

# Application of Fuzzy Multi Tributes of Decision (MADM) in Supporting Decision to Determine Best Graduate

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**Abstract:** In determining the best graduates there are several criteria that can be used as the basis of assessment such as the IPK, similar cases also occur in STMIK WidyaCipta Dharma in determining the best graduates. To help determine in establishing the best graduates then a decision support system is required. Fuzzy Multiple Attribute Decision Making FMADM is an appropriate method used to find the optimal alternative of a number of alternatives with certain criteria. The core of the method is to determine the value of weight on each criterion, then performed calculations to be discussed in the next chapter. By applying the Fuzzy Multi Attribute Decision Making (MADM) method with several decision-making criteria to determine the best graduates to be faster, accurate and realistic.

**Index Terms:** best graduates, fuzzyMADM, criteria, decision supportsystems (arbansyah)

## I. INTRODUCTION

In determining the best graduates there are several criteria that can be used as the basis of assessment of which is the grade point average (IPK), basically just a IPK of an educational institution has been able to determine the best graduates, but problems may arise when there are multiple IPK same, this of course will be difficult for the institutions to choose who deserves to be the best graduates because of the criteria used as an indicator assessment using only one criterion alone is IPK.

In addition to the IPK, there are still some other criteria that can be used as a reference assessment that may be considered include the Old Study, a long completion of the final project, the value of Final (Rian Anggraeni, Sri Kusumadewi, Wawan Indarto, 2004) As already mentioned, in addition to the IPK there are some alternative use other criteria, namely the old Study, these criteria can be used to assess the speed of graduates in completing their studies, further criteria for long settlement final project, these criteria can assess how long a lady student can complete the task Finally, the faster finish the TA will certainly get added value for students.

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Fuzzy logic (fuzzy logic) is one of the branches of AI (artificial intelligence). Fuzzy logic is a modification of set theory where each member has a degree of membership that is worth continuously between 0 and 1. Since it was first discovered by Lotfi A. Zadeh in 1965, fuzzy logic has been used in the scope of the problem domain is quite extensive, such as process control, classification and pattern matching, management and decision-making.

## II. RESEARCH METHOD

### A. Data

Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to find the optimal alternative of a number of alternatives to certain criteria. The essence of Fuzzy MADM is to determine the weight values for each attribute, followed by the ranking process that will select the alternative that has been given.

Basically, there are three approaches to find the value of attribute weights, ie the subjective approach, objective approach and an integrated approach between the subjective and objective. Each approach has its advantages and disadvantages. In the subjective approach, the weight value is determined based on the subjectivity of decision-makers, so that some of the factors in the ranking process could alternatively be determined freely. While on an objective approach, the weight value is calculated mathematically so that ignores the subjectivity of the decision makers.

There are several methods that can be used to solve the problem FMADM. among others :

- Simple Additive weighting method (SAW);
- Weighted Product (WP);
- Elimination Et Choix Traduisant la réalité (ELECTRE);
- Technique for Order Preference by Similarity to Ideal Solution (TOPSIS);
- Analytic Hierarchy Process (AHP)

### B. Metode

Simple Additive Weighting (SAW)

The basic concept Simple Additive weighting method (SAW) is looking for a weighted sum of the performance rating for each alternative on all attributes. SAW method requires a decision matrix normalization process to a scale that can be compared with all the ratings of existing alternatives.

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max_i x_{ij}} & \text{If } j \text{ is an attribute profits benefit} \\ \frac{\min_i x_{ij}}{x_{ij}} & \text{If } j \text{ is an attribute cost} \end{cases}$$

Where rij is the normalized performance rating of alternative Ai and attribute Cj; i = 1, 2, ..., m and j = 1, 2, ..., n.

Preference value for each alternative (Vi) is given as :

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

### III. RESULTS AND DISCUSSION

As we know, the student is one aspect of the process of learning and teaching at a college. During taking courses hinga eventually graduate and holds a particular, students will try her best to get the title of the best, this is one of them carried out in order to gain recognition and appreciation for all the hard work they have done over the years.

