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Development of Decision Making Information System for Student Executive Board Election of Faculty of Computer Science, Santo Thomas Catholic University Using Topsis Method

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ABSTRACT

This study aims to solve the problems in the recruitment of prospective BEM members at the Catholic University of Santo Thomas Medan. To select competent and fair members of the Student Executive Board (BEM) of the Catholic University of Santo Thomas Medan, several stages of selection are carried out. However, decision making in recruitment is prone to collusion and nepotism at the student level on campus. To overcome this, a decision support system (DSS) for the recruitment of BEM members was designed using the TOPSIS method. DSS was designed using the following criteria: minimum GPA of 3.00, experienced in student organizations, and to become the Chair of BEM must be a 7th semester student. The result of this study is a decision support system using the TOPSIS method. The result of the TOPSIS method calculation process is in the form of information on the selection of the Student Executive Board (BEM) at the Catholic University of Santo Thomas Medan and getting the results of the selection in the system.

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INTRODUCTION

BEM (Student Executive Board) is a student organization that has an official position in the university environment and its position is higher than other student organizations. Santo Thomas Catholic University has BEM in each faculty that is the driving force of every student activity, likewise the faculty of computer science has a BEM management that is a liaison that channels student aspirations, needs, and activities to the management of Santo Thomas Catholic University from both institutions, faculties, and study programs. The requirements to become a candidate for BEM member of the Faculty of Computer Science are: active students of Santo Thomas Catholic University, have a minimum GPA of 3.00, have experience in student organizations, and to become BEM Chair must be a 7th semester student. The BEM election process in Computer Science is still carried out manually through direct elections, which require students to come to the faculty to vote. However, there are several obstacles in its implementation, such as the large number of students who cannot attend when the election takes place and the BEM election schedule which often clashes with the student's lecture schedule, so that it can interfere with learning activities. This can increase student participation and minimize clashes with lecture schedules, so that the BEM election process can run smoothly without disrupting student academic activities.

To solve the problems described above, this study developed decision-making using the TOPSIS method. The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) is one of the decision-making methods used to select the best alternative from several available options. This method considers the distance between each alternative and the positive ideal solution and the negative ideal solution. The positive ideal solution is the alternative with the highest value for each criterion, while the negative ideal solution is the alternative with the

lowest value for each criterion. By implementing TOPSIS in the development of a decision-making information system, the system can provide recommendations based on predetermined criteria, as well as rank the best alternatives based on the closest distance to the positive ideal solution and the furthest distance to the negative ideal solution.

Based on previous research, it has succeeded in developing decision making for specific purposes. According to Titin Kristiana's research, the TOPSIS method was applied in selecting the best location for a wholesale credit business. This method helps in determining the most appropriate location based on predetermined criteria, the results of the TOPSIS calculation show the most appropriate location for a wholesale credit business. Aziza Najar's research, Volvo Sihombing, Musthafa Haris Munandar applied the SAW and TOPSIS methods in designing a decision support system for recruiting BEM members at Labuhan Batu University. This method helps select competent members and presents candidate rankings using both methods, with limited alternatives identified as A7 and A8. This system aims to simplify the recruitment process by enabling fast and efficient decision making. Fawwaz Ramzy Darmawan's research, Eka Larasati Amalia, Ulla Defana Rosiani applied the TOPSIS method to the Decision Support System for Cities Implementing Large-Scale Social Restrictions Caused by the Corona Outbreak. This method helps the government in making decisions on selecting cities that must implement large-scale social restrictions appropriately and efficiently.

Research by Fitri, Dwi Oktarina Decision Support System for Determining Student Executive Board (BEM) Positions Using Forward Chaining and TOPSIS Methods. This paper discusses the application of TOPSIS and Forward Chaining methods in decision support systems for various purposes such as selecting scholarship recipients, determining organizational management positions, employee recruitment, guidance and counseling consultations, and selecting building materials in a company. Specifically, the development of a decision support system for determining positions in the BEM organization is explored using the TOPSIS and Forward Chaining methods. The aim is to facilitate decision making in selecting positions by finding the highest value using TOPSIS and creating rules based on the desired position using Forward Chaining. The System Development Life Cycle (SDLC) is used as a system development methodology, which consists of stages such as project identification, planning, analysis, design, implementation, and maintenance.

Irvan Muzakkir's research applies the TOPSIS method for a decision support system for determining poor families in Panca Karsa II Village. This study discusses the implementation of the TOPSIS method in a decision support system for determining poor families in Panca Karsa II Village. This answers the challenges in poverty alleviation and the importance of accurately identifying poor families to obtain targeted assistance. The TOPSIS method is used to evaluate the best alternatives based on predetermined criteria, with the steps for running the system described in the article.

Based on the introduction above, the author conducted a study entitled "Development of a Decision-Making Information System in the Election of the Student Executive Board of the Faculty of Computer Science, Santo Thomas Catholic University, Medan Using the TOPSIS Method" with the aim of supporting the decision-making process in order to produce optimal decisions.

Theoretical basis

Decision support system

A Decision Support System (DSS) is an information system that supports the decision-making process by providing data, models, and analytical tools that aid in complex decision-making. The theoretical underpinnings for DSS span a variety of disciplines, including computer science, management, economics, and operations research. Here are some of the major theoretical underpinnings for DSS:

1. System Theory
   DSS is based on the concept of systems theory that views organizations as a collection of interacting subsystems. DSS functions as a subsystem that provides information and analysis to support the management subsystem in decision making.

2. Decision Making Theory
   This theory involves processes, methods, and models for making rational and optimal decisions. DSS uses various decision-making models, such as deterministic, probabilistic, and fuzzy models, to help decision makers generate alternatives and choose the best solution.

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)

The TOPSI (Technique for Order Preference by Similarity to Ideal Solution) method is one of the decision-making methods used to select the best alternative from several available options. This method considers the distance between each alternative and the positive ideal solution and the negative ideal solution. The positive ideal solution is the alternative with the highest value for each criterion, while the negative ideal solution is the alternative with the lowest value for each criterion. By implementing TOPSIS in the development of a decision-making information system, the system can provide recommendations based on predetermined criteria, as well as rank the best alternatives based on the closest distance to the positive ideal solution and the furthest distance to the negative ideal solution.

