Advances in Intelligent Systems Research, volume 172
Sriwijaya International Conference on Information Technology and Its Applications (SICONIAN 2019)

Development of Decision Support System for Selection of Yayasan Alumni Scholarship Using MOORA Method

Arindia UTAMI[1], Endang Lestari RUSKAN [2]*

[1]*utamiarindia@gmail.com, Study Program of Information System, Computer Science Faculty of Sriwijaya University Indonesia*
[2] *endanglestari@unsri.ac.id, Study Program of Information System, Computer Science Faculty of Sriwijaya University Indonesia*
**Corresponding author: endanglestari@unsri.ac.id*

ABSTRACT

Yayasan Alumni Scholarship is a form of concrete contribution from the alumni to SMA N 1 to increase access and study opportunities in higher education for SMA N 1 students who are economically incapable and have academic potential. Yayasan Alumni routinely provides scholarships once a year. Several obstacles are starting from the registration process, the collection of prospective scholarship recipients, and the selection process which takes a long time due to many determining criteria. Also, the assessment tends not to be objective due to the subjectivity of each jury because there are no assessment standards. Therefore we need a decision support system that can provide the best solution to solve all existing problems. In this study using the Multi-Objective Optimization Method based on Ratio Analysis (MOORA), the MOORA method was chosen because it has a high level of flexibility, can provide results quickly and easy to understand.
Keywords: *decision support system, MOORA method, scholarship*

INTRODUCTION

Education is the process of learning science, learning individual and social skills, physical and spiritual, and developing one's potential to become a skilled, creative and better person. Although providing education is a government obligation, students also need money to meet their needs during the learning process, but not all students come from well-off families but some students come from underprivileged families. To support these costs, one of them with a scholarship.

Yayasan Alumni is an example of an institution that provides special scholarships to SMA N 1 students which are held once a year. This foundation was established to help to provide educational funding to the alumni of the students of SMA N 1 who will continue their tertiary education and introduce the simulation of scholarship registration for provision at universities.

The process of providing scholarships held by Yayasan Alumni was carried out using the foundation conducting socialization which was attended by all 12th-grade students of SMA N 1 and all students were allowed to register. After that, prospective scholarship recipients fill out forms and complete the files that have been determined by the foundation. Then prospective scholarship recipients will collect the files and conduct interviews. Several criteria have been set by the foundation, namely parents 'income, parents' dependents, academic value, achievement certificates, electricity bills, homes, and interviews. And to get a scholarship prospective scholarship recipients must meet these criteria. Of the many scholarship registrants, Yayasan Alumni only provides scholarships for 2 to 3 applicants who are deemed eligible to receive the scholarship.

Several obstacles are starting from the registration process, the selection process which takes a long time due to many determining criteria. Also, the assessment tends not to be objective due to the subjectivity of each jury because there are no assessment standards. Therefore we need a decision support system that can provide the best solution to solve all the problems of the selection of prospective scholarship recipients at Yayasan Alumni. Decision support system (DSS) is a system that processes data into information that produces many alternative decisions to provide support for the manager's consideration in making semi-structured decisions and improve the quality of decisions made[1]. This system was created so Yayasan Alumni can carry out all the screening processes in one system and shorten the selection time. MOORA is a multi-objective system that optimizes conflicting attributes simultaneously namely criteria that have value or benefit and which do not value or cost. This method refers to the toa matrix of responses of alternatives to objectives, to which ratios are applied[2].

Literature Review

STUDY LITERATURE

Based on Gadakh's research, Gadakh said that the MOORA method is very simple and easy to implement compared to other methods so it is very stable in solving various decision-making problems. In the MOORA method, there are two kinds of criteria, namely the criteria of beneficial value and cost criteria. Beneficial criteria have a higher value than the cost criteria, this can be determined directly by the designer[3].

