IMPLEMENTATION OF MULTI-ATTRIBUTE UTILITY THEORY METHOD FOR SELECTING EDUCATIONAL SCHOLARSHIP AID RECIPIENTS

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ABSTRACT

Ayah Amil Zakat Infaq and Shadaqah Muhammadiyah (LazisMu) Institution is one of the national amil zakat institutions located in Ayah District, Kebumen Regency. The problem that is often encountered in determining potential aid recipients is that the number of requests for assistance is not proportional to the number of officers processing screening data. The selection process for aid recipients still uses manual methods, which often creates obstacles, such as the selection process for potential aid recipients which takes up to a week and calculation errors occur, resulting in inaccurate selection results for potential aid recipients. Therefore, it is necessary to have a system for selecting potential aid recipients using the multi-attribute utility theory (MAUT) method. This method was chosen because it is able to choose the best alternative from a number of alternatives, in this case the alternative in question is people who are entitled to receive assistance based on 10 criteria and 5 alternative data on potential aid recipients. The results of calculations from 5 prospective educational scholarship recipients showed that the students receiving educational scholarships from these calculations were Rianti Agistiani and Farid Al Hakim who received high scores, namely 36.25 and 32.5 respectively. The results of this ranking assistance are used as the basis for potential recipients. The greater the profit, the greater the opportunity to receive educational scholarship assistance.

Keywords: *Decision Support Systems, Multi Attribute Utility Theory, Recommendation Systems, Maut*

1. INTRODUCTION

LazisMu is an institution that manages zakat, infaq and alms funds which are then distributed back to the community to solve social problems such as poverty, disasters, education and health [1]. Every month, LazisMu Ayah Service Office provides assistance to people in need in the Ayah sub-district area in the form of house renovation programs, scholarships for high school or college level education and business capital [2].

The stage of obtaining assistance begins with an application from someone from your immediate family, neighbors and the community in general. Then LazisMu conducted a survey visiting the homes of potential aid recipients by bringing a screening form and carrying out the screening directly. To receive zakat or assistance through this screening, it must comply with the established criteria [3]. There are 10 aspects of criteria that are assessed. The results of the screening data will later be discussed and discussed at the meeting sharing management with all staff and office heads so it takes about 1 week to get the results.

The problem that is often encountered in determining potential aid recipients is that the large number of requests for aid is disproportionate to the number of officers processing screening data[4]. The selection process for aid recipients still uses manual methods, which often creates obstacles such as the selection process for potential aid recipients which takes a long time and calculation errors occur, resulting in less accurate selection results for potential aid recipients[5]. Therefore, the method used as a solution model in providing decisions on the system for selecting potential aid recipients at LazisMu Ayah is the multi attribute utility theory (MAUT) method. This method was chosen because it is able to select the best alternative from a number of alternatives, in this case the alternative referred to is people who are entitled to receive assistance based on predetermined criteria[6]. The MAUT method is also widely used to complete practical decision making. This is because the concept is simple and easy to understand, computationally efficient, and has the ability to measure the relative performance of decision alternatives[7]. This model is used to convert several interests

into numerical values on a scale of 0-1 with 0 representing the worst choice and 1 the best[8]. The MAUT method provides an assessment of the final results by ranking them from the highest alternative value to the lowest [9].

Similar research has been carried out by Alfiarini and Primadasa, in their research explaining the application of the multi attribute utility theory method to analyze the provision of Raskin assistance to residents in Dempo Village, East Lubuklinggau II District. Through direct observation, efforts to distribute Raskin in Dempo Subdistrict experienced several obstacles, such as selection for receiving Raskin assistance which was carried out by directly providing Raskin assistance to target households which were deemed inappropriate. Not only that, in determining the criteria, some aspects are still considered to be less than appropriate. Through a review in determining the Raskin eligibility acceptance criteria, after obtaining 4 valid criteria, and using 20 family heads as a simulation. Analysis of decision support systems using the MAUT method. The results of the evaluation score calculation show that the 10 heads of families with the highest scores are those entitled to receive Raskin assistance[10].