METHODOLOGY

In this context, the stages that must be carried out to develop a research methodology that can provide direction and facilitate analysis of existing problems will be explained. The stages of the study research on the development of a decision-making information system for the election of the Student Executive Board (BEM) of the Faculty of Computer Science, Santo Thomas Catholic University, Medan using the TOPSIS method can be briefly explained as follows:

1. Problem Identification: Identifying problems in BEM elections, such as obstacles in the election process, low student participation, or conflicts with lecture schedules.
2. Determining Research Objectives: Establishing specific and measurable research objectives, such as developing an efficient decision-making information system, increasing student participation, and reducing disruption to academic activities.
3. Literature Review: Conducting a literature study on information system development, TOPSIS method, and BEM selection to understand the theoretical basis and approaches that have been taken previously.
4. Data Collection: Collecting relevant data, such as BEM selection criteria, student participation data, and lecture schedule data.
5. Information System Design: Designing a BEM decision-making information system using the TOPSIS method, including system structure, user interface, TOPSIS calculation algorithm, and integration with the data obtained.
6. System Implementation: Implementing the designed information system, including software development, testing, and integration with the existing environment.
7. Evaluation and Analysis: Evaluate the performance of the implemented information system, such as system efficiency, student participation, and impact on academic activities. The evaluation results are used to analyze the effectiveness of the system and evaluate the achievement of research objectives.
8. Conclusions and Recommendations: Drawing conclusions from the research and providing recommendations for improvement or further development of the BEM election decision-making information system.

By following these stages, it is hoped that research can be carried out in a focused manner, facilitating problem analysis, and producing an effective information system in decision-making for selecting the BEM of the Faculty of Computer Science, Santo Thomas Catholic University, Medan.

Method analysis

The stages carried out in designing a decision support system for recruiting BEM members at the Catholic University of Santo Thomas Medan, Faculty of Computer Science using the TOPSIS

method were carried out with the stages used and the weight of each criterion in recruiting members.

Table 1. Criteria and weights

CODE	CRITERIA	WEIGHT
K1	GPA	4
K2	Certificate	3
K3	Organizational experience	2
K4	Interview scores	5
K5	Commitment	3

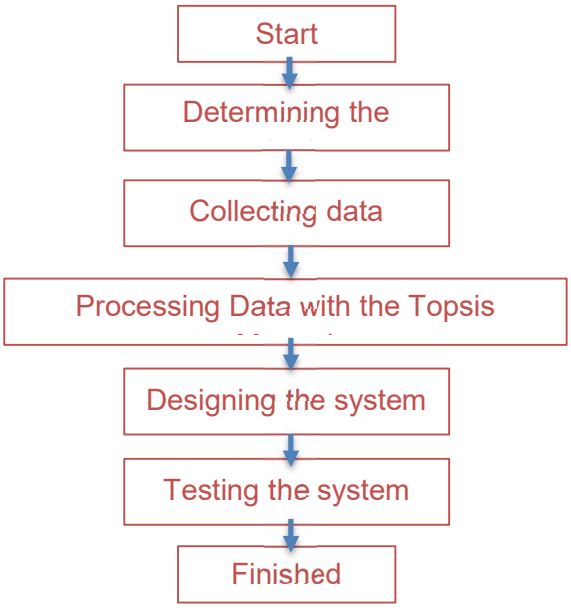


Figure 1. Research framework

In Figure 1, the stages of designing the BEM recruitment SPK can be seen starting from determining the criteria and weight of each criterion. Then continued by designing a Decision Support System that is able to process the data that has been collected using the Topsis method. And the alternatives that will be selected as BEM candidates are as follows:

a. Alternative 1 = A1 = Candidate 1
b. Alternative 2 = A2 = Candidate 2
c. Alternative 3 = A3 = Candidate 3

After determining the assessment criteria, then determine the preference weight value of each criterion based on the level of importance between one criterion and another. The comparative value of the level of importance between one criterion and another can be expressed with the following statement:

a. Very unimportant = 1
b. Not important = 2
c. Quite important = 3
d. Important = 4
e. Very important = 5

Form a decision matrix based on the preference values of each criterion for all alternatives:

	K1	K2	K3	K4	K5
Candidate 1	4	2	1	2	2
Candidate 2	2	3	1	1	3
Candidate 3	3	1	2	4	1

After forming the decision matrix, the next step is to normalize the decision matrix values as follows:

$$Rij = \frac{X_{IJ}}{\sqrt{\sum_{i=1}^{m} X_{ij}^2}}$$

Where :

rij = Performance ranking of alternative i on criterion j

xij = i-th alternative on j-th criteria

$\sqrt{\sum_{i=1}^{m} x_{ij}^2}$ = The root of the sum of the powers of each number

Alternatives to one criterion from the formula above, then the value of each alternative for each criterion can be calculated as follows:

X1 = 42+ 22+ 32 = 5.385
R11 = 45385 = 0.685
R21 = 25385 = 0.371
R31 = 35385 = 0.742

X2 = 22+ 32 + 12 = 3,741
R12 = 23.741 = 0.534
R22 = 33.741 = 0.801
R32 = 13.741 = 0.267

X3 = 12+12+ 22 = 2
R13 = 12 = 1
R23 = 12 = 0.5
R33 = 22 = 1

X4 = 22+ 12 + 42 = 4.472
R14 = 24.472 = 0.447
R24 = 14.472 = 0.223
R34 = 44.472 = 0.894

X5 = 22 + 32 + 12 = 3,741
R15 = 23.741 = 0.534
R25 = 33.741 = 0.801
R35 = 13.741 = 0.801

So the value (R) is obtained as follows:

$$R = \begin{pmatrix} 0{,}685 & 0{,}534 & 1 & 0{,}447 & 0{,}534 \\ 0{,}371 & 0{,}801 & 0{,}5 & 0{,}223 & 0{,}801 \\ 0{,}742 & 0{,}267 & 1 & 0{,}894 & 0{,}801 \end{pmatrix}$$

After obtaining the normalized matrix, the next step is to find the values in the normalized matrix.

