

## **DECISION SUPPORT SYSTEM TO DETERMINE SCHOLARSHIP RECIPIENTS AT SMAN 1 BANGUNREJO USING SAW METHOD**

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### **Abstract**

*Abstract – SMAN 1 Bangunrejo is still a lot of parents who belong to underprivileged families economy, therefore the programs that support the smooth process learning as highly desirable for smooth scholarship students in completing education. Distribution of scholarships is done by the Department of Education Central Lampung greatly assist students who are not able to or achievement during their studies. To assist the determination in determining the eligible student then takes a decision support system. In the process of development of a decision support system to determine the scholarship recipients at SMAN 1 Bangunrejo use traditional methods Simple Additive Weighting (SAW). This method was chosen because it is able the best alternative from a number of alternatives, in this case the alternative meant that the right to receive scholarships based on criteria specified. Research done by finding the weight values for each attribute, then do ranking process that will determine the optimal alternative, that the best students achieving the eligible. Based on test results, a system built to help the working team selectors scholarship, can accelerate the scholarship selection process, can reduce errors in determining the scholarship recipients, so the scholarships granted in accordance with the target.*

*Keywords — Criteria, SAW, Scholarship, Decision Support System*

## **1.0 INTRODUCTION**

### **1.1 Background of the Problems**

To provide a quality education required a considerable education costs. Therefore, for each learner in each educational unit is entitled to receive tuition fees for those whose parents can not afford to pay for their education, and are entitled to a scholarship for those who excel. To obtain a scholarship, there are several predefined criteria. The usual criteria are defined as the amount of parental income, the number of dependents of the parents, the number of siblings, the average value, and the percentage of student attendance (craft). To help determine a student receives a scholarship, a Decision Support System (SPK) can be used using Fuzzy Multiple Attribute Decision Making (FMADM) model which is a method used to find the optimal alternative from a number of alternatives with certain criteria. One method of solving Fuzzy MADM problem is Simple Additive Weighting (SAW). The basic concept of SAW is to seek the weighted sum of the performance ratings on each alternative on all attributes, in this case the students at SMAN 1 Bangunrejo as Case studies are eligible to receive scholarships based on predetermined criteria. With this method is expected assessment will be more precise and accurate so that will get more accurate results on who will receive the scholarship.

### **1.2 Formulation of the Problems**

How to build Decision Support System using Simple Additive Weighting (SAW) method to determine the students of SMAN 1 Bangunrejo who are eligible to receive the scholarship?

### 1.3 Limitation of the Problems

In order that the discussion does not deviate from the objectives then the following limits are given:

1. Creation of Decision Support System in selecting outstanding students of Scholarship Recipients at SMAN 1 Bangunrejo.
2. Scholarships are processed scholarships for students who are less able achievers.

### 1.4 Objective and Benefits of the Research

The purpose of this research is to build a decision model using Fuzzy Multiple Attribute Decision Making (FMADM) method with Simple Additive Weighting (SAW) method:

1. To facilitate the School in the selection of scholarship recipients. And to get more accurate results on who will receive the scholarship.
2. Apply Fuzzy Multiple Attribute Decision Making (FMADM) method using Simple Additive Weighting (SAW) method to determine scholarship recipients.

## 2.0 THEORETICAL

### 2.1 Definition of Scholarship

Basically, a scholarship is an income for those who receive it. This is in accordance with the provisions of Article 4 paragraph (1) of Income Tax Law 2000. Mentioned the definition of income is the addition of economic ability by name and in any form received or obtained from sources of Indonesia or outside Indonesia that can be used for consumption or increase the wealth of taxpayers (WP). Understanding Scholarship as quoted from [www.wikipedia.org](http://www.wikipedia.org) is a gift in the form of financial assistance provided to individuals who aim to use for the sustainability of education undertaken. Scholarships can be provided by government agencies, companies or foundations. Understanding Scholarship according to Indonesian Dictionary of the Third Edition of Indonesia is the allowance given to students or students as a cost of learning assistance. The scholarship is a grant of financial assistance given to individuals who aim to be used for the sustainability of education pursued

### 2.2 Decision Support System

Decision support system is a combination of individual intelligence resources with component capabilities to improve the quality of decisions. Decision support systems are also computer-based information systems for decision-making management that deal with semi-structured problems [1]. Decision support system is an interactive computer-based system, which helps decision makers to use data and models to solve unstructured problems [2]. Decision Support System is an information retrieval system aimed at a particular problem that must be solved by the manager and can assist the manager in the decision maker.

