Optimization of Simple Additive Weighting Method in Assessment of Research Reviewer Selection

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Abstract - Quality research will not be separated from controlling systems that require a review mechanism. This demand considers it necessary to form an assessment committee or reviewer that ensures that all processes proceed towards the target target. The internal reviewer selection process is carried out by looking at several requirements of each prospective reviewer. The selection process is carried out by looking at the requirements files one by one. For this reason, it is necessary to optimize the method that is able to manage the assessment data of prospective reviewers who have the highest rating value from the results of weight calculations. Decision making in determining internal reviewers requires a method that can provide optimal decision results in terms of relatively fast processing time. The decision support method applied in determining internal reviewers is Simple Additive Weighting (SAW). The reason for choosing the SAW method in this study, the method has a basic concept that is used to find weight values on the performance rating of each alternative on all attributes. The SAW method is commonly known as the weighted summation method. There are six criteria used and fifty-five records for alternatives used. The results of the SAW method ranking obtained by A20 have the highest preference value of 0.77. This study shows the optimality of the SAW method in providing decision results based on an accuracy test value of 80%.

Keywords: Accuracy testing; decision support system; optimalization; reviewer research; simple additive weighting

I. INTRODUCTION

The establishment of a college certainly has a fundamental reason. This fundamental reason is not only an educational institution that organizes education at the upper level but also answers several important aspects in life, both phenomena, cases, events, and the development of society must be answered, solved, and developed. The *Tridharma* of Higher Education is an important foothold in the establishment of a Higher Education regarding it. The *Tridharma* of Higher Education has three points that must be run by universities. The three points include education (teaching), research, and community service.

Research in the *Tridharma* of Higher Education plays an important role. With research, one can find out the usefulness of science for all elements of life through investigation and investigation activities.

Some of the foundations for the implementation of research refer to the national research system, national research standards, and other provisions imposed. Aspects of quality and quality are important in a study for the input process, process, output, and even the outcome of a study are important to pay attention to. All of them are measurable and affordable units based on the needs and capabilities of resources, infrastructure availability, funding, time allocation, and especially commitments.

Efforts to obtain quality and quality research results will not be separated from system control. The research system needs a review mechanism for inputs, processes, outputs, and outcomes. This demand considers it necessary to establish an assessment committee or reviewer that ensures that all processes proceed towards the target [1].

The internal reviewer selection process is carried out by looking at several requirements of each prospective reviewer. The selection process is carried out by looking at the requirements files one by one. For this reason, it is necessary to have a calculation that can manage the assessment data of prospective reviewers who have the highest rating value from the results of the weight calculation. Decision support systems can help determine the best alternative in a society that arises on both large and small scale which greatly affects the

outcome of a decision. In the decision support system, there are alternatives, criteria, and weights that will be used in determining the best solution [2].

Optimization of the Simple Additive Weighting method results in a better and easier assessment of employee abilities to determine the appropriate work position. The results of the performance appraisal application show that the SAW method can be applied even in the form of a computer program. In this study, it was also mentioned the critical point of the SAW method grading system on weighting, for which a mutual agreement is needed in the company [3]. The SAW algorithm with the weighting of each variable can provide an optimum distribution of solving a problem. This optimization is applied to the decision support system using the SAW algorithm for the distribution of resource sharing in the implementation of health protocols in the New Normal Era in the world of education [4]. Optimization of SAW ranking results using Euclidean Length of A Vector aims to obtain more results from a ranking method. Optimizations are carried out by adding features to be used on many rankings at once. The feature is added by providing normalization contained in the TOPSIS method. With this optimization, it can improve the SAW ranking feature [5].

Decision making in determining internal reviewers requires a method that can provide optimal decision results [6]. The decision support method applied in determining internal reviewers is Simple Additive Weighting (SAW). The reason for choosing the SAW method in this study, the method has a basic concept that is used to find the weight value in the performance rating of each alternative on all attributes [7-8]. The SAW method is commonly known as the weighted summation method [9-10].

The application of the SAW decision support method for the selection of internal re-viewer candidates, it can optimize the results of recommendations from a series of objective processes based on systematic and mathematical calculations produced. Optimization of the SAW method can be reviewed from the results of testing the accuracy of the resulting decisions.

II. METHOD

A. Data

The data sources in this study used primary data. Primary data is data that is collected and then carried out in a data processing process [7]. There are several techniques used in this study, including observation techniques, interviews, and literature studies. Observation is carried out as an observation activity directly related to the process of selecting internal research reviewers followed by interviews directly at one of the research institutions in universities. Quantitatively, there are fifty-five amounts of data processed in the study.