$y11 = w1 \times r11 = 4 \times 0.685 = 2.74$
$y21 = w1 \times r21 = 4 \times 0.371 = 1.484$
$y31 = w1 \times r31 = 4 \times 0.742 = 2.968$

$y12 = w2 \times r12 = 3 \times 0.534 = 1.602$
$y22 = w2 \times r22 = 3 \times 0.801 = 2.403$
$y32 = w2 \times r32 = 3 \times 0.267 = 0.801$

$y13 = w3 \times r13 = 2 \times 1 = 2$

$y23 = w3 \times r23 = 2 \times 0.5 = 1$
$y33 = w3 \times r33 = 2 \times 1 = 2$

$y14 = w4 \times r14 = 5 \times 0.447 = 2.235$
$y24 = w4 \times r24 = 5 \times 0.223 = 1.115$
$y34 = w4 \times r34 = 5 \times 0.894 = 4.47$

$y15 = w5 \times r15 = 3 \times 0.534 = 1.602$
$y25 = w5 \times r25 = 3 \times 0.801 = 2.403$
$y35 = w5 \times r35 = 3 \times 0.267 = 0.801$
So we get the matrix Y:

$$Y = \begin{matrix} 2{,}74 & 1{,}602 & 2 & 2{,}235 & 1{,}602 \\ 1{,}484 & 2{,}403 & 1 & 1{,}115 & 2{,}403 \\ 2{,}968 & 0{,}801 & 2 & 4{,}47 & 0{,}801 \end{matrix}$$

Determining positive ideal matrices$A+$ and negative ideal matrices$A-$

1. Determining positive ideal matrices$A+$
   $Y1+ = \max \{ 2.74 ; 1{,}484 ; 2.968 \} = 2.968$
   $Y2+ = \max \{ 1{,}602 ; 2{,}403; 0.801 \} = 2.403$
   $Y3+ = \max \{ 2 ; 1 ; 2 \} = 2$
   $Y4+ = \max \{ 2{,}235 ; 1{,}115 ; 4.47 \} = 4.47$
   $Y5+ = \max \{ 1{,}602 ; 2{,}403; 0.801 \} = 2.403$
2. Determining negative ideal matrices$A-$
   $Y1- = \min \{ 2.74 ; 1{,}484 ; 2.968 \} = 1.484$
   $Y2- = \min \{ 1.602 ; 2{,}403; 0.801 \} = 0.801$
   $Y3- = \min \{ 2 ; 1 ; 2 \} = 1$
   $Y4- = \min \{ 2{,}235 ; 1{,}115 ; 4.47 \} = 1.115$
   $Y5- = \min \{ 1.602 ; 2{,}403; 0.801 \} = 0.801$

Determine the distance between the weighted value of each alternative to the positive ideal solution:

$D1+ = \sqrt{(2{,}74 - 2{,}968)2 + (1{,}602 - 2{,}403)2 + (2 - 2)2 + (2{,}235 - 4{,}47)2 + (1{,}602 - 2{,}403)2} = 3{,}662$

$D2+ = \sqrt{(1{,}484 - 2{,}968)2 + (2{,}403 - 2{,}403)2 + (1 - 2)2 + (1{,}115 - 4{,}47)2 + (2{,}403 - 2{,}403)2} = -5{,}307$

$D3+ = \sqrt{(2{,}968 - 2{,}968)2 + (0{,}801 - 2{,}403)2 + (2 - 2)2 + (4{,}47 - 4{,}47)2 + (0{,}801 - 2{,}403)2} = 5{,}132$

Determine the distance between the weighted value of each alternative to the negative ideal solution:

$D1- = \sqrt{(2{,}74 - 1{,}484)2 + (1{,}602 - 0{,}801)2 + (2 - 1)2 + (2{,}235 - 1{,}115)2 + (1{,}602 - 0{,}801)2} = 6{,}901$

$D2- = \sqrt{(1{,}484 - 1{,}484)2 + (2{,}403 - 0{,}801)2 + (1 - 1)2 + (1{,}115 - 1{,}115)2 + (2{,}403 - 0{,}801)2} = 6{,}584$

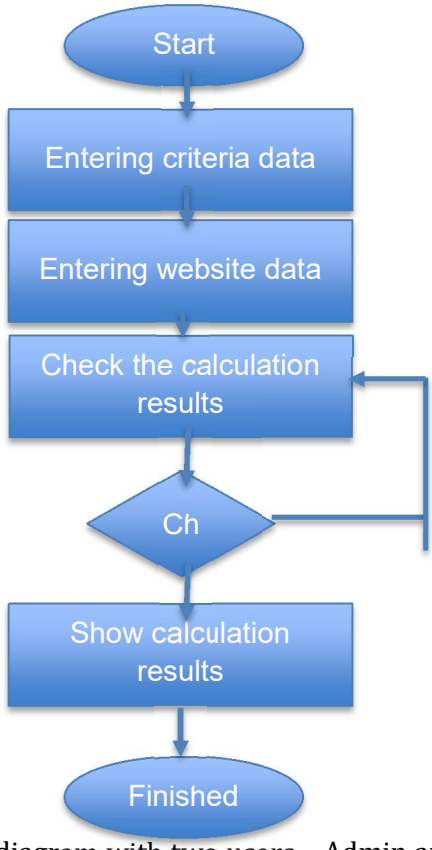
$D3- = \sqrt{(2{,}968 - 1{,}484)2 + (0{,}801 - 0{,}801)2 + (2 - 1)2 + (4{,}47 - 1{,}115)2 + (0{,}801 - 0{,}801)2} = 6{,}557$

Determine the preference value for each alternative:
V1= 6.9013 /.662 + 6.901 = 0.653
V2= 6.584 /-5.307 + 6.584 = 5.155

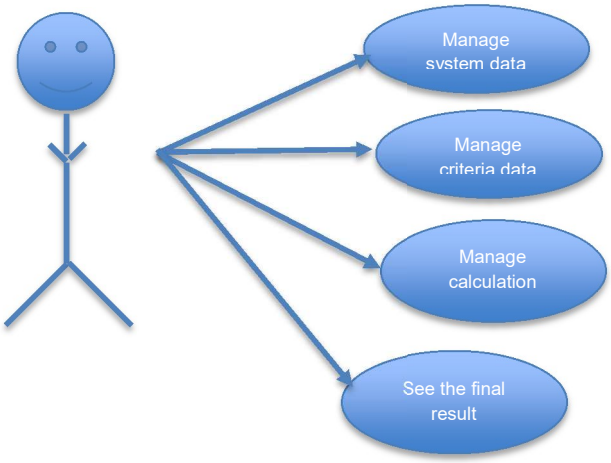
V3= 6.557 /5.132 + 6.557 = 0.560

From the results of the manual calculation above, the alternative with code A2, namely Candidate 2, has the highest preference value with a preference value of 5.155, higher than alternative A1 with a value of 0.653 and alternative A3 with a value of 0.560. So the most suitable candidate is Candidate 2 with the criteria of GPA, Certificates, organizational experience, interview scores, and commitment.