Based on research conducted at PT. Warta Media Nusantara to recruit new employees using SAW and Weighted Product. This paper uses 4 criteria. the results of this study are the SAW method requires a shorter selection time than the Weighted Product method because the Weighted Product method calculation is more complex. SAW method has a simpler calculation than the Weighted Product method, but the Weighted Product method gives better results than the SAW method.[4].

DECISION SUPPORT SYSTEM

DSS is a computer program application that provides support to managers in making decisions, improving the quality of decisions to be made and shorten the time of decision making [5]. DSS is also used to help solve complex problems[6]. According to Simon, the process of making a decision is divided into 4 phases, such as[7]:

Intelligence phase.

Herbert A. Simon called the first phase of the decision making the process an intelligence activity. At this stage of the search, two important things must be done, namely defining the problem and identifying information that will be needed to solve the problem at hand.

Design phase.

The second phase also called the design phase deals with the analysis and formulates alternatives to solve the problem then identifies and evaluates these alternatives

Selection phase.

This stage chooses the best solution or alternative among the alternatives.

Implementation phase

Implement alternatives or solutions that have been chosen to solve the problem at hand.

Scholarships

Scholarships are aids to ease the burden of students while in education, especially the issue of cost[5]. The granting of this scholarship will be a passion for students to improve their learning achievement.

MOORA

MOORA is a multi-objective system that optimizes conflicting attributes simultaneously. Namely, criteria that are of value or benefit and which are not of value or cost. The best alternative does not always have a higher cost than the benefit[8]. MOORA method was first used by Brauers in 2004 and introduced in 2006 by Zavadkas and Brauers. The MOORA procedure steps are as follows [9][3][10].

Input criteria

The first step is inputting the criteria value in an alternative where the value will be processed and produce a decision

Change the value of the criteria into a matrix value

Xij is an alternative response j to criterion i. I am the order number of the attribute or criterion. J is an alternative sequence number. X is the decision matrix. N is the number of attributes. M is the number of alternatives.

$$X = \begin{bmatrix} x_{11} & x_{1i} & x_{1n} \\ x_{j1} & x_{ij} & x_{jn} \\ x_{m1} & x_{mi} & x_{mn} \end{bmatrix}$$

(1)

Normalization in the MOORA method

At this stage, normalization aims to unite each matrix element so all elements in the matrix have the same value.

$$X^*_{ij} = X_{ij} / \sqrt{\left[\sum_{i=1}^{m} X_{ij}^2\right]}$$

(2)

Calculate the value of optimization

Calculating the value of this optimization can be done in two ways, namely if the criteria have weights and do not have weights. If the criteria have weights, it indicates that an attribute or criterion that is more important can be multiplied by the appropriate weights. Can use the following equation:

$$Y_i = \sum_{j=1}^{g} w_j x^*_{ij} - \sum_{j=g+1}^{n} w_j w^*_{ij}$$

(3)

If the criteria have no weight. Can use the following equation::

$$Y_i = \sum_{i=1}^{i=g} x^*_{ij} - \sum_{i=g+1}^{i=n} x^*_{ij}$$

(4)

Determine the ranking of the results of MOORA calculation.

From all the above stages an alternative ranking will be generated. The best alternative is the alternative which has the highest final value (Yi) while the worst alternative is the alternative that has the lowest final value (Yi).[3] The final value (Yi) can be positive or negative depending on the maximum (benefit) and minimum (cost) [3][7][10].

Research Methods

According to Simon, the process of making a decision is divided into 4 phases, such as[7]:

Intelligence phase.

This stage is the process of negotiation carried out by the decision-maker for all problems that must be resolved. Data consists of primary data and secondary data. Primary data was collected through interviews with the chairman of the Yayasan Alumni the agency that organized the program. And secondary data were collected by concluding the literature with previous research. And then, the installation must analyze the problems or opportunities that might occur under the old decision-making system. Like the problem with the registration process which is done by sending files via school or by email, these published files can be lost and piling up. and also the long selection time due to the number of determinants and students who register. Each judge has a standard of judgment that makes the data subjective. After that, analyze the system feasibility. From technical and operational feasibility, this system will be created on a website using PHP program language and the admin of Yayasan Alumni is accustomed to using a computer. From economical feasibility, this system will be used once a year and make the selection process faster and more accurate. From law feasibility, the system will be under the rules by the government because the data, steps, judges, etc are based on interviews.