B. Simple Additive Weighting

A decision-making process goes through several phases, including intelligence, design, choice, and implementation [11-13]. Intelligence is a search carried out by identifying information on problems that occur, namely related to the selection process of internal research reviewers. Design formulates the assessment criteria used in determining the best alternatives based on the assessment criteria used. Choice carries out the process of selecting the Simple Additive Weighting method as a solution used in determining internal research reviewers. At the implementation stage, the decision maker carries out the chosen solving action at the selection stage. Successful implementation is characterized by answering of the problem [14]. From the decision-making phase, a report on the implementation of the solution was obtained and the results were in the form of determining the decision of the internal research reviewer as a result of the calculation of the SAW method.

The Simple Additive Weighting decision support method has several stages of processes, including 1) determining criteria, 2) giving weight to each criterion, 3) determining the value of each alternative, 4) making a normalization matrix, 5) creating a normalized matrix, 6) determining the preference value in producing decisions. The SAW method is a simple and popular method and this method is commonly used in the discipline of human resource management [15].

In the matrix normalization process, there is a formula that is used by taking into account the categories of criteria used including benefits and costs. Here is the formula for determining the normalization of the matrix. Eq. (1) is used in determining matrix normalization for the benefit criterion category, while (2) for the cost criterion category.

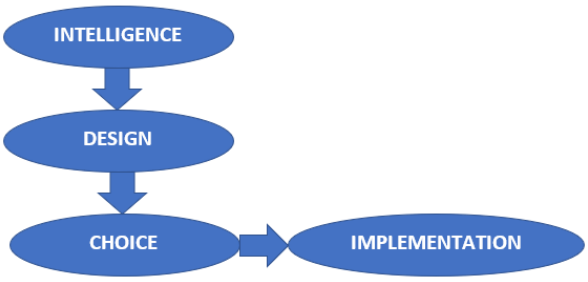

Figure 1. Phases of the decision making process

$$r_{ij} = \frac{x_{ij}}{\text{Max } x_{ij}} \quad (1)$$

$$r_{ij} = \frac{\text{Min } x_{ij}}{x_{ij}} \quad (2)$$

Eq. (3) is an equation used in determining the preference value with (Vi) being the final value of the alternative, (wij) is the weight of the predetermined criterion and (rij) is the value of the normalization of the matrix. The final result is obtained from the ranking process, namely by summing the multiplication result between the normalized matrix and the weight vector. The best alternatives are obtained based on the final value of the preference that has the highest value.

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

C. Accuracy Test

Testing of the results of the decisions produced by the SAW method in determining research reviewers using accuracy test techniques. The purpose of the accuracy test technique is to determine the level of performance of a decision support method in providing decision results [16][14]. Some classifications of the accuracy test results, namely good, good enough, not good and not good.

As for the percentage value of each criterion, namely good classification with a value range of 76% - 100%, a fairly good classification with a value range of 56% - 75%, a poor classification with a value range of 40% - 55% and an unfavorable classification with a value range of less than 40% [17]. The equation used in conducting the test with the accuracy test technique is as follows (4):

$$\text{Accuracy } (\%) = \frac{\sum correct\ test\ data}{\sum allignment\ test\ data} \times 100\% \quad (4)$$

III. RESULT AND DISCUSSION

A. Determination of Criteria and Weights

The initial stage of solving the SAW method is to first define the criteria that will be used as a benchmark for solving problems [6]. Table I presents data related to assessment criteria that are referenced in the process of determining reviewers.

B. Determination of Criteria Weights

Weight is the value of a criterion indicator. Techniques in weighting based on a priority scale [11]. In this study, the process of giving weight criteria used the rules of the percentage approach. On weighting, the percentage has a range of values of 0 to 100% with a record of the total value of the weight equal to 100%. The criteria and weights used as a reference in determining the internal research reviewer are presented in the Table II.

Functional position criteria are requirements needed in determining the re-viewer of internal research. Career development of a lecturer there are five levels of functional positions including Educators, Expert Assistants, Lectors, Associate Professors and the highest level is Professor [18]. Data related to functional positions along with weights are presented in Table III.

Educational criteria are a requirement needed in determining internal research reviewers (Table IV). The level of education of a lecturer who became an estimate in this study was Magister Degree and Doctoral Degree.

The criteria for the head of internal grants are a requirement needed in determining the reviewer of internal research. On this criterion to find out the track record of prospective reviewers who have experience in being chairmen in internal grants (Table V).