System Design



Below is a use case design diagram with two users—Admin and User. To manage website data, criteria data, sub-criteria data, calculation data, and display the final results, a login process is required by the Administrator and User.



Implementation

Determination of criteria and weights for each criterion and input of alternative data processed in the design of a decision support system for recruiting BEM members using the saw and topsis methods.

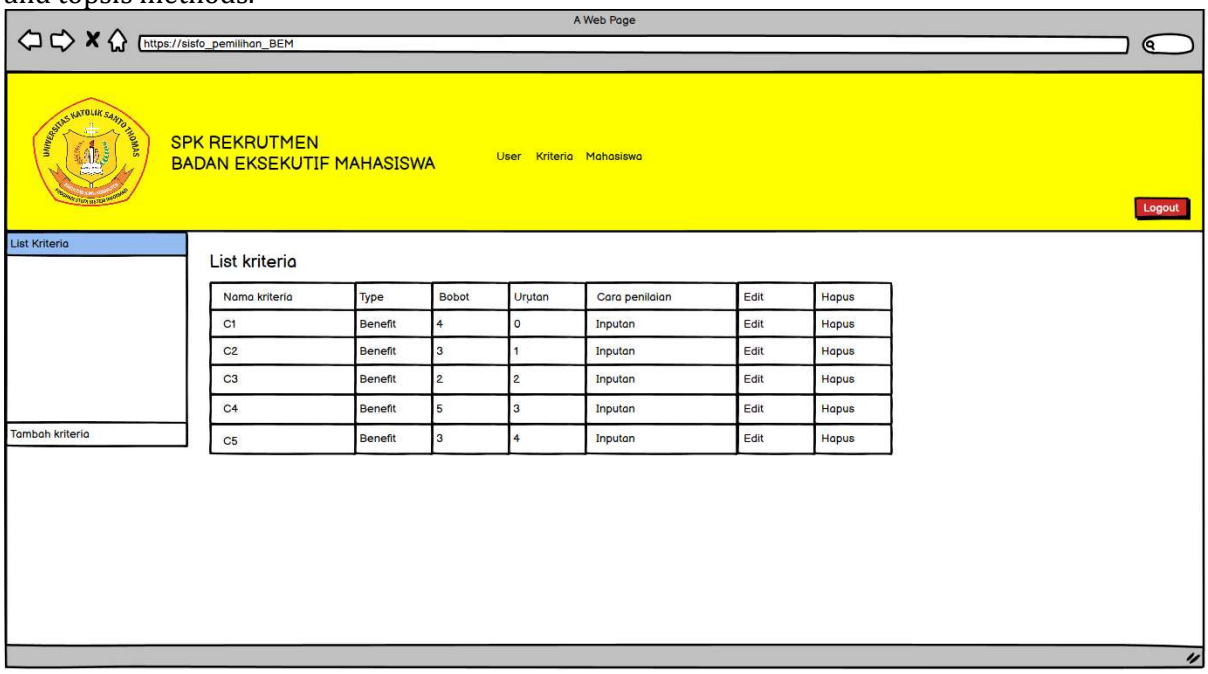


Figure 2. Criteria data

To add criteria, you can do this by clicking the Add Criteria menu on the Criteria menu as in Figure 3.

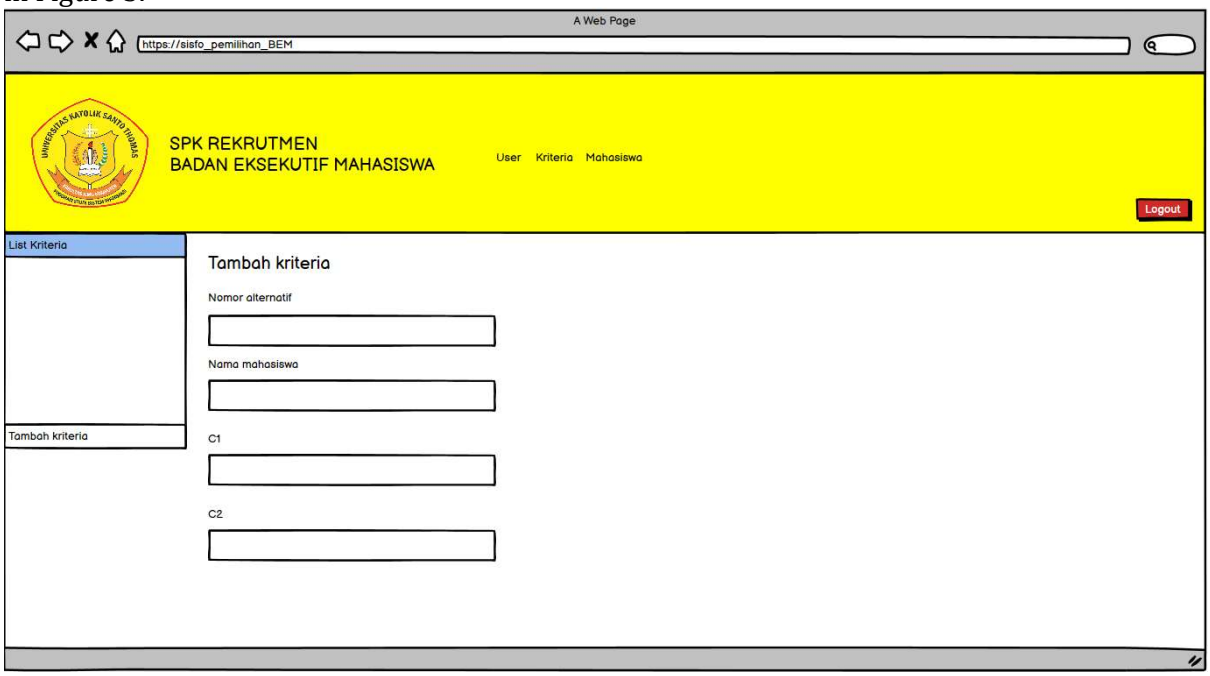


Figure 3. Add criteria

To add alternative data for students to be recruited, you can use the Student Menu. The Student List display can be seen in Figure 4.