Apart from that, Pantatu and Drajan also conducted research explaining the selection of MSME aid recipients using the MAUT method. Providing assistance to MSMEs is one of the problems faced by the Department of Industry and Trade in determining who is entitled to receive assistance for MSMEs. The Department of Industry and Trade still makes decisions using subjective or manual methods so that the appropriate indicators for one person will be different from those for another person. A decision support system is a solution that can be used to find out the results of the selection of MSME Assistance Recipients using the MAUT method so that it can be implemented [11]. The results of the research carried out provide an assessment of the final results by ranking them from the highest alternative value to the lowest. To prove the feasibility of this system, the system has been tested with a Cyclometic Complexity result of 6, thus this system is suitable for use.

Sari also conducted research in 2021 regarding the feasibility of providing PKH assistance using the multi attribute utility theory (MAUT) method in Bulumario Village, Sipirok District. The selection of eligibility for PKH assistance in Bulumario Village, Sipirok District is still manual and requires a long time to make a decision. So, to solve this problem, it is necessary to create a decision support system using the chosen method, namely Multi Attribute Utility Theory (MAUT). This research produces a decision support system that can recommend granting eligibility for PKH assistance in Bulumario Village, Sipirok District based on criteria that have been determined using the MAUT method. The trial was carried out by entering a data sample of 15 prospective PKH participants. Through the existence of a decision support system, it is able to provide recommendations for granting eligibility for PKH assistance based on ranking[12].

Different from previous research, this research uses 10 data criteria, including: income of the head of the family, Income of other family members, debts owned, occupation of the head of the family, condition of the head of the family, mustahik marital status, mustahik status in the family, last education of the head of the family, house ownership, and house walls. There are 5 examples of alternative data for potential recipients of LazisMu Ayah assistance which will be used for the selection process using the MAUT method. This decision support system is expected to help in the selection process for receiving assistance more quickly and accurately in the calculation process.

2. RESEARCH METHODOLOGY

2.1 System Analysis

System analysis is the stage of outlining the component parts of the system that is already running at the LazisMu Ayah service office with the aim of studying how well the component parts work, identifying problems, obstacles that occur and expected needs so that improvements can be proposed. The distribution of aid and determining potential aid recipients is handled by the tasyaruf program division team which is carried out every month. Not all proposals submitted are immediately given financial assistance, because the proposals that are submitted will be selected first. Proposals will only be processed for selection if they meet the requirements determined by LazisMu. There are two proposal requirements that must be fulfilled by prospective aid recipients, namely a proposal letter and KTP.

The next stage is a location survey (residence) of potential aid recipients. The survey was carried out on data that was considered doubtful. This is intended to ensure the validity of the proposal data with future field data, so that aid distribution is right on target. Site surveys are conducted by program divisions or assigned volunteers. After getting the survey results, the proposal data will then be checked with the survey results in the field. If appropriate, it will be processed by LazisMu to determine whether it is accepted or not. The results of this data are then discussed to determine whether or not assistance is appropriate (sharing management meeting).The results of the selection meeting for potential aid recipients are submitted to the head of the office and approved.

The new system that will be designed is a decision support system for selection of aid recipients which is expected to help in resolving problems related to the selection of potential aid recipients. Input requirements are in the form of data on prospective aid recipients that are already held in the LazisMu database of potential aid recipients according to the aid program category.

2.2 Multi Attribute Utility Theory (MAUT) Method

The MAUT method is a quantitative method that is used as the basis for decision making through a systematic procedure that recognizes and analyzes several variables[13]. This method is widely used to complete instant decision making. This is because the concept is simple and easy to understand, the computation is effective, and it has the ability to measure the relative performance of decision alternatives[14] [15]. The steps for using the MAUT method are as follows:

At this stage, weighting is carried out to obtain the criteria weights. In general, Rank Order Centroid weighting can be formulated as follows:

$$W_k = \frac{1}{k} \Sigma_i^k = 1 \left(\frac{1}{i}\right) \quad (1)$$

The total of all weights (∑w = 1) when added up is worth 1.