Calculation method using Fuzzy Multiple Attribute Decision Making (FMADM) will be implemented in the present study, in order to produce a decision support system for the determination of the best graduates

#### A. Stages Research

In addition to the observation of determining the background issues that will be used as research material, literature study was also conducted to deepen the understanding of how the FMADM. In the next phase of data collection, will be followed by implementation of the method FMADM. And continued with the analysis results FMADM method. And in the end is drawing conclusions and recommendations regarding the use FMADM in this study

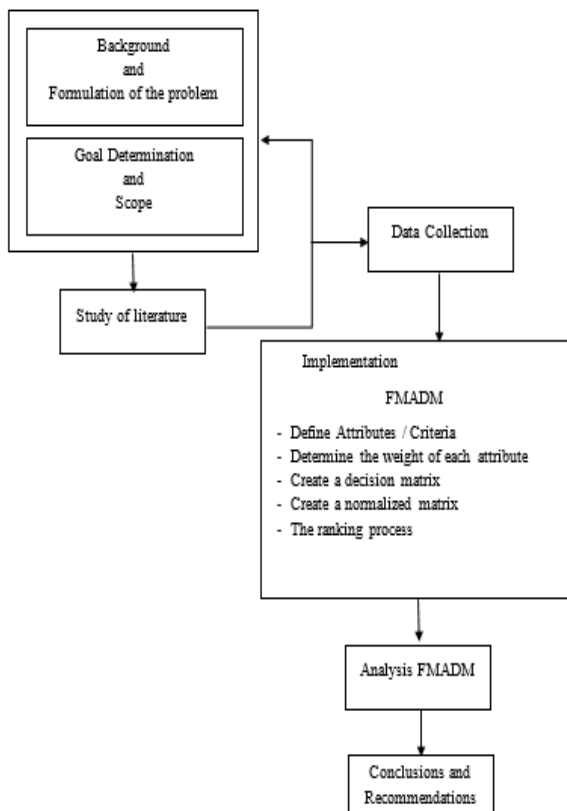


Figure 1 Framework for Thinking

#### B. Attributes

The perpetrators determine the background of the problem to be used as research materials, literature studies are also conducted to deepen the understanding of how the FMADM works. In the next stage of data, then will proceed with FMADM method. And proceed with analysis of FMADM result method. And in the end are interesting findings and related to the use of FMADM in this study.

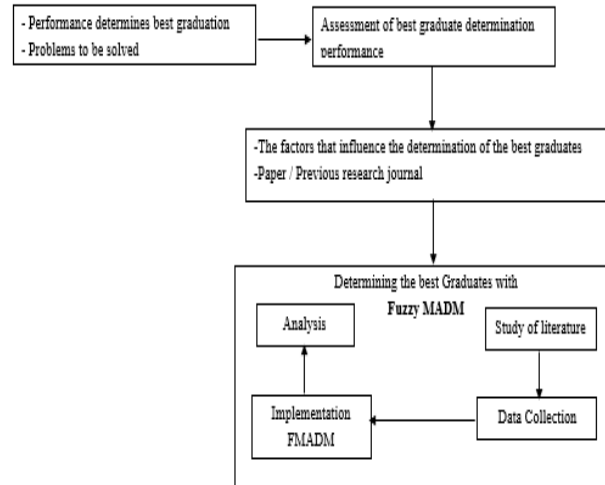


Figure 2 Structure of Attribute Hierarchy Problem

No	Attribut	Descripti
1.	NIM	Identification Number is a student, not an attribute count, but it is a unique identifier in the data.
2.	Name	Student Name
3.	ladder	Study Study: Tier 1 and Diploma 3
4.	Prodi	Study program : Technical Information Informatics Management Information Systems
5.	GPA	The index grade point average
6.	old Study	Old college adopted (Years)
7.	Old Final	The final task of making long (Month)
8.	value TA	Value Thesis

Table 1 Attributes

From the above table, some of the attributes or criteria that will be used as assessment parameters are as the following table below.

Rating level of interest and fuzzy representation of each criterion authors present as the following data.