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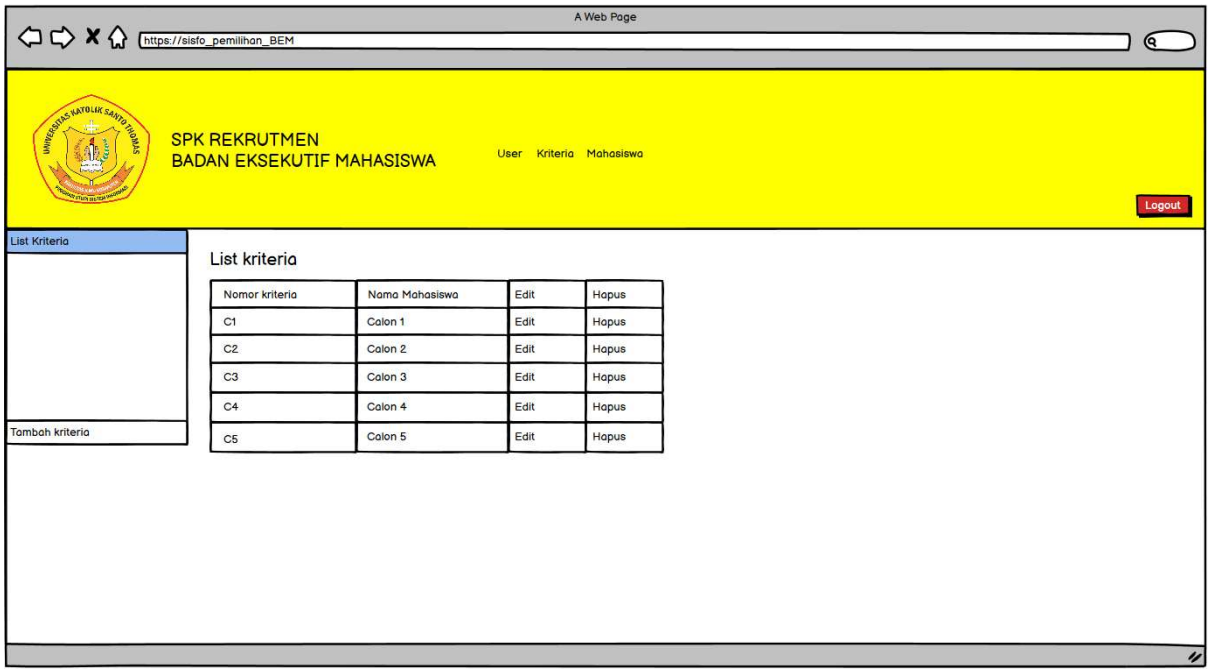

Figure 4. Alternative Data

To add data on students to be recruited, you can do this by selecting the Add Student menu in the Student menu as shown in Figure 5.

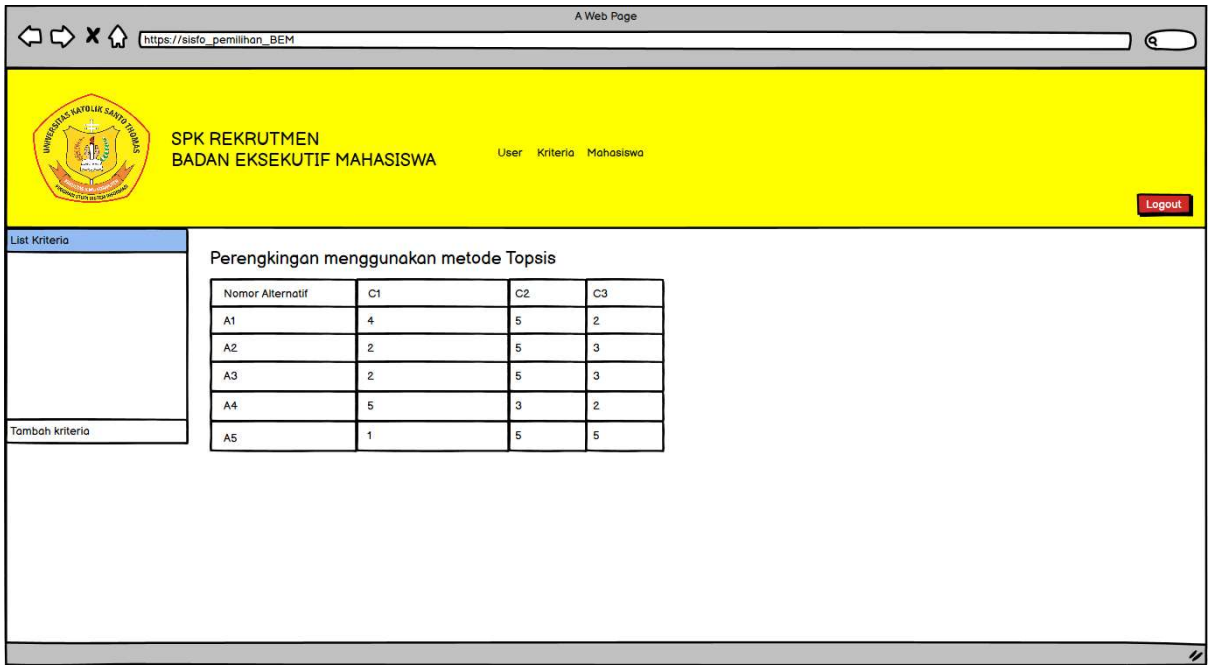

Figure 5. Alternative Data

Next, the preference weight of each criterion will be displayed.