### 2.3 Fuzzy Multiple Attribute Decision Making (FMADM)

FMADM is a method used to find the optimal alternative of a number of alternatives with certain criteria. The core of FMADM is to determine the weight value for each attribute, then proceed with the ranking process that will select the alternatives already given. There are basically three approaches to finding attribute weight value, that is subjective approach, objective approach, and integration approach between subjective and objective. Each approach has its advantages and disadvantages. In the subjective approach, the weighted value is determined on the subjectivity of decision-makers, so that several factors in the alternative ranking process can be determined freely. Whereas in the objective approach, the weighted value is calculated mathematically so as to ignore the subjectivity of the decision maker [3].

There are several methods that can be used to solve FMADM problems such as:

1. Simple Additive Weighting (SAW)
2. Weighted Product (WP)
3. Elimination Et Choix Traduisant la Realite (ELECTRE)
4. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
5. Analytical Hierarchy Process (AHP)

### 2.4 Simple Additive Weighting (Saw)

The SAW (Simple Additive Weighting) method is often also known as the weighted summing method. The basic concept of the SAW method is to find the weighted sum of performance ratings on each alternative on all attributes. The SAW method requires the process of normalizing the decision matrix (X) to a scale comparable to all existing alternative ratings.

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\text{Max}_i x_i} & \text{if } j \text{ benefit} \\ \frac{\text{Min}_i x_{ij}}{x_{ij}} & \text{if } j \text{ cost} \end{cases}$$

- $r_{ij}$  = normalized performance rating score
- $x_{ij}$  = attribute value of each criterion
- Max  $x_{ij}$  = the largest nilai of any criteria
- Min  $x_{ij}$  = the smallest nilai of any criteria
- Benefit = if the greatest value is best
- Cost = if the smallest value is best

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:

$$V_i = \sum_{j=1}^n w_j r_{ij}$$

Information:

- $V_i$  = rank for each alternative
- $w_j$  = weighted value of each criterion
- $r_{ij}$  = normalized performance rating value

A larger value of  $V_i$  indicates that  $A_i$ 's alternatives are preferred.

### 3.0 METHODOLOGY

#### 3.1 Methodology of Systems Development

##### 3.1 Data of analysis

The process of organizing and sorting data into patterns, categories, and units of basic description so that the theme can be found and can be formulated working hypothesis as suggested by data [4]. Data analysis used in this research is Qualitative data analysis, because the analysis of the data obtained based on the reasoning ability in the phenomenon that existed in the object of research. Qualitative data presents interview results and then draw conclusions from the description of the object that has been studied

##### 3.2 Observation Method

Observation method is a research method where, the researcher observes and researches directly to the research object about all activities related to the purpose of the research, by analyzing evaluating the current system and providing the solution through the information system to be built so that it can be more useful. Associated with the method of observation, the author made a direct observation of SMA Negeri 1 Bangunrejo to get some information needed related to the research undertaken.

##### 3.3 Design Model

The decision support system for this scholarship recipient is SDLC (Systems Development Life Cycle). (System Development Life Cycle / SDLC): a structured development method with a system development life cycle approach or the main stages of system development life cycle. System

development can mean setting up a new system to replace the old system as a whole or improve existing systems. The stages of SDLC include:

- a. Feasibility study. The feasibility study aims to determine whether the new system is realistic in terms of financing, time, and differences with the current system. Usually in the feasibility study phase it is decided to update the existing system or replace it with the new system.
- b. Analysis. Users and software developers work together to collect, learn, and formulate business needs.
- c. Design. Making system blueprints and adjustments with telecom architecture, hardware, and software for further development, as well as creating system models creating graphical user interface models, databases, and more.
- d. Development. At this stage, then the programmer coding to apply the design into the real system, create the program, and prepare the database.
- e. Testing. Once the system has been successfully developed, the next step is testing to see if the system is in line with user expectations and needs.
- f. Implementation. This stage, software that has been tested ready to be implemented into the user system. The creation of user guide and training is also done.