The next stage is normalizing the decision matrix x_ij. At this stage, calculations are carried out to obtain a normalized matrix (r*ij). There are two types of normalization that can be done, depending on the profit criteria (equation 2) and cost criteria (equation 3).

$$r * ij = \frac{xij - min(xij)}{max(xij) - min_{(x_ij)}} \quad (2)$$

$$r * ij = 1 + \left(\frac{xij - min(xij)}{max(xij) - min_{(x_ij)}}\right) \quad (3)$$

Information:
r*ij : Normalized matrix.
x_ij : Decision matrix.
min x_ij : The lowest value for the j-th attribute.
max x_ij : The highest value for the j-th attribute.

The next step is to calculate the marginal utility value (u_{ij}) using the following formula:

$$U_{ij} = \frac{exp(r*ij)^2 - 1}{1.71} \quad (4)$$

Information:
U_{ij} :Marginal utility
exp() : Exponential

This final stage calculates the final utility value by considering the weight of each attribute or criterion, which can be seen in equation 5 as follows:

$$U_i = \Sigma_j^n = 1^{Uij \cdot w_j} \quad (5)$$

Information:
U_i : Utilitas akhir
u_{ij} : Utilitas marjinal
w_j : Bobot atribut ke j
j : Atribut
n : Number of attribute

2.3. System Design Method

The process design stage is the stage of designing everything related to the process that can be carried out by the decision support system for determining aid recipients to help overcome problems at the LazisMu Father's Service Office. The business process for the decision support system for determining aid recipients can be seen as follows.

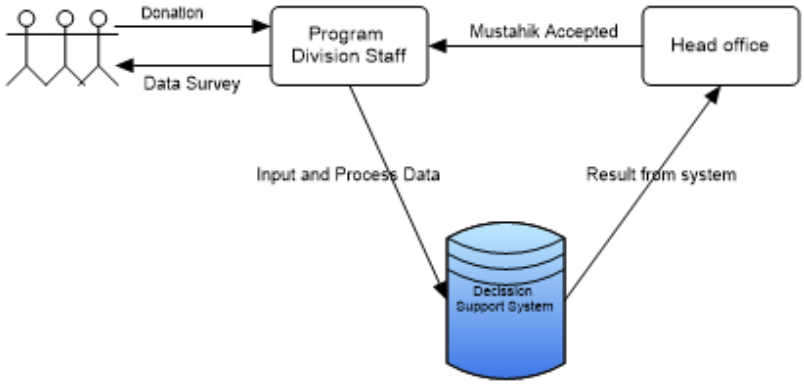

Figure 1. Decision support system business processes

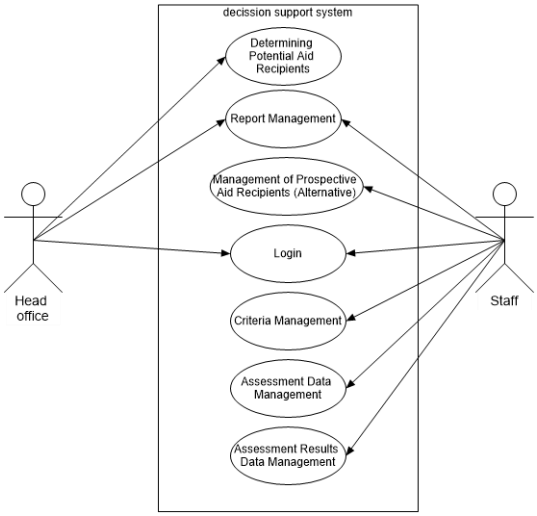

Figure 2. Use Case Deccision Support System

Figure 1 above explains that the survey form data for incoming potential aid recipients will be input by the program division and processed using a decision support system for determining aid recipients. The data resulting from the decision is then accessed by the head of the office and approved. The final process is the provision of aid funds to a list of eligible aid recipients based on data from decisions made by the system.

