Multi Attribute Utility Theory (MAUT) Method of Decision on The Selection of the Head of Study Program Digital Business

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Abstract– The head of the study program is the spearhead of success in a study program. So a head of a study program is required to have good leadership and management skills in order to be able to carry out his duties and functions correctly. The problem that arises is that the appointment of a head of a study program is often carried out not looking at some aspects or criteria, usually the appointment is subjective and based on how long he has been a lecturer in the study program. Even though the appointment of a study program head must be seen from many aspects and criteria, this is done because if you appoint a study program head who is not competent, it can result in not running well with the study program he leads. The criteria used in this research are Functional Position, Education, Working Period, Research, PKM Activities, Supporting Activities and Lecturer Achievement. To overcome this problem, a decision support system with the MAUT method is the right solution to use. The advantage of the MAUT method is that the calculation and decision-making process is faster because it can directly calculate the final evaluation value without the need to compare the importance weight values between criteria. This method will process the criteria values of each candidate so that the results will be more objective. In this study, the number of alternatives used was 6 data on the value of the prospective head of the study program. Based on the MAUT process, a decision was obtained that the chosen head of the digital business study program was a Candidate-01 lecturer with a value of 1.0.

Keywords – Decision Support System, MAUT, Head of Program Study

I. INTRODUCTION

The use of technology as a reference in a decision decisions are not foreign for a company or organization, because technology in various fields at this time is very advanced very rapidly both in terms of speed and convenience[1]. Examples of the application of technology such as in the field of health[2], the field of agriculture (Wendra et al., 2020), the field of management[4], the field of Education [5], the field of environment[6] and many other applications.

Apart from the development of technology, various branches of technology have also emerged, such as expert systems[7], fuzzy systems[8], robotics[9], decision support systems [10], forecasting systems[11] and many other branches of technological science. In this study, the branch of technology applied is a decision support system, which in general can be interpreted as a computer-based system that can help decision making to solve certain problems[12].

The application of decision support systems is often applied to problems of a certain nature in their nature selection and is often also faced with complex decision alternatives as well as requires expert opinion. The application of DSS includes the selection of employees who are entitled to get rewards [13], the selection of the best state civil apparatus, with the results a system that is built only as a tool to provide information to the leadership as a consideration in making decisions[14], then for the selection of the best interns with the final result of the system built provides a sequence of employee assessments from the highest to the lowest based on the criteria used by

the company[15]. In the decision support system, knowledge can be embedded in the form of algorithms or methods that function as data processing inputted by users who want to make decisions. These methods include the topsis method[16], the SAW method[17], the AHP method[18] and many more decision support system methods others. In this study, the method used was multi attribute utility theory (MAUT).

Where the MAUT method is a method that consists of several attributes (multi discrete criteria) the decision to create a model that prioritizes existing alternatives, while giving a relative weight called MAUT weight[19]. The Multi-Attribute Utility Theory (MAUT) approach is a quantitative comparison method that usually combines the measurement of various risks and costs of benefits. There are several alternatives for each of the existing criteria, which can provide solutions. The advantage of the MAUT method is that the calculation and decision-making process is faster because it can directly calculate the final evaluation value without the need to compare the importance weight values between criteria. The selection of this method is because it has been applied to decision making both in the organization and in solving non-organizational problems. The application of the MAUT method in this study is for the selection of the head of the digital business study program .

In the context of the world of education, the existence of leaders is important to carry out the work programs of educational institutions, especially in carrying out control over the work programs of these educational institutions[20]. The head of the study program is the spearhead of the success of a study program. So a head of

a study program is required to have good leadership and management skills in order to be able to carry out his duties and functions properly. The head of the study program is a strategic position within the college, which is responsible for the back and forth of an education department at the college. This position serves to lead the implementation of education, research, community service, cooperation and fostering the academic community and administrative personnel within the study program [21].

The problem that arises is that the appointment of a head of a study program is often carried out not looking at some aspects or criteria, usually the appointment is subjective and based on how long it takes has been a lecturer in the study program. Even though the appointment of a study program head must be seen from many aspects and criteria, this is done because if you appoint a study program head who is not competent, you can resulting in not running well the study program he led.

Based on this, through this research, solutions will be offered as consideration for decision makers. The solution offered is to build a system that is able to provide decision recommendations to the head of the study program with the MAUT method, this method will provide the best decision based on the value of each prospective head of the study program.