TABLE I
CRITERIA DATA

Code	Kriteria	Types of criteria
C1	Functional Positions	Benefit
C2	Education	Benefit
C3	Chairman of Internal Grants	Benefit
C4	Chair of External Grants	Benefit
C5	H Scopus Index	Benefit
C6	H GS Index	Benefit

TABLE II
CRITERIA WEIGHT DATA

Code	Range	Weight
C1	20%	0,2
C2	15%	0,2
C3	10%	0,1
C4	20%	0,2
C5	15%	0,1
C6	20%	0,2

TABLE III
FUNCTIONAL POSITION CRITERIA DATA

No	Functional Posisition	Weight
1	Educators (E)	1
2	Expert Assistant (EA)	2
3	Lector (L)	3
4	Associate Professor (AP)	4
5	Professor (P)	5

TABLE IV
EDUCATION CRITERIA DATA

No	Education	Weight
1	Magister (MD)	3
2	Doctoral (DD)	5

The criteria for the head of an external grant (Table VI) are a requirement needed in determining the reviewer of internal research. On this criterion to find out the track record of prospective reviewers who have experience in being chairmen in external grants.

Criterion H Scopus Index is a requirement needed in determining internal research reviewers. Table VII presents data related to matching the Scopus Index H criterion values with the scoring weights.

Criterion H The Google Scholar Index is a requirement needed in determining internal research reviewers (Table VIII).

C. Determination of Alternatives Value

The next stage is to create a table of alternative value data on each criterion. The alternative used is a research reviewer candidate. There are fifty-five data processed using the SAW method, Table IX presents preliminary data for each alternative.

TABLE V
INTERNAL GRANT CHAIR CRITERIA DATA

No	Number of Internal Grant Chairmen	Weight
1	<1	1
2	1	2
3	2	3
4	3	4
5	>3	5

TABLE VI
EXTERNAL GRANT CHAIR CRITERIA DATA

No	Number of External Grant Chairmen	Weight
1	<1	1
2	1	2
3	2	3
4	3	4
5	>3	5

TABLE VII
SCOPUS INDEX H CRITERION DATA

No	H Index Scopus	Weight
1	0	1
2	1	2
3	2	3
4	3	4
5	>3	5

TABLE VIII
GOOGLE SCHOLAR INDEX H CRITERION DATA

No	H Index GS	Weight
1	0	1
2	1	2
3	2	3
4	3	4
5	>3	5

TABLE IX
ALTERNATIVE DATA

Alternative	C1	C2	C3	C4	C5	C6
A1	L	DD	0	0	0	0
A2	L	DD	0	0	1	2
A3	L	DD	0	0	0	1
A4	L	MD	0	0	0	0
A5	L	MD	0	0	0	3
A6	L	MD	0	0	0	1
A7	EA	DD	0	0	0	1
A8	L	DD	0	0	0	1
A9	L	DD	0	0	0	0
A10	L	DD	1	1	0	3
A11	L	DD	2	1	0	2
A12	L	S3	2	0	0	1
A13	L	S3	2	0	0	1
A14	L	S2	2	2	0	1
A15	L	S2	1	0	0	1
A16	L	S2	1	0	0	1
A17	L	S2	1	1	0	1
A18	P	S3	1	0	0	8
A19	EA	S3	1	0	3	7
A20	L	S3	2	0	3	6
…	…	…	…	…	…	…
A55	L	S3	0	0	0	5

From the alternative data the next stage determines the weight on each criterion used. The giving of this weight value is obtained from the match results of each criterion value. The following table presents the matching result data of each aternative criterion.

TABLE X
CRITERIA ALTERNATE MATCH DATA

Alternative	C1	C2	C3	C4	C5	C6
A1	3	5	1	1	1	1
A2	3	5	1	1	2	3
A3	3	5	1	1	1	2
A4	3	3	1	1	1	1
A5	3	3	1	1	1	4
A6	3	3	1	1	1	2
A7	2	5	1	1	1	2
A8	3	5	1	1	1	2
A9	3	5	1	1	1	1
A10	3	5	2	2	1	4
A11	3	5	3	2	1	3
A12	3	5	3	1	1	2
A13	3	5	3	1	1	2
A14	3	3	3	3	1	2
A15	3	3	2	1	1	2
A16	3	3	2	1	1	2
A17	3	3	2	2	1	2
A18	5	5	2	1	1	5
A19	2	5	2	1	4	5
A20	3	5	3	1	4	5
…	…	…	…	…	…	…
A55	3	3	1	1	1	5

D. Determination of Matrix Normalization

The normalization of the matrix of each alternative is obtained from the results of calculations to determine the value of the normalization on each of the alternatives. The five alterna-tives used include the category of benefits (benefits). The formula used in determining the normalization of the matrix refers to (1).

The determination of normalization for the profit category is necessary to find out the maximum value of all alternatives on each criterion first. Table 11 presents the results of determining the maximum value of each criterion.

