By conducting direct interviews at the SRCC UMSU where the research was carried out and meeting the SRCC management by asking several questions including:

1. How has the selection process been carried out to determine the feasibility of a PKM proposal?
2. Does the selection process for the PKM proposal use certain rules imposed by the University?
3. What obstacles are commonly experienced by reviewers and the selection team when conducting the feasibility selection process for PKM proposals submitted by students

b. Web Browsing

Search the SRCC and SIMBELMAWA web domains as a reference for PKM data

RESULTS AND DISCUSSION

Results

Calculation using SAW allows for the similarity of vector values for alternatives with different criteria values, whereas in the WP method there is no equal vector value for different criteria. Ranking using WP is more accurate than SAW because the calculation of the best alternative is obtained from multiplying the performance rating value and then ranking it with the corrected weight value. (Abdullah et al., 2018) The shortcomings of the WP method are, among others, due to the use of this method in expert systems, causing it to have no cost and benefit for the

criteria so that it affects one of the calculations to determine ranking so that the advantages of the SAW method are better in terms of ranking due to determining alternative preferences based on positive ideal solutions. and a negative ideal solution. In addition, the advantages of the WP method include, when the initial weighting is carried out, the weight is improved so that it can cover the shortcomings of the SAW method, namely it does not have a calculation for weighting. So that by taking advantage of the advantages and disadvantages of each method, this research was carried out by combining each of these calculation methods, hereinafter referred to as the MOD SAW method. (Kusrini, nd):

1. Calculation of Criteria for Ideas (C1)

$$R_{11} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,7$$

In the same way, and so on until the value of each 35th criterion is calculated.

2. Product / Service Excellence Criteria

$$R_{21} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,9$$

In the same way, and so on until the value of each 35th criterion is calculated.

3. The process of calculating the normalization of R for the market opportunity criteria

$$R_{31} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,9$$

In the same way, and so on until the value of each 35th criterion is calculated.

4. Potential Criteria for Profit

$$R_{41} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,9$$

In the same way, and so on until the value of each 35th criterion is calculated.

5. Normalization of R for Potential Criteria for Business Sustainability

$$R_{51} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,9$$

In the same way, and so on until the value of each 35th criterion is calculated.

6. Normalization Criteria for Scheduling Activities & Personnel

$$R_{61} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,8$$

In the same way, and so on until the value of each 35th criterion is calculated.

7. Normalization of R for the Criteria for Cost Budgeting

$$R_{71} = \frac{5}{\max \{5;6;6;6;7;6;5;6;6;5;6;6;5;6;6;6;7;5;7;5;6;5;6;6;6;5;6;6;7;5;6;6;5;6;7;\}} = 0,7$$

DISCUSSION

The conclusion section is the stage of determining conclusions on the results of the tests that have been carried out. This aims to determine whether the application of the algorithm that has been carried out using a combination of the SAW and WP methods is successful and to

determine the level of accuracy and to compare each algorithm. The suggestions section contains possible developments that can be made to this research.

CONCLUSION

Based on the results that have been done, the selection of criteria for recommendation requires several criteria as a consideration. The more criteria used, the more appropriate choice of recommendations as a reference for selecting the feasibility of a PKM proposal. From the application of the SAW method is used as a weighting and normalization process, and determining alternative preferences and rankings. The result of the selected recommendation is the highest V value which will be the chosen alternative based on the criteria selected by the selection team for PKM proposal acceptance. From the results of the above recommendations, it was found that out of 5 student proposals, the ranking value that had the highest score was V5 with a value of 0.0717. So that in the system, recommend the best proposal which is the recommendation option. In other words, a proposal by the name of Diki Ramadhani is feasible to take part in the next stage in the Student Creativity Program for Entrepreneurship (PKM-K). Then followed by Hanifa Khairiah with a final score of 0.0644 and in third place is Chandra Ismail with a score of 0.0612. Calculation using SAW allows for the similarity of vector values for alternatives with different criterion values

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