II. RESEARCH METHODOLOGY

The research framework is the order that will be carried out in a study. So that the steps taken by the author in this design do not deviate from the subject matter and are easier to understand, the sequence of research steps will be made systematically so that it can be used as a clear and easy guide to solve existing problems. The sequence of steps to be made in this study can be seen in the following figure:
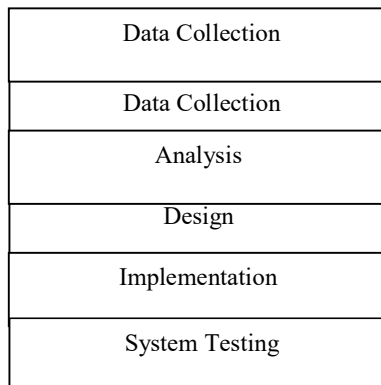
Data Collection
Data Collection
Analysis
Design
Implementation
System Testing

Figure 1. Research Framework

Stages of Research

Research (*research*) is a scientific activity to find, develop and test the truth of a knowledge or problem in order to find a solution to a problem. In general, the data obtained from research can be used to understand, solve, and anticipate a problem. The function of the research is to find explanations and answers to problems and provide alternatives to possibilities that can be used for problem solving. The solution and answer to the problem can be abstract and general as is the case in basic research (*basic reasearch*) and can be specific as is usually found in *applied research (applied reasearch)*.

In conducting research, a method is needed to conduct such research. Research methods are a series of ways / activities of conducting research according to scientific steps that are arranged systematically and logically so that they can be used as clear and easy guidelines to solve a problem. Each stage is an interrelated part to determine the process at the next stage.

Preliminary Research

Preliminary Research is the first step in conducting a study by first analyzing the problems to be developed. Problems regarding the symptoms of autistic disease that are not well known by the public and solutions and actions that must be taken to be able to overcome autistic diseases earlier so that it is not too late to be treated. This research was conducted by conducting interviews. This study aims to help users in recognizing the symptoms of autistic disorders and can also provide information to users in overcoming the problem of autistic disorders early on.

Data Collection

Data collection is the second stage after preliminary research is carried out which contains sequences from the beginning to the end of the study. In conducting research, to obtain information about the object of study, a data collection stage is needed,

Analysis

In this stage, it can be done with three stages of analysis as follows:

1. Data Analysis
   The data obtained from the interview results will then be analyzed so that a set of rules (*rulebase)* will be obtained that will be associated with facts (*input data*) using the MAUT method that has been applied to the system so that the system can provide the right decision.
2. Process Analysis
   At this stage of process analysis, the author uses the MAUT method*,* where this system can help users in resolving uncertainty. Uncertain outcomes are caused by two things: uncertain rules and uncertain user answers or a question asked by an expert system.
3. System Analysis
   At the analysis stage, this system is carried out to design and build a system that will be made using the MAUT method*.* These design and development include, designing user views, designing databases for the system so that existing file management is more organized, and designing coding programs from information. Where the program will be created using PHP and MySQL languages. From these stages, an expert system is formed that can be used

Design

At this stage there are two types of design that will be carried out including:

1. Model Designing
   The processes carried out in this design resistance are to collect data and facts that support the design of the system by consulting with experts.

Furthermore, a comparison stage is carried out between the results of expert research and those in books and other references. At this stage, UML (*Unified Modeling Language*) is used which is a data logic model created to describe where the data comes from, where the data that comes out of the system, where the data is stored, what processes produce the data, the interaction between the stored data and the processes imposed on the data.

2. *Interface Design*

Interface design or interface design is a form of temporary display design from the creation of this expert system application. This design was created to provide an explanation of the appearance faced by actors when using the system, so that it can make it easier to implement applications and will facilitate the construction of applications that meet the principles of good interface design.

Implementation

System implementation is part of the system development life cycle. at this stage, an expert system application specifically for autistic diseases will be designed using PHP and MySQL programming languages to create a website and database that will store data on the symptoms of autistic diseases by applying the *Dempster-Shafer method.*

Testing

System testing is a stage of *testing* to find out errors in the system. one of the important things in the expert system is being able to consult computerized and find out the errors that occur in the system.testing this system will be carried out by testing the LAN and *Online networks.*

III.   RESULTS AND DISCUSSION

Data Analysis

The data analysis process is one of the important stages in this study, because at this stage, identification of the problems that exist in the assessment of lecturer performance at STMIK GICI will be carried out.