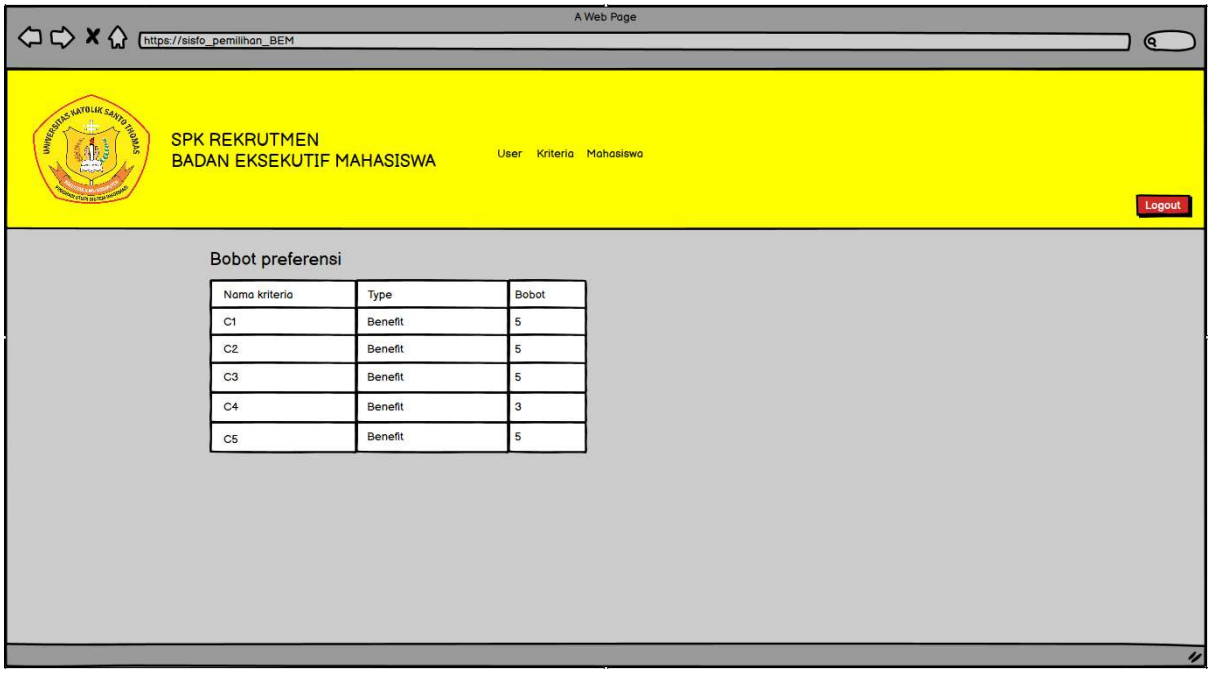

Figure 6. Preference Weight

The next step, the system will display the Normalized Matrix (R) as shown in Figure 7.

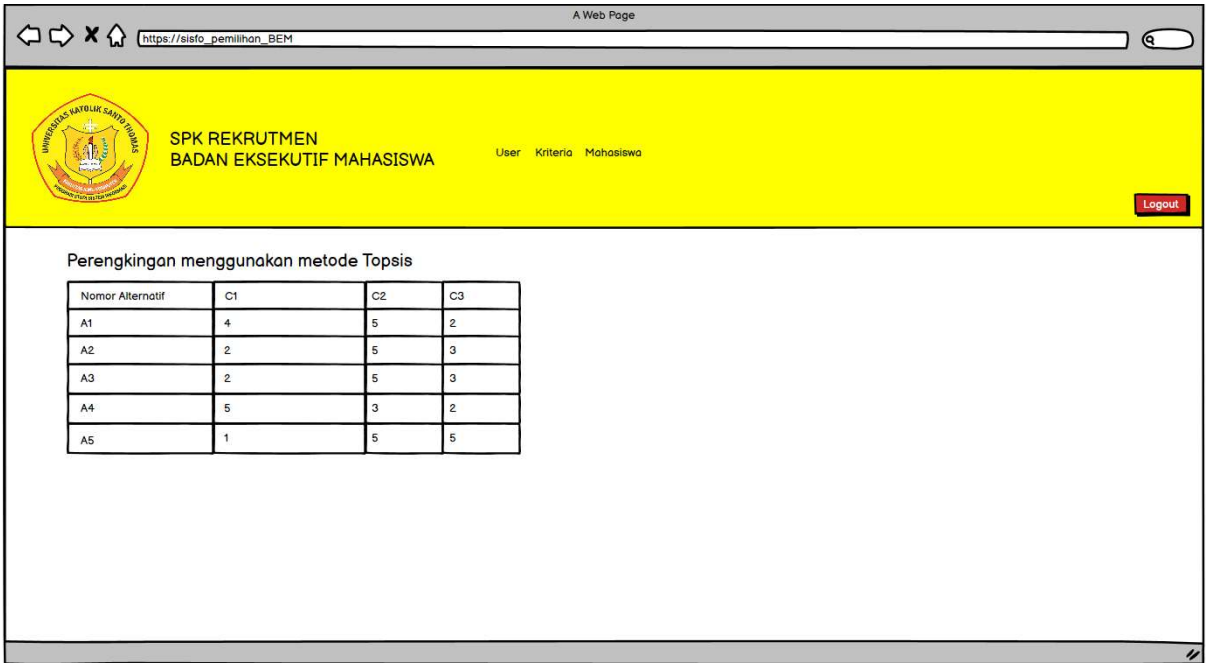

Figure 7. Normalized Matrix (R)

Each data contained in the matrix above is multiplied based on the weight of each criterion, with the result being the Y Matrix as in Figure 8.