Design phase.

This stage is the process of modeling the problem that has been previously defined by outlining the decision elements,

alternative decision variables, and evaluation criteria were chosen. The model will be validated by the criteria set out to conduct an alternative evaluation of the selected decision. The process of determining a solution is a process for designing or developing alternatives, determining decisions and assigning values and weights given to each alternative that exists.

Selection phase.
This stage chooses the best solution or alternative among the alternatives.
Implementation phase
This stage is the implementation of a system that already designs in the design phase.

RESULTS AND DISCUSSION

This research is needed to determine :

Criteria

Table 1. Criteria

Criteria	Description	Weight	Type
C1	Parents income	12%	Cost
C2	Parents dependents	20%	Benefit
C3	Academic value	20%	Benefit
C4	Achievement certificates	13%	Benefit
C5	Electricity bills	10%	Cost
C6	House status	5%	Cost
C7	House type	5%	Cost
C8	Interview	15%	Benefit

1. Subcriteria

1) Subcriteria of Academic value

Table 2. Subcriteria of academic value

Description	Value
Participants certificates	1
Big 3 school certificates	2
Big 3 regency certificates	3
Big 3 provincial certificates	4
Big 3 National certificates	5

2) Subcriteria of House Status

Table 3. Subcriteria of house status

Description	Value
Rent	1
Join with family	2
Own house	3

3) Subcriteria of House Type

Table 4. Subcriteria of house type

Description	Value
Not Permanent	1
Semi-Permanent	2
Permanent	3

4) Subcriteria of Interview

Table 5. Subcriteria of interview

Description	Value
Unable to communicate well	1
Less able to communicate well	2
Able to communicate well	3

2. Alternative Data

Based on the previous analysis, it can implement a simulation of MOORA in Excell with the steps below. Steps in MOORA :

1) Input Criteria

Table 6. Subcriteria of house status

KA	C1	C2	C3	C4	C5	C6	C7	C8
A1	500.000	3	81,57	1	42.282	2	3	1
A2	750.000	1	79,3	2	107.033	3	2	2
A3	3.000.000	3	84,14	3	25.000	1	2	3
A4	300.000	1	81,68	3	24,615	3	2	2
A5	1.500.000	4	83,87	1	30.000	3	1	3

2) Change the value of the criteria into a matrix value

$$X = \begin{bmatrix} 500000 & 3 & 81{,}57 & 1 & 42282 & 2 & 3 & 1 \\ 750000 & 1 & 79{,}30 & 2 & 107033 & 3 & 2 & 2 \\ 3000000 & 3 & 84{,}14 & 3 & 25000 & 1 & 2 & 3 \\ 300000 & 1 & 81{,}68 & 3 & 24615 & 3 & 2 & 2 \\ 1500000 & 4 & 83{,}87 & 1 & 30000 & 3 & 1 & 3 \end{bmatrix}$$

3) Normalization in the MOORA method

$$X_{ij} = \begin{bmatrix} 0.143 & 0.5 & 0.444 & 0.204 & 0.341 & 0.353 & 0.640 & 0.192 \\ 0.215 & 0.167 & 0.432 & 0.408 & 0.863 & 0.530 & 0.426 & 0.385 \\ 0.861 & 0.5 & 0.458 & 0.612 & 0.202 & 0.176 & 0.426 & 0.577 \\ 0.086 & 0.167 & 0.445 & 0.612 & 0.199 & 0.530 & 0.426 & 0.385 \\ 0.430 & 0.667 & 0.457 & 0.204 & 0.242 & 0.530 & 0.213 & 0.577 \end{bmatrix}$$