Problem analysis is carried out so that the findings of the problems obtained can be known the cause, so that from the analysis of the problem, a form of problem solving is obtained. Problem solving is a way that can solve the problems that have been described in the problem analysis above is to build a support system for the selection of the head of the digital business study program.

Process Analysis With MAUT

MAUT method is a method consisting of several attributes (multi discrete criteria) of decisions to create a model that prioritizes existing alternatives, while giving it a relative weight called a weighted MAUT. Here are some stages of applying the MAUT[19].

The procedure for selecting the head of the digital business study program Using the MAUT Method will be explained in the order of how the procedure is, the author uses data samples and alternative data based on data obtained from field studies. Where the data amounts to 8 alternative and 7 criteria. To determine the value of each

criterion the author collected data in the previous year and had interviews directly with the high school. The critria used are as follows:

K1 = Functional Position
a. Head Lector = 5
b. Lector   = 4
c. Expert   Assistants = 3
d. NJFA   = 2

K2 = Education
a. S3 = 5
b. S2 = 4

K3 = Service Life
a. >=5 years =5
b. <5 years = 3

K4 = Research
a. >=10=5
b. 8 – 9 = 4
c. 6 – 7 = 3
d. <=6=2

K5 = PKM Activities
a. Ada = 5
b. None = 2

K6 = Supporting Activities
a. Ada = 5
b. None = 2

K7 = Lecturer Achievement
a. Ada = 5
b. None = 2

Furthermore, the determination of the weight of each grade contained in the student will be carried out as follows:

Table 1. Weighting Criteria

Code	Weight
K1	0.25
K2	0.20
K3	0,15
K4	0.10
K5	0.10
K6	0.10
K7	0.10

After the indicator value is known, the assessment data obtained will be used as follows:

Table 2. Lecturer Value Data

NO	Lecturer	K1	K2	K3	K4	K5	K6	K7
1	Nominee-01	4	5	5	5	5	5	5
2	Nominee-02	4	5	5	5	5	5	2
3	Nominee-03	3	5	3	4	2	5	2
4	Nominee-04	3	4	5	5	2	5	5
5	Nominee-05	4	4	2	5	2	5	5
6	Nominee-06	4	5	2	2	5	2	5
7	Nominee-07	3	5	3	4	2	5	2
8	Nominee-08	4	5	2	2	5	2	5

The normalization of the matrix is determined by the formula:

$$U_{(x)} = \frac{X - X_i^-}{X_i^+ - X_i^-}$$

X = Alternate weight
X_i^- = Worst weight (minimum) of the Xth criterion
X_i^+ = Best weight (maximum) of the Xth criterion
The following is the calculation of the normalization matrix:

a. **Normalization of Candidates-01 (A1)**

$$A1_1 = \frac{4-3}{4-3} = \frac{1}{1} = 1$$
$$A1_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A1_3 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A1_4 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A1_5 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A1_6 = \frac{5-3}{5-3} = \frac{3}{3} = 1$$
$$A1_7 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$

b. **Normalization of Candidates-02 (A2)**

$$A2_1 = \frac{4-3}{4-3} = \frac{1}{1} = 1$$
$$A2_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A2_3 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A2_4 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A2_5 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A2_6 = \frac{5-3}{5-3} = \frac{3}{3} = 1$$
$$A1_7 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$

c. **Normalization of Candidates-03 (A3)**

$$A3_1 = \frac{3-3}{4-3} = \frac{0}{1} = 0$$
$$A3_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A3_3 = \frac{3-2}{5-2} = \frac{1}{3} = 0,33$$
$$A3_4 = \frac{4-2}{5-2} = \frac{2}{3} = 0,67$$
$$A3_5 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A3_6 = \frac{5-2}{5-3} = \frac{3}{3} = 1$$
$$A3_7 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$

d. **Normalization of Candidates-04 (A4)**

$$A4_1 = \frac{3-3}{4-3} = \frac{0}{1} = 0$$
$$A4_2 = \frac{4-4}{5-4} = \frac{0}{1} = 0$$
$$A4_3 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A4_4 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A4_5 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A4_6 = \frac{5-2}{5-3} = \frac{3}{3} = 1$$
$$A4_7 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$

e. **Normalization of Candidates-05 (A5)**

$$A5_1 = \frac{4-3}{4-3} = \frac{1}{1} = 1$$
$$A5_2 = \frac{4-4}{5-4} = \frac{0}{1} = 0$$
$$A5_3 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A5_4 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A5_5 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A5_6 = \frac{5-2}{5-3} = \frac{3}{3} = 1$$
$$A5_7 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$