- IndeksPrestasiKumulatif (IPK)
  - 0-2.0 **VB** Very Bad  $\rightarrow (0, 0, 1, 2.0)$
  - 1-2.75 **Bd** Bad  $\rightarrow (1.0, 1.5, 2.25, 2.75)$
  - 2.-3.25 **M** Medium  $\rightarrow (2.0, 2.5, 3.0, 3.25)$
  - 2.75-3.75 **Gd** Good  $\rightarrow (2.75, 3.25, 3.5, 3.75)$
  - 3.25-4.0 **Vg** Very Good  $\rightarrow (3.25, 3.75, 4.0, 4.0)$

- 0 – 3**VB** Very Bad  $\rightarrow (0, 0, 1, 3)$
- 0 – 5**Bd** Bad  $\rightarrow (0, 2, 3, 5)$
- 3 – 8**M** Medium  $\rightarrow (3, 5, 6, 8)$
- 5 – 10 **Gd** Good  $\rightarrow (5, 7, 8, 10)$
- 7 – 10 **Vg** Very God  $\rightarrow (5, 7, 8, 10)$

Figure 3.6 Representation fuzzy criteria weight

#### IV. CONCLUSIONS

As mentioned in the previous chapter, in this study the data to be used is the 2014-2015 program year student of Computer Science. Here are some views of data that will be used in the process of further calculations.

Table 2 Student Data

Final Assignment Value	Final Project	Length of Study	GPA
1	2	2	0
0.02	0.132	0.322	0.42

Normalized Value

Amount Normalized weight = 1  
If it's equal to 1 (one) then it's correct

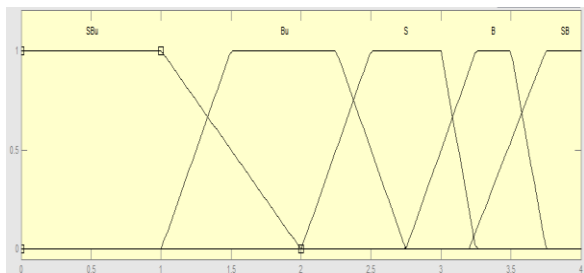


Figure 3 RepresentasiGPA

- Old Study (LS)
  - 7-8 **VL** Very Long  $\rightarrow (7, 8, 8, 8)$
  - 6-8 **O** Old  $\rightarrow (6, 6.5, 7.5, 8)$
  - 4-7 **M** Medium  $\rightarrow (4, 5, 6, 7)$
  - 3-5 **F** Fast  $\rightarrow (3, 3.5, 4.5, 5)$
  - 3-4 **VF** Very Fast  $\rightarrow (3, 3, 4)$

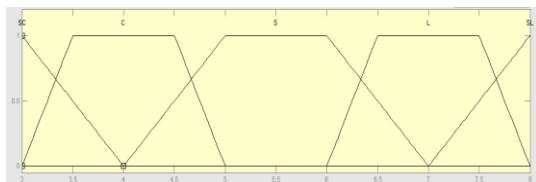


Figure 4 Representation Old Studies

- Old Completion Final (OCF)
  - 11-42 **VL** Very Long  $\rightarrow (11, 15, 42, 42)$
  - 8-15 **O** Old  $\rightarrow (8, 11, 11, 15)$
  - 6-11 **M** Medium  $\rightarrow (6, 8, 8, 11)$
  - 3-7 **F** Fast  $\rightarrow (3, 4, 6, 7)$
  - 1-5 **VF** Very Fast  $\rightarrow (1, 1, 3, 5)$

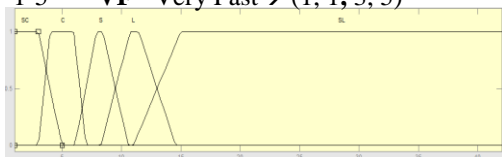


Figure 5 Representation Old Final

- The Final (TF)
  - 0 – 40 **VB** Very Bad  $\rightarrow (0, 0, 20, 40)$
  - 20 – 50 **Bd** Bad  $\rightarrow (20, 30, 40, 50)$
  - 40 – 70 **M** Medium  $\rightarrow (40, 50, 60, 70)$
  - 60 – 90 **Gd** Good  $\rightarrow (60, 70, 80, 90)$
  - 70 – 100 **Vg** Very God  $\rightarrow (70, 90, 100, 100)$

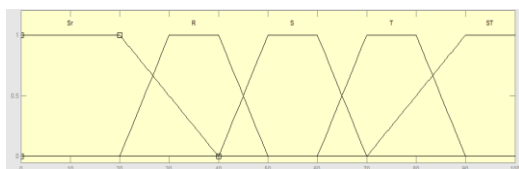
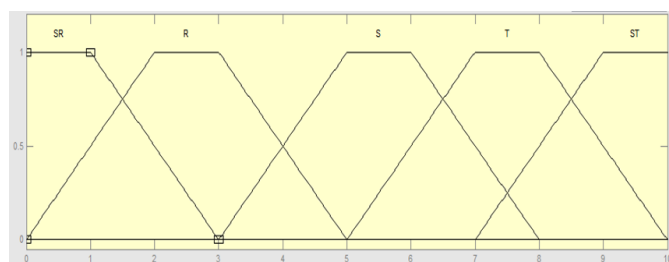


