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DECISION SUPPORT FOR PRIORITIZING PROMOTIONAL MEDIA USING THE PROMETHEE METHOD

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ABSTRACT

STMIK Bina Sarana Global is a private university which always competes with other private universities) and even with state universities in gaining the number of enrolled students. So far, STMIK Bina Sarana Global in determining the priority of promotional media is still done manually without any system, namely by counting the number of the students entering because one of the promotional media promoted by STMIK Bina Sarana Global is obtained from the new student application form. This has shortcomings in terms of effectiveness and efficiency of time and funds provided by the agency for promotional activities. In solving these problems, the authors designed a Decision Support System with the aim of being a tool for the relevant agencies, to determine the priority of the right promotional media to market products and must be supported by one of the methods from the DSS, namely the Promethee method to evaluate what alternative promotional media are suitable based on the decision-making parameters. In this design the author uses object-oriented programming techniques, namely Unified Modeling Language (UML) and the Java programming language with database storage using PostgreSQL. Utilization of a decision support system with the Promethee method can provide the best alternative for agencies in choosing the promotional media used based on the ranking order (priority).

Keywords: Promotional Media, Decision Support System, Promethee, Ranking.

1. INTRODUCTION

Promotion is a way to introduce and market a product that is aimed to increase sales. With the rapid development in this era of globalization, educational institutions are required to be able to develop their promotions while reducing problems that arise due to the lack of utilization of information technology (Doncho Petkov, et.all. 2008). Good promotional activities also require appropriate promotional media (Marissa Grace Haque. 2020), so that they can be right on target. Accuracy in the selection of promotional media will greatly affect the success of the promotional activities carried out.

So far, most educational institutions (Panji Priyanto, 2020), in determining the priority of promotional media are carried out by management manually using the predetermined standardization. This has many shortcomings, among others, in terms of effectiveness and efficiency of time and funds provided by the agency for promotional activities. If an error occurs in the selection of promotional media, it will be detrimental to the agency itself. Like other agencies, in promoting their products, they use many media so that these products can be widely known by the public. In fact, some forms of promotional media might not effective to attract many targets.

In determining the promotional media, STMIK Bina Sarana Global calculates how many students enter because one of the promotional media that is marketed is from the data of new students (Bambang Afriadi. 2020) who fill out the application form. Given these conditions, the managers of STMIK Bina Sarana Global need a system to determine the type of promotional media that is appropriate and feasible to use. In the problems discussed above, the author wants to build an application for a Decision Support System for Prioritizing Promotional Media Using the Promethee Method with Promethee calculations (Fatkhurrochman, 2022). The Promethee method is used for determining the order (priority) in multi-criteria analysis (Rachman Jaya. 2020).

2. RESEARCH METODOLOGY

A. Data Preference

Table 1. Basic Data for Promethee Analysis

Kriteria	Min Max	Alternatif					LF	EF	NF
		A1	A2	A3	A4	A5			
K1	Min	K1(A1)	K1(A2)	K1(A3)	K1(A4)	K1(A5)			
K2	Max	K2(A1)	K2(A2)	K2(A3)	K2(A4)	K2(A5)			
K2	Max	K3(A1)	K3(A2)	K3(A3)	K3(A4)	K3(A5)			
K4	Max	K4(A1)	K4(A2)	K4(A3)	K4(A4)	K4(A5)			
K5	Max	K5(A1)	K5(A2)	K5(A3)	K5(A4)	K5(A5)			

Source: Nofriansyah dan Defit (2017:107)

In the promethee, six forms of the criterion preference function are presented, including the following:

1. Preference I: Ordinary Criteria

In this preference, there is no difference between a and b if and only if f (a) = f (b), if the criterion value for each alternative has a different value, the decision maker makes an absolute preference for the alternative that has a better value.

$$P(d) = \begin{cases} 0 \text{ jika } d \leq 0 \\ 1 \text{ jika } d > 0 \end{cases}$$

2. Preference II: Quasi Criteria

Two alternatives have an equally important preference as long as the difference or P (d) value of each alternative for certain criteria does not exceed the value of q, and if the difference in the evaluation results for each alternative exceeds the value of q, an absolute preference is formed.

$$P(d) = \begin{cases} 0 \text{ jika } d \leq q \\ 1 \text{ jika } d > q \end{cases}$$

3. Preference III: Criteria with Linear Preference

The linear preference criteria can explain that so far the difference value has a lower value than p, the preference of the decision maker increases linearly with the value of d. If the value of d is greater than the value of p, then there is an absolute preference.