## 4.0 DESIGN AND IMPLEMENTATION

### 4.1 Design

This design stage describes what the system can do. The decision support system designed within the scholarship information system has several functions that are based on a survey of the needs of the relevant parties in this system.

#### 4.1.1 Flow Of Document (FOD)

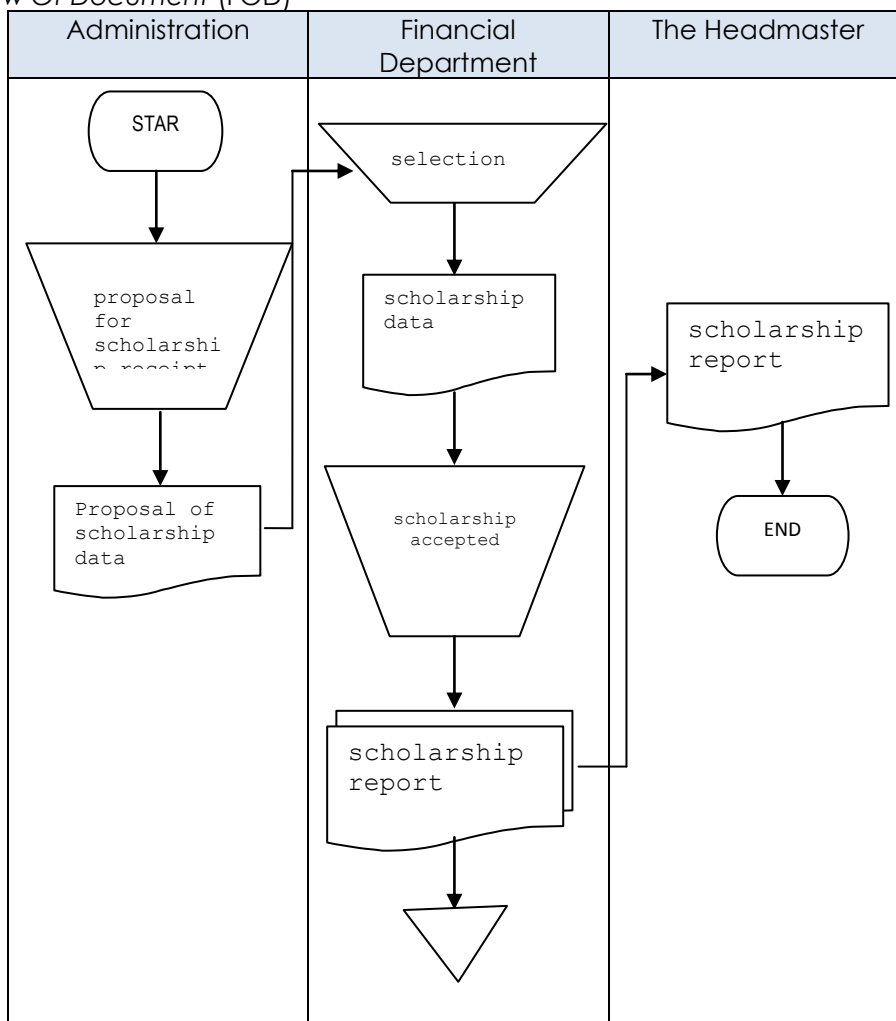


Figure 1. Flow Of Document

1. The design of FMADM Criterion

In the selection of scholarships at SMAN 1 Bangunrejo using Fuzzy Multiple Attribute Decision Making (FMADM) method with Simple Additive Weighting (SAW) method required criteria and weights to perform the calculation so that the best alternative will be obtained.