The decision support system consists of 7 use cases as in Figure 2, which is a description of the activities carried out by the head of the office and program division staff in the decision support system for determining aid recipients. Each actor has certain authority over the use of the application system.

The head of the office has the authority, including determining potential aid recipients, accessing mustahik reports and data. Meanwhile, program division staff have the authority to input data on potential aid recipients (alternative), access criteria data, screening form results data, and carry out calculations using the MAUT method.

3. RESULT AND DISCUSSIONS

In the Table 1 following are 5 examples of alternative data (An) for selection of prospective recipients of assistance in the educational scholarship category at the Muhammadiyah Ayah Kebumen Vocational School.

Table 1. Alternative

Alternative	Name
A1	Farid Al Hakim
A2	Muhammad Iqbalul Khasan
A3	Mufti Ikhsan
A4	Rianti Agistiana
A5	Muhammad Luthfi Aditya Nugroho

Table 2. Criteria

Criteria	Name
C1	Income of the head of the family
C2	Income of other family members
C3	Debts owned
C4	Occupation of the head of the family
C5	Condition of the head of the family
C6	Mustahik marital status
C7	Mustahik status in the family
C8	Last education of the head of the family
C9	House Ownership
C20	House walls

Data on 10 criteria used as a reference in determining aid recipients as in the Table 2.
The weight values for each criteria using Schäfer's rule [16], are as follows:
1 = Not important
2 = Not too important
3 = Quite important
4 = Significance
5 = Very significant.

An example of assigning weight values to each criterion to make calculations easier using the MAUT method can be seen in Table 1.

Table 3. Criteria weighting value

Criteria	Criteria Selection	Weight
C1=Income of the head of the family	(0 – 1.000.000)	5
	(1.000.000 – 1.500.000)	4
	(1.500.000 – 2.000.000)	3
	(2.000.000 – 2.500.000)	2
	(> 2.500.000)	1
C2 = Income of other family members	(0 – 1.000.000)	5
	(1.000.000 – 1.500.000)	4
	(1.500.000 – 2.000.000)	3
	(2.000.000 – 2.500.000)	2
	(> 2.500.000)	1
C3 = Debts owned	(>7.500.000)	5
	(7.500.000-5.000.000)	4
	(5.000.000-2.500.000)	3
	(2.500.000-500.000)	2
	(<500.000)	1
C4 = Occupation of the head of the family	Unemployed	5
	Part time work	4
	Laborer	3
	Small traders	2
	Employee	1
C5 = Condition of the head of the family	Chronic pain	5
	Sickly	4
	Seniors	3

Criteria	Criteria Selection	Weight
	Healthy	2
	Healthy but smoking	1
C6 = Mustahik marital status	Widow	5
	Widower	4
	Marry	3
	Single	2
	-	1
C7 = Mustahik status in the family	Husband	5
	Wife	4
	Child	3
	Brother	2
	Not family	1
C8 = Last education of the head of the family	No school	5
	elementary school	4
	junior high school	3
	senior high school	2
	diploma or bachelor's degree	1
C9 = House Ownership	Hitchhiking	5
	Renting a house	4
	Follow your parents	3
	Have your own	2
	Have a boarding house	1
C10 = House walls	Cardboard or paper	5
	Bamboo	4
	Zinc	3
	Semi permanent	2
	Wall	1

Determine the suitability rating of each alternative on the criteria using sample data. At this stage, a simulation is carried out using alternative data, from this data the max and min values for each alternative criterion are obtained. Alternative data and criteria can be seen in table 2 below.
After alternative data and criteria are obtained, the next step is to normalize the matrix using the formula:

$$U_{(x)} = \frac{x - xi^{-}}{xi^{+} - xi^{-}} \quad (6)$$

The overall results of matrix normalization can be seen in Table 3.