Figure 6 Representation Value Final

- Representation fuzzy criteria weight



No	STUDY PROGRAM	GPA	Length of Study	Final Project	Final Assignment Value
1	TEKNIK INFORMATIKA	3,51	5	9	81,28
2	TEKNIK INFORMATIKA	3,63	4	4	79,53
4	TEKNIK INFORMATIKA	2,43	5	15	82,50
5	TEKNIK INFORMATIKA	3,01	6	19	80,00
.....	.....	.....	.....	.....	.....
231	TEKNIK INFORMATIKA	2,54	4	6	81,31
232	TEKNIK INFORMATIKA	2,94	5	18	77,16
233	TEKNIK INFORMATIKA	2,89	5	14	81,84
234	TEKNIK INFORMATIKA	3,13	4	2	80,10
235	TEKNIK INFORMATIKA	3,25	6	28	76,95

After that the next step is to write the Crisp value into the Fuzzy value according to the Fuzzy representation of each Criteria using the Trapezoid and Triangle equations.

There are 4 attributes of cryia to determine the best graduate students that have been determined, namely: GPA (C1), Length of Study (C2), Length of Final Project Completion (C3), Final Assignment Value (C4)

A. In the FMADM model there are criteria needed to determine support for the decision to determine the best graduates. The criteria are as follows :Table 3

Kriteria	Linguistic Term	Value Fuzzy			
C1 - GPA	ST	7	9	10	10
C2 - Length of Study	T	5	7	8	10
C3 - Final Project	R	0	2	3	5
C4 - Final Assignment Value	SR	0	0	1	3

B. Weight Criteria

As for each criterion to determine the best graduates as follows:

Table 4 Cumulative Achievement Index

C1 GPA		Linguistic Term	Value Fuzzy			
0.00	2.00	SBu	0	0	1	2
1.00	2.75	Bu	1	1.5	2.25	2.75
2.00	3.25	S	2	2.5	3	3.25
2.75	3.75	Ba	2.75	3.25	3.5	3.75
3.25	4.00	SBa	3.25	3.75	4	4

Table 5. Length of Study

C2- Length of Study		Linguistic Term	Value Fuzzy			
7	8	SL	7	8	8	8
6	8	L	6	6.5	7.5	8
4	7	S	4	5	6	7
3	5	C	3	3.5	4.5	5
3	4	SC	3	3	3	4

Table 6 Final Project

C3 - Final Project		Linguistic Term	Value Fuzzy			
11	42	SL	11	15	42	42
11	15	L	8	11	11	15
6	11	S	6	8	8	11
3	7	C	3	4	6	7
1	5	SC	1	1	3	5

Table 7 Final Assignment Value

C4- Final Assignment Value		Linguistic Term	Value Fuzzy			
0	40	SBu	0	0	20	40
20	50	Bu	20	30	40	50
40	70	S	40	50	60	70
60	90	Ba	60	70	80	90
70	100	SBa	70	90	100	100

C. Normalization Weight

Untuk menghitung normalisasi bobot diperlukan data dari tabel 4.2 bobot kriteria di mana hasil tersebut akan menghasilkan nilai DeFuzzy dan nilai Normalisasi Bobot :

Perhitungan Nilai DeFuzzy :

$$(7 \oplus 9 \oplus 10 \oplus 10) : 4 = 9$$

$$(5 \oplus 7 \oplus 8 \oplus 10) : 4 = 7.5$$

$$(0 \oplus 2 \oplus 3 \oplus 5) : 4 = 2.5$$

$$(0 \oplus 0 \oplus 1 \oplus 3) : 4 = 1$$

Perhitungan Normalisasi Bobot :

$$9 + 7.5 + 2.5 + 1 = 20$$

$$9 : 20 = 0.45$$

$$7.5 : 20 = 0.375$$

$$2.5 : 20 = 0.125$$

$$1 : 20 = 0.05$$

D. Match Rating

In selecting to determine the best graduates with Fuzzy MADM, a Match Rating is needed to do the calculation so that the best alternative value is obtained.