2. Criteria and Weight

In FMADM method with SAW method there are criteria needed to determine who will be selected as the scholarship recipient. The criteria are as follows:

**Table 1. Criteria**

No.	Criteria	Description
1	C1	Age
2	C2	Amount of parent income
3	C3	Number of dependents parent
4	C4	Number of siblings
5	C5	The average value of report cards
6	C6	Activity in organization
7	C7	Distance of residence

From each of these criteria will be determined the weights. The weights consist of six fuzzy numbers, very low (SR), low (R), medium (S), middle (T1), high (T2), and very high (ST) as shown in Figure 6 below.

**Table 2. Weight**

No.	Weight	Information
1	SR	very low
2	R	low
3	S	medium
4	T1	middle
5	T2	high
6	ST	very high

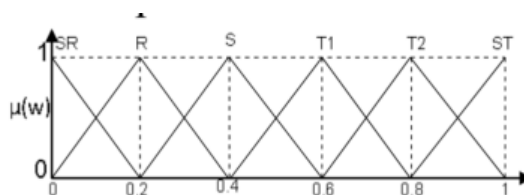


Figure 3. Fuzzy number for weight

From the picture above, fuzzy numbers can be converted to crisp numbers. For more details weights are formed in the table below.

**Table 3. Weight**

Number of Fuzzy	Value
Very Low (SR)	0
Low (R)	0.25
Medium (S)	0.5
Central (T1)	0.75
Very High (ST)	1

Sample case:

**Table 4. Scholarship applicants**

Name	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>	C <sub>6</sub>	C <sub>7</sub>
WANTI JULIA	15	450.000	2	2	76	70	5
NURHIDAYAH	17	1.000.000	5	5	88	83	3
FITRIANI	18	400.000	3	3	70	75	1

Scholarship Selection Calculation

1. Give the value of each alternative (A<sub>i</sub>) on each criteria (C<sub>j</sub>) that has been determined.

a. Age C<sub>1</sub>

Table 4. AgeC<sub>1</sub>

C <sub>1</sub>	Number Of Fuzzy	Value
C <sub>1</sub> ≤ 15 Years	Very Young (SM)	0.25
C <sub>1</sub> ≤ 16 Years	Young (M)	0.5
C <sub>1</sub> ≤ 17 Years	Medium (S)	0.75
C <sub>1</sub> ≤ 18 Years	Old (T)	1

2. Parent Earnings C<sub>2</sub>

Table 5. Parental Income Amount

C <sub>2</sub>	Number Of Fuzzy	Value
C <sub>2</sub> ≤ Rp. 500.000	Low (R)	0.25
C <sub>2</sub> ≤ Rp. 500.000 - Rp. 1.500.000	Simply (C)	0.5
C <sub>2</sub> ≤ Rp. 1.500.000 - Rp. 3.000.000	High (T)	0.75
C <sub>2</sub> ≥ Rp. 3.000.000	Very High (ST)	1

b. Number of Parents C<sub>3</sub>

Table 6. Number of Parent Expenditures

C <sub>3</sub>	Number Of Fuzzy	Value
C <sub>3</sub> = 1 chlid	Very Few (SS)	0
C <sub>3</sub> = 2 chlidren	Little (S)	0.25
C <sub>3</sub> = 3 chlidren	Medium (SD)	0.5
C <sub>3</sub> = 4 chlidren	Many (B)	0.75
C <sub>3</sub> ≥ 5 chlidren	Very Many (SB)	1

b. Number of C<sub>4</sub> Brothers

Table 7. Number of Brothers

C <sub>4</sub>	Number Of Fuzzy	Value
C <sub>4</sub> = 1 chlid	Very Few (SS)	0
C <sub>4</sub> = 2 chlidren	Little (S)	0.25
C <sub>4</sub> = 3 chlidren	Medium (SD)	0.5
C <sub>4</sub> = 4 chlidren	Many (B)	0.75
C <sub>4</sub> ≥ 5 chlidren	Very Many (SB)	1