$$P(d) = \begin{cases} \frac{d}{p} \text{ jika } 0 \leq d \leq p \end{cases}$$

4. Preference IV: Level Criteria

In this case, the trend is not different from q and the preference trend is determined simultaneously. If it is between the values of p and q, this means a weak preference situation.

$$P(d) = \begin{cases} 0,5 \text{ jika } q < d \leq p \end{cases}$$

5. Preference V: Criteria with Undifferentiated Linear and Area Preference

In this case, the decision maker considers the preference increase linearly from no different to absolute preference in the two trend areas q and p. The two parameters p and q have been assigned values.

$$P(d) = \begin{cases} 0 \text{ jika } d \leq 0 \\ \frac{d-q}{p-q} \text{ jika } 0 \leq d \leq p \\ 1 \text{ jika } d > q \end{cases}$$

6. Preference VI: Gaussian Criteria

This function is conditional if the value of has been determined, which can be made based on the normal distribution in static.

$$P(d) = \begin{cases} 1 & d^2 \end{cases}$$

Where:

P(d) = the function of the difference between the criteria betweenalternatives
d = difference in criteria value {d = f(a) – f(b)}
q = must be a fixed value
p = value of upward trend

Table 2. Preference Table

Generalised criterion	Definition	Parameters to fix
Type 1: Usual Criterion	$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 & d > 0 \end{cases}$	–
Type 2: U-shape Criterion	$P(d) = \begin{cases} 0 & d \leq q \\ 1 & d > q \end{cases}$	q
Type 3: V-shape Criterion	$P(d) = \begin{cases} 0 & d \leq 0 \\ \frac{d}{p} & 0 \leq d \leq p \\ 1 & d > p \end{cases}$	p
Type 4: Level Criterion	$P(d) = \begin{cases} 0 & d \leq q \\ \frac{1}{2} & q < d \leq p \\ 1 & d > p \end{cases}$	p, q
Type 5: V-shape with indif-ference Criterion	$P(d) = \begin{cases} 0 & d \leq q \\ \frac{d-q}{p-q} & q < d \leq p \\ 1 & d > p \end{cases}$	p, q
Type 6: Gaussian Criterion	$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 - e^{-\frac{d^2}{2s^2}} & d > 0 \end{cases}$	s

Promethee Ranking, the calculation of the direction of preference is considered based on the index value:

a. *Leaving Flow*, is used to determine the order of priority in the promethee process that uses partial order..

$$\varphi + (a) = \frac{1}{n-1} \sum x \in A \; \varphi (a, x)$$

b. *Entering Flow*, is used to determine the order of priority in the promethee process.

$$\varphi - (a) = \frac{1}{n-1} \sum x \in A \; \varphi (a, x)$$

c. *Net Flow,* is used to produce the final decision in determining the sequence in solving the problem so as to produce a complete sequence.

$$\varphi (a) = \varphi + (a) - \varphi - (a)$$

..

3. RESULTS AND DISCUSSION

A. Calculation Stages of AHP Method

In designing a system based on the AHP method for decision making, the first step is to define the problem and determine goals by arranging them into a hierarchy, then determine the criteria that will be given weight. Then after the parameters are obtained, the next step is the ranking process by determining the alternative to be used.

There are several alternative media used in determining what is the best media to use for promotion of STMIK Bina Sarana Global, namely:

1. Banner
2. Brochure
3. Member Get Member (MGM)
4. Presentation
5. Social Media

In choosing the right promotional media for STMIK Global based on several available alternatives, five parameters are determined, namely:

1. Manufacturing Cost
2. Ad Scale (Distance)
3. Weight Duration (Time)
4. Operational Cost
5. Target Achievement

From the process of determining the value of the weight of the criteria above, the next process is to calculate the pairwise comparison matrix, which is described in table 5 below.

Table 5. Pairwise Comparison Matrix

Parameter	F1	F2	F3	F4	F5	Eigen Vektor
F1	1	5	4	3	0.6	0.3170
F2	0.2	1	0.5	0.333333	0.2	0.0581
F3	0.25	2	1	0.5	0.25	0.0906
F4	0.333333	3	2	1	0.333333	0.1451
F5	1.666667	5	4	3	1	0.3892
Counts	3.450	16	11.5	7.833	2.383	1.0000
					λ maksimum	5.129
					Consistency Index (CI)	0.0324
					Consistency Ratio (CR) %	0.0289

The calculation results from table 5 above can be explained as follows:

1. The comparison between each parameter comes from the weight given by the stakeholders, where the number of paired data will be inversely related.
2. Then add up each parameter is done by adding up each column vertically. From the results of the calculation of the number of F1: (1+0.2+0.25+0.33+1.667), the total is 3.450, then add up F2, F3, F4, F5 in the same way. So that the values obtained are: 16, 11.5, 7,833, 2,383.
3. Then determine the eigenvector, the result of the data for each cell is divided by the number that has been calculated in point 2 and divided by the number of parameters used.
   From the calculation of the eigenvector (first row): ((1/3.450) + (5/16) + (4/11.5) + (3/7.833) + (0.6/2.383))/5, the result is 0.3170, then determine for the row second to last. So that the eigenvectors obtained are 0.0581, 0.0906, 0.1451, 0.3892.
4. Determine the λ maximum by adding up the product of each cell in the number of rows with each cell of the eigenvector column. From the calculation results: (0.3170 x 3.450) + (0.0581 x 16) + (0.0906 x 11.5) + (0.1451 x 7.833) + (0.3892 x 2.383), the λ maximum is 5.129.
5. The process of calculating the Consistency Index with the formula:
   CI = (λ max – n) / (n-1)
   Where:
   CI = Consistency Index
   λ max = eigenvector value
   n = Number of parameters used
   From the calculation results: (5,129-5) / (5-1), the Consistency Index is 0.0324.
6. The process of calculating the Consistency Ratio with the formula:
   CR = CI/RI
   From the calculation results: (0.0324/1.12), the Consistency Ratio obtained is 0.0289.
   Because the CR value is 0.0289 or 0.1, the data obtained is fairly consistent.

B. Stages of Calculation of the Promethee Method

Based on field observations, data were obtained for each alternative with predetermined criteria as shown in table 4.2.

Table 6. Criteria Value for Each Alternative

Parameter	Kriteria	Media Promosi					Tipe Preferensi	Ket
		A1	A2	A3	A4	A5		
F1	Min	60000	2000	35000000	0	500000	II	Q =
F2	Max	1	1	4	1	1	I	-
F3	Max	4	4	4	2	4	I	-
F4	Min	100000	100000	350000	100000	100000	II	Q =
F5	Max	2	1	193	11	34	IV	Q = ; P =

After obtaining the criteria value of each alternative then look for the value of leaving flow, entering flow and net flow

Table 7. *Promethee Score*

	Leaving Flow	Entering Flow	Net Flow	Urutan
Spanduk	0.34694263	0.36849642	-0.02155	4
Brosur	0.34694263	0.36849642	-0.02155	5
MGM	0.372827636	0.342471674	0.030356	1
Presentasi	0.362025168	0.376603496	-0.01458	3
Medsos	0.376272872	0.348942925	0.02733	2

A. Diagram of System Design

The design of this system is the stage of system design that will be formed which can be in the form of describing the processes of an element of a component. This design process is an early stage of designing the application of a decision support system for determining the priority of promotional media.

To describe the interaction of actors that will be made in the decision support system in determining the priority of promotional media, a Use Case Diagram is made.

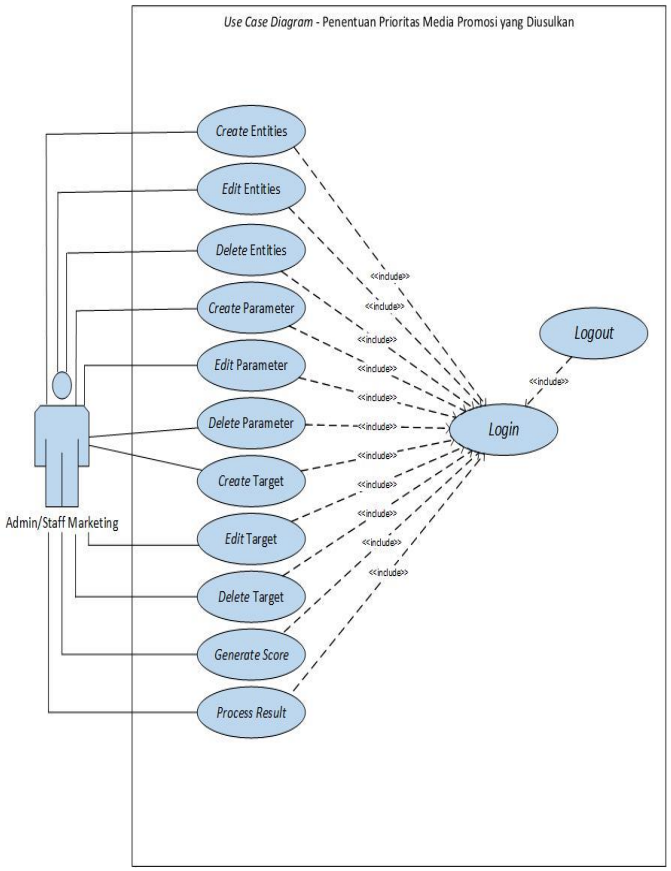

Figure 2. The proposed Use Case Diagram

In Figure 2 Use Case Diagram, there is only one actor involved in the system, namely the Marketing Staff as the Admin.