Table.8 Match Rating

No.	GPA	Length of Study	Final Project	Final Assignment Value
1	SBa	C	S	SBa
2	SBa	SC	C	SBa
3	Bu	C	SL	SBa
4	Ba	S	SL	SBa
5	Bu	SC	C	Ba
...	.....	.....	.....	.....
220	S	SC	C	SBa
221	S	C	SL	Ba
222	S	C	SL	SBa
223	Ba	SC	SC	SBa
224	Ba	S	SL	Ba

E. Fuzzy MADM results

After summing up the Match Rating, Decision Matrix, Normalization Matrix tables, the results of Fuzzy MADM will be obtained and the best graduates are obtained.

Table 9 Results Comparison Fuzzy MADM

Ranking	No	GPA	Length of Study	Final Project	Final Assignment Value	GPA	Length of Study
1	18	1143050	3.64	4	3	80.25	1.0000
2	193	1143098	3.53	4	2	80.25	1.0000
3	128	1143051	3.09	4	2	79.69	0.9475
4	145	1143131	3.1	4	3	79.15	0.9475
5	174	1143142	3.06	4	2	80.25	0.9475
220	70	0843011	2.76	7	49	76.85	0.5496
221	93	0843172	2.73	7	49	77.23	0.5496
222	108	0843154	2.65	7	31	77.2	0.5496
223	112	0843096	2.77	7	31	76	0.5496
224	134	0843180	2.43	7	41	76.69	0.4521

F. Explanation of the Fuzzy MADM Application  
On the Fuzzy linguistic display page the TA value only shows the results of the calculation of one criterion, namely TA value.

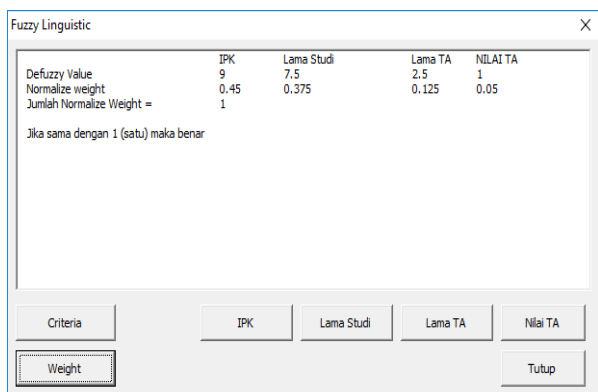


Figure 7 Normalize Weight Fuzzy MADM application

On the Normalization display page the weights of the four GPA criteria, Study Length, TA Length, TA Value, which results in defuzzification values and Normalization Weights.