b. Average Value of Raport C<sub>5</sub>

Table 8. Average Ratorf Value

C <sub>5</sub>	Number Of Fuzzy	Value
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$C_5 \leq 60$	Very Low (SR)	0
$C_5 = 61-70$	Low (R)	0.25
$C_5 = 71-80$	Simply (C)	0.5
$C_5 = 81-90$	High (T)	0.75
$C_5 > 91$	Very High (ST)	1

b. Activity In Organizing

Table 9. Activity In Organizing

$C_6$	Number Of Fuzzy	Value
$C_6 \leq 70$	Very Low (SR)	0.25
$C_6 = 71-80$	Low (R)	0.5
$C_6 = 81-90$	Simply (C)	0.75
$C_6 \geq 91$	High (T)	1

b. Distance of Residence

Table 10. Distance of Residence

$C_7$	Number Of Fuzzy	Value
$C_7 \leq 1$ km	near ( R )	0.25
$C_7 = 2-3$ km	Simply ( C )	0.5
$C_7 = 4-7$ km	Far (T)	0.75
$C_7 \geq 8$ km	Very far (ST)	1

From the above table is converted into X decision matrix with data:

$$X = \begin{bmatrix} 0,25 & 0,25 & 0,25 & 0,25 & 0,5 & 0,25 & 0,75 \\ 0,75 & 0,5 & 1 & 1 & 0,75 & 0,75 & 0,5 \\ 1 & 0,25 & 0,5 & 0,5 & 0,25 & 0,5 & 0,25 \end{bmatrix}$$

Give weight value (W).

$$W = [0.75 \ 0.5 \ 0.5 \ 0.5 \ 0.75 \ 0.75 \ 0.5]$$

1. Normalize matrix X into matrix R based on equation (1)

$$R = \begin{bmatrix} 1 & 1 & 0,25 & 0,25 & 0,5 & 0,25 & 0,75 \\ 0,33 & 0,5 & 1 & 1 & 0,75 & 0,75 & 0,5 \\ 0,25 & 0,25 & 0,5 & 0,5 & 0,25 & 0,5 & 0,25 \end{bmatrix}$$

1. Ranking process by using equation(2).

$$\text{Wanti Julia} = (0.75 * 1) + (0.5 * 1) + (0.5 * 0.25) + (0.5 * 0.25) + (0.75 * 0.5) = 1,88$$

$$\text{Nurhidayah} = (0.75 * 0.33) + (0.5 * 0.5) + (0.5 * 1) + (0.5 * 1) + (0.75 * 0.75) = 2.05$$

$$\text{Fitriani} = (0.75 * 0.25) + (0.5 * 1) + (0.5 * 0.5) + (0.5 * 0.5) + (0.75 * 0.25) = 1.39$$

From the summing process obtained Wanti Julia value = 1.88 Nurhidayah = 2.05 and Fitriani = 1.39. the last step is the ranking process and the biggest value is in Nurhidayah = 2.05. Nurhidayah is the chosen alternative as a scholarship recipient in SMA Negeri 1 Bangunrejo.

## 5.0 CONCLUSION

### 5.1 Conclusions

After conducting the research in SMAN 1 Bangunrejo and analyzing the data, the conclusions are drawn as follows, The built system can assist the SMAN 1 Bangunrejo scholarship selection team in selecting scholarships and accelerating the selection process of scholarships and reducing errors in determining scholarship recipients. The fuzzy method of multiple attribute decision making (fmadm) with simple additive weighting (saw) method can be applied to determine the scholarship recipient.

### 5.2 Suggestions

In reference to the conclusion above, some suggestions are given to support the success of information systems to determine scholarship recipients at sman 1 bangunrejo using saw method as follows:

1. In the research that has been done used five criteria, for developers can make modifications to the criteria and weight (plus or minus) as needed.
2. Required to regularly back-up your data regularly to avoid data loss due to damage to the system.
3. It is expected that the school can socialize in the use of this information system in order to run properly as needed.



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