f. **Normalization candidate-06 (A 6)**

$$A6_1 = \frac{4-3}{4-3} = \frac{1}{1} = 1$$
$$A6_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A6_3 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A6_4 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A6_5 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A6_6 = \frac{2-2}{5-3} = \frac{0}{3} = 0$$
$$A6_7 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$

g. **Normalization of Candidates-07 (A7)**

$$A7_1 = \frac{3-3}{4-3} = \frac{0}{1} = 0$$
$$A7_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A7_3 = \frac{3-2}{5-2} = \frac{1}{3} = 0,33$$
$$A7_4 = \frac{4-2}{5-2} = \frac{2}{3} = 0,67$$
$$A7_5 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A7_6 = \frac{5-2}{5-3} = \frac{3}{3} = 1$$
$$A7_7 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$

h. **Normalization candidate-08 (A 8)**

$$A8_1 = \frac{4-3}{4-3} = \frac{1}{1} = 1$$
$$A8_2 = \frac{5-4}{5-4} = \frac{1}{1} = 1$$
$$A8_3 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A8_4 = \frac{2-2}{5-2} = \frac{0}{3} = 0$$
$$A8_5 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$
$$A8_6 = \frac{2-2}{5-3} = \frac{0}{3} = 0$$
$$A8_7 = \frac{5-2}{5-2} = \frac{3}{3} = 1$$

The next stage will be carried out the multiplication of the normalization matrix by the preferential weight using the formula:

$$V_{(x)} = \sum_{i=1}^{n} Wj.Xij \ldots \ldots \ldots \ldots (1)$$

The following is the calculation of the normalization matrix multiplication using equation (1):

A1 = (0.25 * 1) + (0.20* 1) + (0.15 * 1) + (0.1 0 * 1) + (0.1 0 * 1) + (0.1 0 * 1) + (0.1 0 * 1)
    =1.0

A2 = (0.25 * 1) + (0.20* 1) + (0.15 * 1) + (0.1 0 * 1) + (0.1 0 * 1) + (0.1 0 * 1) + (0.1 0 * 0)
    =0.9

A3 = (0.25 * 0) + (0.20* 1) + (0.15 * 0.33) + (0.1 0 * 0.67) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 0)
    =0.4165

A4 = (0.25 * 0) + (0.20* 0) + (0.15 * 1) + (0.1 0 * 1) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 1)
    =0.45

A5 = (0.25 * 1) + (0.20* 0) + (0.15 * 0) + (0.1 0 * 1) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 1)
    =0.55

A6 = (0.25 * 1) + (0.20* 1) + (0.15 * 0) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 0) + (0.1 0 * 1)
    0,65

A7 = (0.25 * 0) + (0.20* 1) + (0.15 * 0.33) + (0.1 0 * 0.67) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 0)
    =0.4165

A8 = (0.25 * 1) + (0.20* 1) + (0.15 * 0) + (0.1 0 * 0) + (0.1 0 * 1) + (0.1 0 * 0) + (0.1 0 * 1)
    0,65

From the results of the equation, the multiplication of the normalization matrix shown in the following table will be produced:

Table 3. Final Results

No.	Name	Score
1	Nominee-01	1,0
2	Nominee-02	0,9
3	Nominee-03	0.4165
4	Nominee-04	0.45
5	Nominee-05	0.55
6	Nominee-06	0.65
7	Nominee-07	0.4165
8	Nominee-08	0.65

IV. CONCLUSION

The results of this study are in the form of lecturer who was elected as the head of the digital business study program . The results of the recommendations are in the form of the highest value of each candidate submitted. Where the results obtained are, lecturers with the code Candidate-01 get a value of 1.0, then Candidate-02 get a value of 0.9, Candidate-03 gets a value of 0.4165, Candidate-04 gets a score of 0.4165, Candidate-05 gets a value of 0.55, Candidate-06 gets a score of 0.65 Candidate-07 gets a value of 0.4165, Candidate-08 gets a score of 0.65 Based on these values, the decision was obtained that the chosen head of the digital business study program was a Candidate-01 lecturer with a value of 1.0. With the help of a decision support system for selected candidates, it is produced from the process of processing data on the value of the criteria of each candidate so that the results obtained are quite objective and most effective and competent as a head of study program.

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