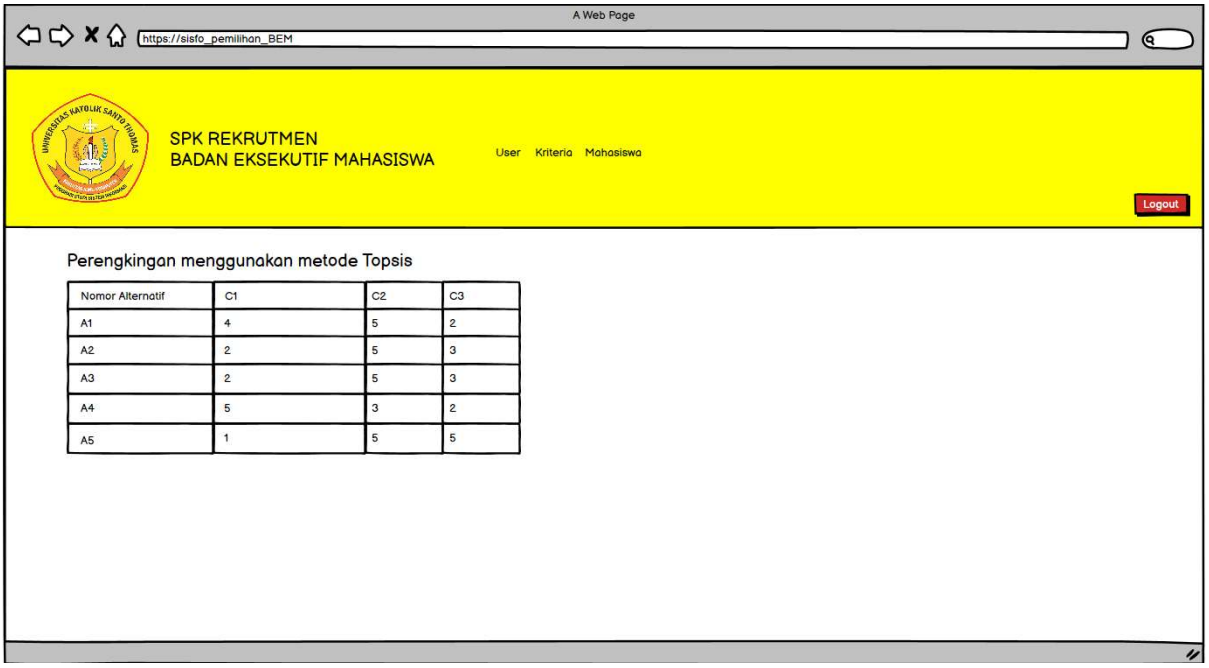

Figure 8. Matrix Y

Then, the system will display the Positive Ideal Solution (A+) and Negative Ideal Solution (A-) values as shown in Figure 9.

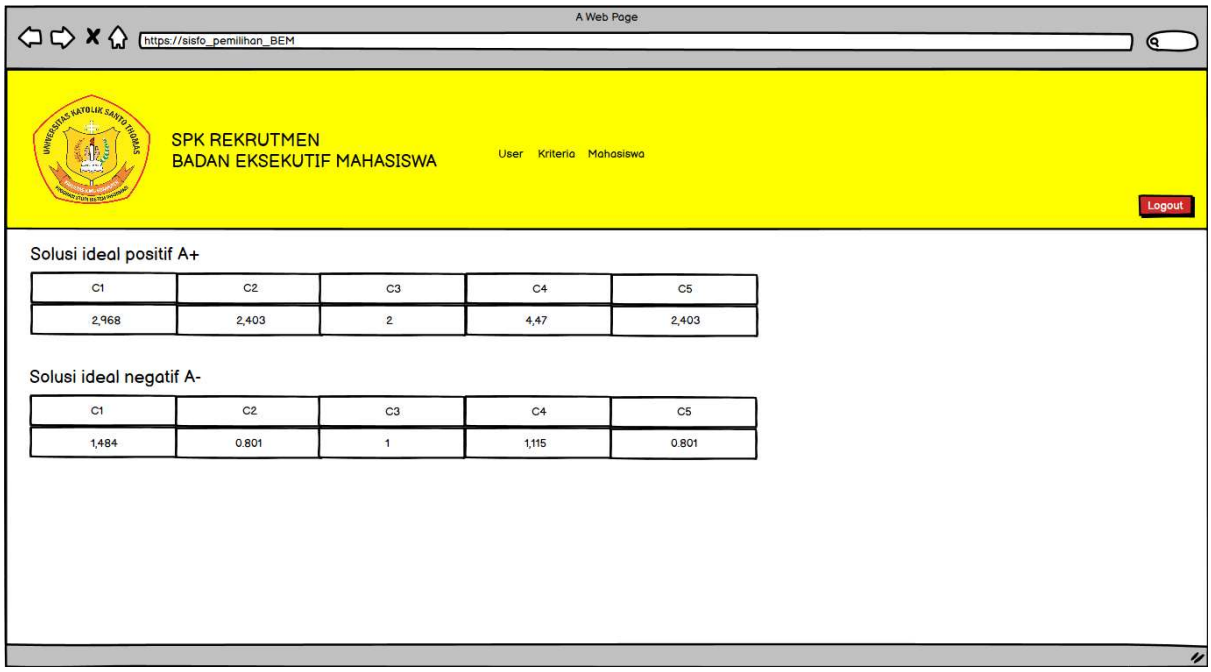

Figure 9. Positive Ideal Solution (A+)

The next stage the system will display the Positive Ideal Distance (Si+) and Negative Ideal Distance (Si-) as shown in figure 10 and figure 11.

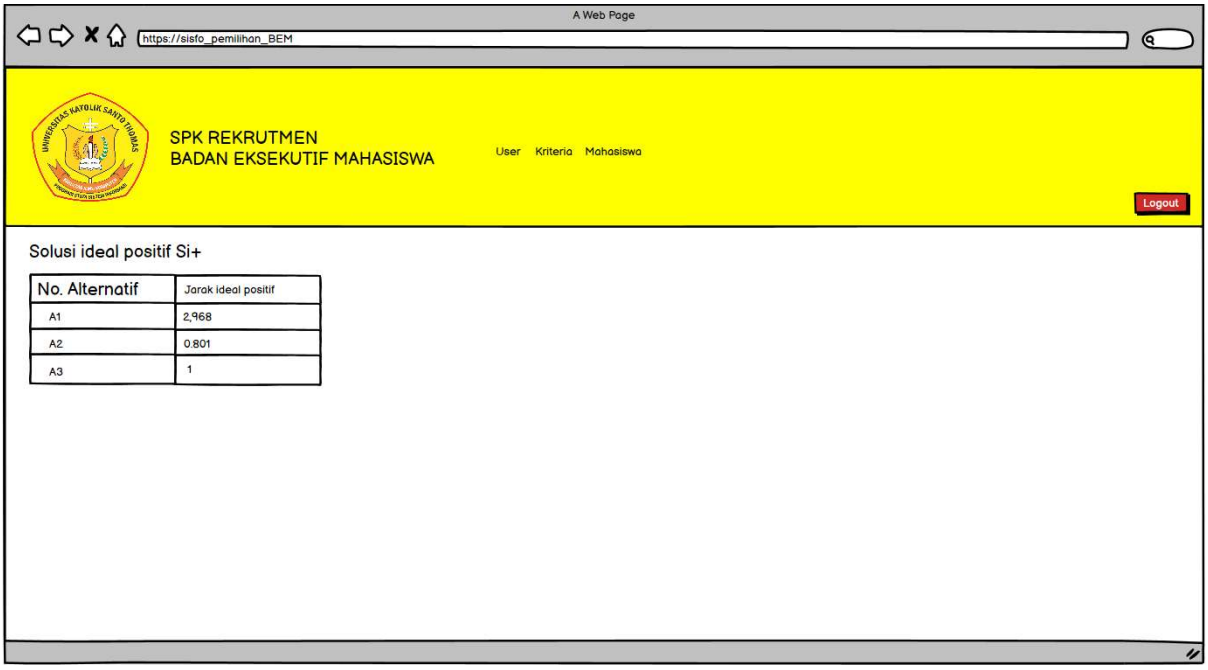

Figure 10. Ideal Positive Distance (Si+)