Table 4. Criteria and Alternative

Alternative	Criteria									
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
A1	4	3	5	3	2	5	4	4	5	1
A2	4	1	1	3	2	2	3	4	2	1
A3	5	3	1	3	2	5	3	4	2	1
A4	5	5	2	3	4	2	3	4	5	2
A5	5	5	3	2	2	2	3	3	5	1
max	**5**	**5**	**5**	**3**	**4**	**5**	**4**	**4**	**5**	**2**
min	**4**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**2**	**1**

Table 5. Matrix normalization results

Alternative	Criteria									
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A1	0	0,5	1	1	0	1	1	1	1	0
A2	0	0	0	1	0	0	0	1	0	0
A3	1	0,5	0	1	0	1	0	1	0	0
A4	1	1	0,25	1	1	0	0	1	1	1
A5	1	1	0,5	0	0	0	0	0	1	0

Table 6 Result Value

No	alternatifve	Calculation	value
1	Farid Al Hakim	=(0*5)+(0,5*5)+(1*5)+(1*5)+(0*5)+(1*5)+(1*5)+(1*5)+(1*5)+(0*5)	32,5
2	Muhammad Iqbalul Khasan	= (0*5)+(0*5)+(0*5)+(1*5)+(0*5)+(0*5)+(0*5)+(1*5)+(0*5)+(0*5)	10
3	Mufti Ikhsan	=(1*5)+(0,5*5)+(0*5)+(1*5)+(0*5)+(1*5)+(0*5)+(1*5)+(0*5)+(0*5)	22,5
4	Rianti Agistiani	=(1*5)+(1*5)+(0,25*5)+(1*5)+(1*5)+(0*5)+(0*5)+(1*5)+(1*5)+(1*5)	36,25
5	Muhammad Luthfi Aditya Nugroho	=(1*5)+(1*5)+(0,5*5)+(0*5)+(0*5)+(0*5)+(0*5)+(0*5)+(1*5)+(0*5)	17,5

The next step is to carry out calculations using the MAUT method to obtain an evaluation value, where the evaluation value becomes a reference in the ranking. Calculation of evaluation values uses a formula:

$$v(x) = \Sigma_i^n = 1^{wivi(x)} \quad (7)$$

Information:
v(x) = evaluation value of an object i.
wi = weight which determines the value of how important element i is compared to other elements.
n = number of elements
vi = the overall value of the alternative choice of a criterion.

The overall results of the evaluation scores can be seen in Table 4.

Looking at the results of the evaluation values at stage number 4, it was concluded that the value of the first alternative (A1) was greater than the other values. So a ranking is obtained starting from the largest evaluation value to the smallest as in table 5 below.

From the calculations of the 5 prospective students above, the results obtained were that the students who received educational scholarships from the above calculations were Rianti Agistiani and Farid Al Hakim who obtained high scores, namely 36,25 and 32,5 respectively. The results of this ranking are used as a basis for candidates who receive assistance. The greater the value, the greater the opportunity to receive educational scholarship assistance. The number of recipients of educational scholarship assistance is adjusted to the amount of funds available that month. If the number of aid recipients exceeds or is not comparable to the funds available at LazisMu, they will be selected again based on the ranking order of the evaluation scores, so that it is hoped that the distribution of scholarship aid funds will be right on target for students who really need it.

Table 7. Ranking of evaluation scores

No	alternatifve	value
1	Rianti Agistiani	36,25
2	Farid Al Hakim	32,5
3	Mufti Ikhsan	22,5
4	Muhammad Luthfi Aditya Nugroho	17,5
5	Muhammad Iqbalul Khasan	10

5. CONCLUSION

Based on the results of calculations from 5 educational scholarship candidates, the result was that the students who received educational scholarships from these calculations were Rianti Agistiani and Farid Al Hakim who obtained high scores, namely 36,25 and 32,5 respectively. The results of this ranking are used as a basis for candidates who receive assistance. The greater the value, the greater the opportunity to receive educational scholarship assistance. The data used for calculations using the MAUT method is data from prospective scholarship recipients at Muhammadiyah Ayah Vocational School, Kebumen.

Suggestions for further research include a method comparison analysis between MAUT and other methods in order to produce more accurate decisions.

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