4) Calculate the value of optimization

$$X_{wj} = \begin{bmatrix} 0.0172 & 0.1 & 0.0888 & 0.0265 & 0.0341 & 0.0177 & 0.0320 & 0.0289 \\ 0.0258 & 0.0334 & 0.0864 & 0.0530 & 0.0863 & 0.0265 & 0.0213 & 0.0577 \\ 0.1033 & 0.1 & 0.0916 & 0.0796 & 0.0202 & 0.0088 & 0.0213 & 0.0866 \\ 0.0103 & 0.0334 & 0.0890 & 0.0796 & 0.0199 & 0.0265 & 0.0213 & 0.0577 \\ 0.0516 & 0.1334 & 0.0914 & 0.0265 & 0.0242 & 0.0265 & 0.0107 & 0.0866 \end{bmatrix}$$

5) Determine the ranking of the results of MOORA calculation

Table 7. Subcriteria of house status

Alternatives	Max (C_{2+} C_{3+} C_{4+} C_8)	Min (C_1+C_{5+} C_{6+} C_7)	Y_i = (Max-Min)
A1	0.2442	0.1049	0.1432
A2	0.2305	0.1599	0.0705
A3	0.3578	0.1536	0.2042
A4	0.2596	0.0780	0.1816
A5	0.3378	0.1130	0.2248

Table 8. Subcriteria of house status

Ranking	Alternatives	Y_i
1	A5	0.2248
2	A3	0.2042
3	A4	0.1816
4	A1	0.1432
5	A2	0.0705

Based on ranking results obtained that alternative 5 with a value of A5 = 0,2248 is the best alternatives with the largest Qi value that will get the scholarship.

CONCLUSION

The implementation of the MOORA method in the decision support system can provide a recommendation system to assist decision-makers in determining the eligible participants to receive scholarships based on predetermined criteria.

REFERENCES

[1] P. B. Keenan, “Changes in DSS disciplines in the Web of Science Changes in DSS disciplines in the Web of Science,” *J. Decis. Syst.*, vol. 25, no. June 2016, pp. 542–549, 2019.

[2] W. Brauers and E. K. Zavadskas, “The MOORA method and its application to privatization in a transition economy,” no. January 2006, 2016.

[3] G. S.V, "Application of MOORA method for parametric optimization of the milling process," vol. 1, no. 4, pp. 743–758, 2011.

[4] A. Setyawan, F. Y. Arini, and I. Akhlis, "Comparative Analysis of Simple Additive Weighting Method and Weighted Product Method to New Employee Recruitment Decision Support System (DSS) at PT. Warta Media Nusantara," vol. 4, no. 1, pp. 34–42, 2017.

[5] M. Ibrahim, "Decision Support System for Determining the Scholarship Recipients using Simple Additive Weighting," vol. 151, no. 2, pp. 10–13, 2016.

[6] R. Accorsi, R. Manzini, and F. Maranesi, “Computers in Industry A decision-support system for the design and management of warehousing systems,” *Comput. Ind.*, vol. 65, no. 1, pp. 175–186, 2014.

[7] T. Limbong and J. Simarmata, "The Implementation of Multi-Objective Optimization based on Ratio Analysis Method to Select the Lecturer Assistant Working at Computer Laboratorium," vol. 7, pp. 352–356, 2018.

[8] W. Fitriani and A. P. U. Siahaan, “Multi-Objective Optimization Method by Ratio Analysis in Determining Multi-Objective Optimization Method by Ratio Analysis in Determining Results in Decision Support Systems,” no. November, pp. 2–7, 2018.

[9] A. Görener, H. Dinçer, and Ü. Hacıoğlu, "Application of Multi-Objective Optimization based on Ratio Analysis (MOORA) Method for Bank Branch Location Selection," vol. 2, no. 2, pp. 41–52, 2013.

[10] R. K. Hondro, M. Syahrizal, A. Putera, U. Siahaan, and R. Rahim, "Student Admission Assesment using Multi-Objective Optimization based on Ratio Analysis (MOORA)," no. First, 2017.