C. Implementation

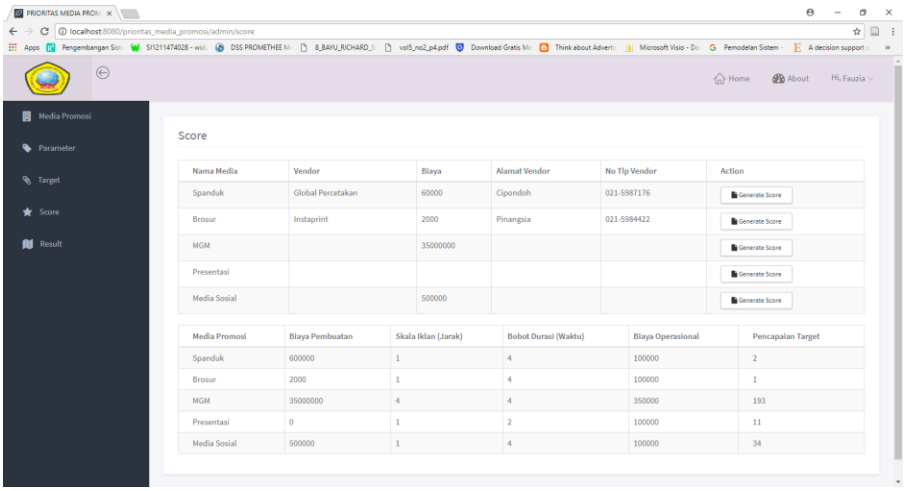

Figure 9. *Generate Score*

Figure 9 shows inputs for the score data for each alternative used.

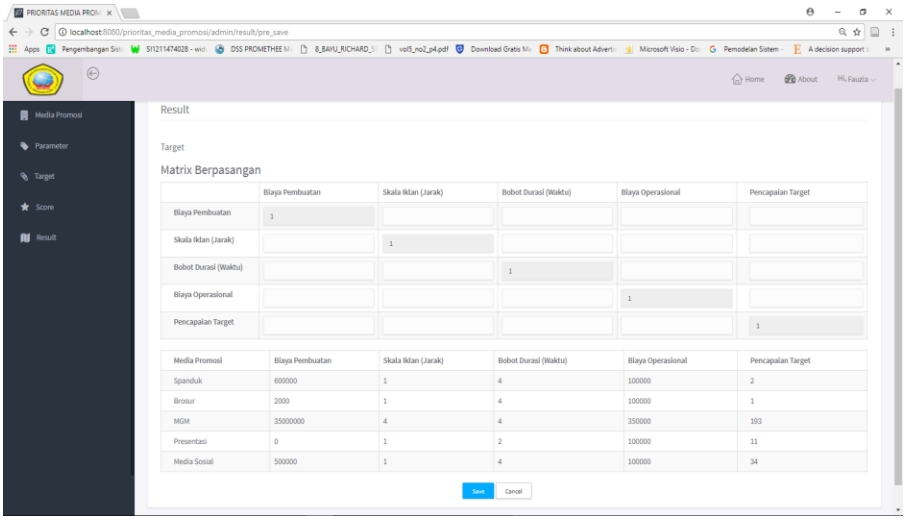

Figure 10. Process Result

Figure 10 shows a form to calculate the weights used using the Analytical Hierarchy Process (AHP) method and if the CR is appropriate the system will process the data using the Promethee method.

4. CONCLUSION

The system used in determining the current promotional media is based on the evaluation of the previous New Student Admissions (PMB), which was obtained from the student applicant forms filled out by the potential students, which is then submitted to the Chairman.

The obstacle faced in determining promotional media at STMIK Bina Sarana Global so far is that when calculating the application form it takes a long time. Then, if there is an error in the analysis, it could even be detrimental since some of promotional media might be ineffective.

The design of a decision support system application for prioritizing promotional media at STMIK Bina Sarana Global was made by ranking using the Promethee method and the weighting was carried out using the Analytical Hierarchy Process

(AHP) method using both methods gave results, namely if the alternative that would be the highest order is the alternative that has the highest importance value in each parameter used.

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