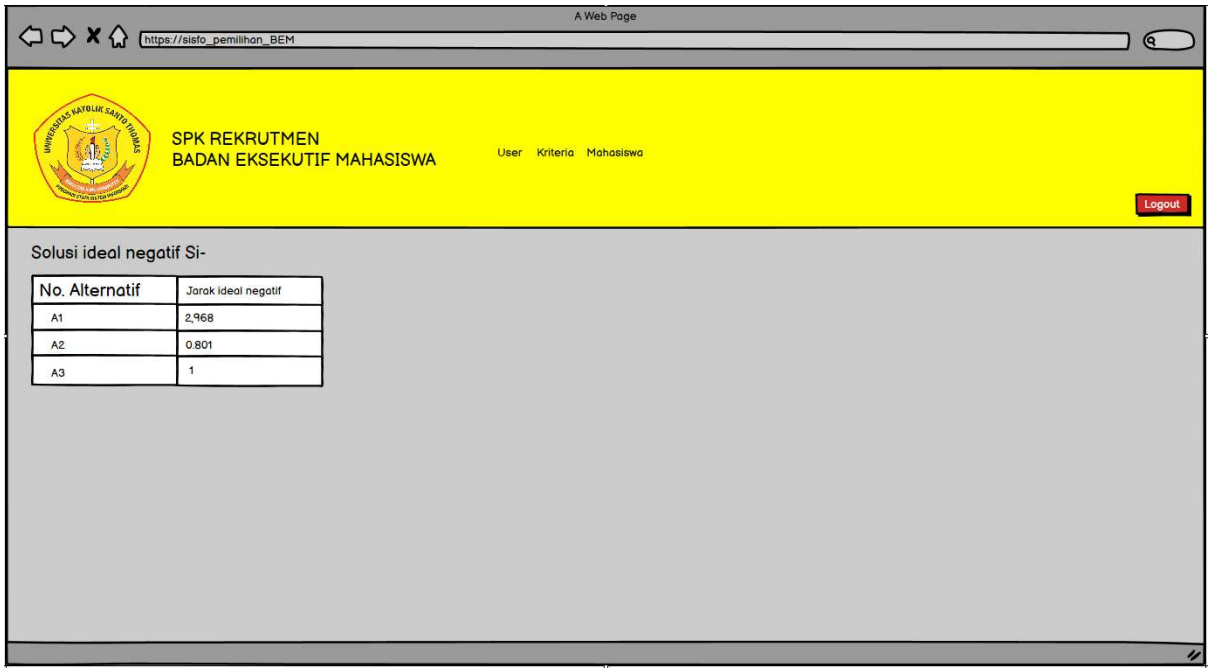

Figure 11. Negative Ideal Distance (Si-)

After all these stages have been passed, the final result of the SPK processing using the Topsis method is produced in the form of a Ranking result (V) as shown in Figure 12.

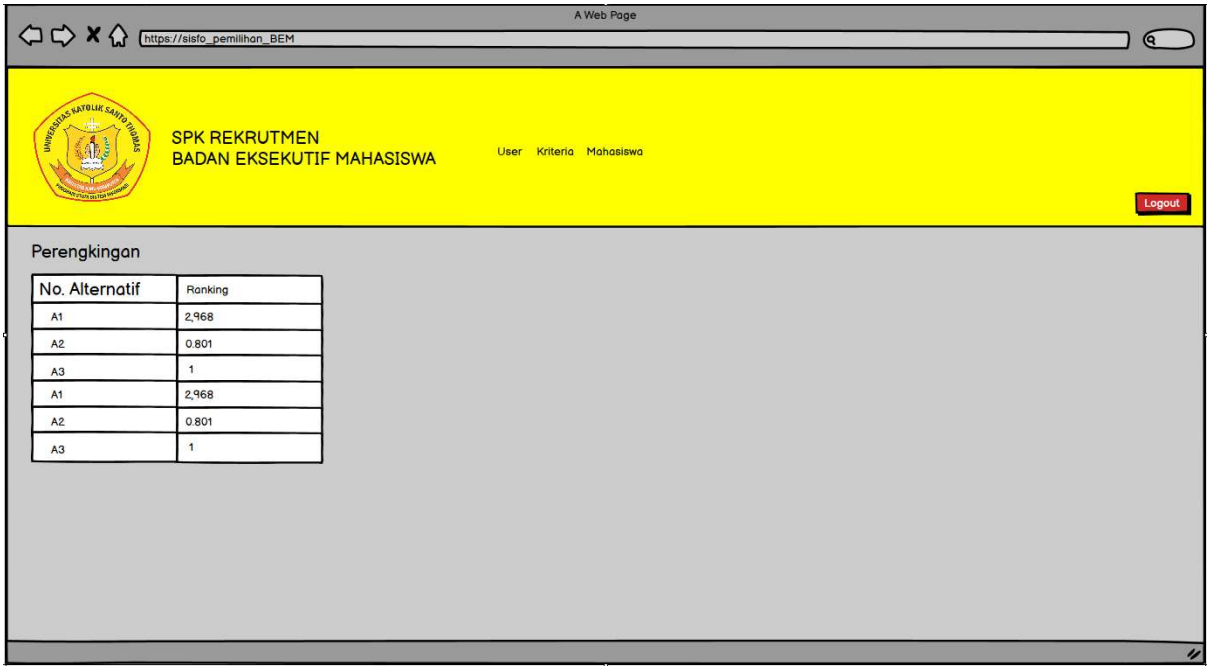

Figure 12. Ranking Results (V) with using the Topsis Method

CONCLUSION

Based on the results of the design of the decision support system for BEM member recruitment using the TOPSIS method, it can be concluded that the use of this system can facilitate BEM in ranking BEM member recruitment quickly and efficiently. This DSS uses the TOPSIS method with criteria consisting of GPA, Interview Score, Supporting Certificates, Organizational Experience, Commitment.

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