Normalization of the matrix for the first and second alternatives to the functional position criterion (C1) is obtained from the results of the following calculations:

$$r_{1.1} = \frac{3}{5} = 0.6 \qquad r_{2.1} = \frac{3}{5} = 0{,}6$$

Normalization of the matrix for the first and second alternatives on the educational criterion (C2) is obtained from the results of the following calculations:

$$r_{1.2} = \frac{5}{5} = 1 \qquad r_{2.2} = \frac{5}{5} = 1$$

E. Determination of Normalized Performance Matrix

From the results of the calculation of the normalization of the matrix that has been determined, it continues to the next process, namely the determination of the normalized performance matrix (R).

0,60	1	0,33	0,33	0,2	0,2
0,60	1	0,33	0,33	0,4	0,6
0,60	1	0,33	0,33	0,2	0,4
0,60	0,6	0,33	0,33	0,2	0,2
0,60	0,6	0,33	0,33	0,2	0,8
0,60	0,6	0,33	0,33	0,2	0,4
0,40	1	0,33	0,33	0,2	0,4
0,60	1	0,33	0,33	0,2	0,4
0,60	1	0,33	0,33	0,2	0,2
0,60	1	0,67	0,67	0,2	0,8
0,60	1	1,00	0,67	0,2	0,6
0,60	1	1,00	0,33	0,2	0,4
0,60	1	1,00	0,33	0,2	0,4
0,60	0,6	1,00	1,00	0,2	0,4
0,60	0,6	0,67	0,33	0,2	0,4
0,60	0,6	0,67	0,33	0,2	0,4
0,60	0,6	0,67	0,67	0,2	0,4
1,00	1	0,67	0,33	0,2	1
0,40	1	0,67	0,33	0,8	1
0,60	1	1,00	0,33	0,8	1
…	…	…	…	…	…
0,60	0,6	0,33	0,33	0,2	1

F. Determination of Preference Value

The next stage determines the preference value for each alternative by using (3). Here's an example of a calculation in determining the preference value for the first alternative.

V1=(0.2×0.6)+(0.2×1)+(0.1×0.33)+(0.2×0.33)+
(0.1×0.2)+(0.2×0.2)=0.77

The results of the overall determination of preference values are presented in the Table XII.

G. Determining the Rankings

The following is the final stage of the SAW method, namely the sequencing of the niali obtained after the calculation of preferences so that the ranking value of the entire alternative is obtained from the highest value to the lowest value.

TABLE XI
MAXIMUM VALUE DATA

Criteria	C1	C2	C3	C4	C5	C6
Max Value	5	5	3	3	5	5

TABLE XII
PREFERENCE VALUE RESULTS

Alternative	Prefrence Value
A1	0,48
A2	0,58
A3	0,52
A4	0,40
A5	0,52
A6	0,44
A7	0,48
A8	0,52
A9	0,48
A10	0,70
A11	0,69
A12	0,59
A13	0,59
A14	0,64
A15	0,47
A16	0,47
A17	0,54
A18	0,75
A19	0,69
A20	0,77
…	…
A55	0,56

TABLE XIII
RANKING RESULT

Alternative	Prefrence Value
A20	0,48
A18	0,58
A25	0,52
A10	0,40
A22	0,52
A11	0,44
A19	0,48
A23	0,52
A37	0,48
A21	0,70
A39	0,69
A53	0,59
A14	0,59
A43	0,64
A24	0,47
A32	0,47
A12	0,54
A13	0,75
A27	0,69
A2	0,77
A54	0,68
A28	0,70
…	…
A51	0,56

H. Accuracy Test Testing

After obtaining the results of preference values and ranking results using the SAW method in the internal research reviewer, the next stage of testing is carried out to determine the performance of the method used. The test used was an accuracy test using twenty records of recitation data. The results of the accuracy test showed that there were sixteen records that matched the results of the reviewer's decision received. The percentage of accuracy test results obtained by 80% shows that the SAW method in determining decision results is included in the good category.

IV. CONCLUSION

The conclusion of the research results used by the Simple Additive Weighting (SAW) method is that there are six criteria used, namely functional position, education, internal grant chairperson, external grant chairperson, h-index scopus, h-index google scholar. The results of the ranking of internal research reviewers of the alternative SAW method A20 obtained the highest preference value of 0.77. The optimization of the SAW method in providing assessment results to research review candidates reached a percentage of 80% of the accuracy test, falling into the category of good decisions. Further research that can be carried out applies other decision support methods such as AHP, TOPSIS and WP which can then be compared with the results of the accuracy test of each method. Another research opportunity that can be done is to develop software applications.

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