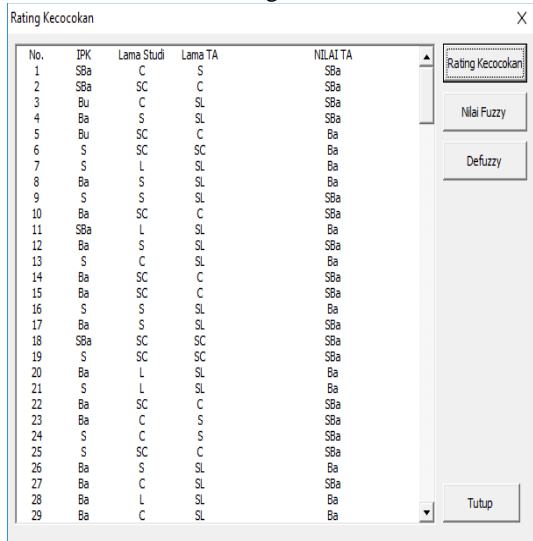


Figure 8 Fuzzy MADM Application Compatibility Rating

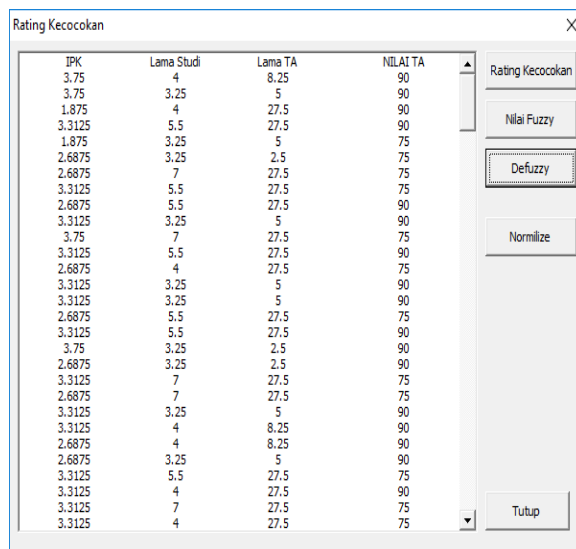


Figure 9 Defuzzification of Fuzzy MADM Applications

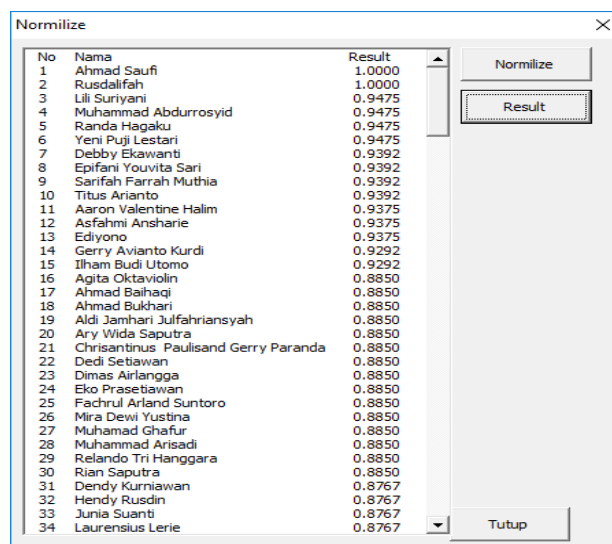


Figure 10 Defuzzification of Fuzzy MADM Applications

G. Comparison of Fuzzy MADM and SAW Results

Comparisons are made using two measurements, namely Fuzzy MADM and SAW on the results of two methods based on the following attributes:

1. GPA
2. Study Length
3. TA length
4. TA value

The results of the interview mention the results of the GPA, Length of Study, Length of TA, TA value as the main priority because to determine the best student is measured from these attributes.

The following is a representation of the results of the Fuzzy MADM and SAW tests in table 4.19, there is a reference data table, where the reference data will be a requirement to be the best graduate.



Table 10 Reference Data

GPA	4
Study Length	4
TA length	1
TA value	100

Table 11 Results from Fuzzy MADM

Fuzzy MADM						
No	Name	GPA	Study Length	TA Length	TA Value	Result
1	Ahmad Saufi	3.64	4	3	80.45	1.000
2	Rusdalifah	3.53	4	2	80.25	1.000
3	Lili Suriyani	3.09	4	2	79.69	0.948
4	Muhammad Abdurrosyid	3.1	4	3	79.15	0.948
5	Randa Hagaku	3.06	4	2	80.25	0.948

Table 12 Error results from Fuzzy MADM

GPA	Study Length	TA Length	TA Value	Error / Difference
0.36	0	2	19.55	2.340
0.47	0	1	19.75	2.303
0.91	0	1	20.31	2.357
0.9	0	2	20.85	2.437
0.94	0	1	19.75	2.329
Rata-rata Error				2.35

Table 13 Results from SAW

SAW						
No	Name	GPA	Study Length	TA Length	TA Value	Result
1	Ilham Budi Utomo	3.76	4	5	78.05	0.937
2	Asfahmi Ansharie	3.72	4	5	79.47	0.935
3	Ediyono	3.68	4	6	80.45	0.931
4	Ahmad Saufi	3.64	4	3	80.45	0.931
5	Gerry Avianto Kurdi	3.66	4	4	78.11	0.926

Table.14 Error results from SAW

GPA	Study Length	TA Length	TA Value	Error / Difference
0.24	0	4	21.95	2.559
0.28	0	4	20.53	2.490
0.32	0	5	19.55	2.493
0.36	0	2	19.55	2.340
0.34	0	3	21.89	2.511
Average Error				2.48

Tables 4.20 to 4.23 above are tables of comparison results with Fuzzy SAW and SAW, according to the average results in Table 4.21, of all students who are said to be accurate for the results of STMIK Wicidacampus ranking is the Fuzzy MADM method. From the results above it can be seen that the Fuzzy MADM value of each of the best graduates selected with the FMADM method is the average error value is smaller than using the SAW method. Thus it can be concluded that the FMADM method is better than the SAW method.

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