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Decision Making For Determining Promotional Targets For The STMIK Kaputama Campus Using The Promethee Method

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Abstract

Every foundation or educational institution certainly has efforts to maintain its existence amidst competition from educational institutions that continue to innovate to attract public interest in an educational institution . The results of good and appropriate promotion can be seen from the development of student admissions each year. To carry out promotions, of course you have to pay attention to things such as the type of school, travel time, number of computer science enthusiasts. Apart from that, determining promotional targets to get good, effective and efficient results. So a decision-making system is needed that is able to assist in the analysis of determining promotional targets at STMIK Kaputama. With the existence of a decision support system and based on STMIK Kaputama promotion target criteria, we are able to get the right promotion target results for the advancement of STMIK Kaputama development and realizing the vision and mission for the future, apart from that, so that prospective STMIK Kaputama students increase, because of the right promotion targets . To make decisions effective and efficient, this decision making system was built using the *Promethee method* , which is one of the decision making methods used to obtain a problem solution. *Promethee* is used to determine and produce decisions from several alternatives. From the results of the research conducted, it was found that the *Promethee method* was able to produce the best concise decisions.

Keywords: *Decision-making,Promotion targets,Promethee method*

1. Introduction

Every foundation or educational institution certainly has efforts to maintain its existence amidst competition from educational institutions that continue to innovate to attract public interest in an educational institution. STMIK Kaputama is a campus in Binjai City which has a vision and mission "To become a university in the field of information technology that is superior, professional, characterful and entrepreneurial in North Sumatra (2022) and Indonesia (2032)". STMIK Kaputama's mission, of course all campus management must work hard to maintain the quality and trust of the community in STMIK Kaputama. Where to introduce STMIK Kaputama, you must use good and appropriate promotional techniques so that all information about STMIK Kaputama can be conveyed to all levels of society, especially in remote or inland villages. The results of good and appropriate promotion can be seen from the development of student admissions each year.

However, regional analysis of the results of new student admissions is rarely carried out to find out which schools have been successfully promoted. Apart from that, there are still many prospective students who do not know the location of the STMIK Kaputama Binjai Campus. To carry out promotions, of course you have to pay attention to things such as the type of school, travel time , number of computer science enthusiasts. Apart from that, determining promotional targets to get good, effective and efficient results. So a decision-making system is needed that is able to assist in the analysis of determining promotional targets at STMIK Kaputama. With the existence of a decision support system and based on STMIK Kaputama promotion target criteria, we are able to get the right promotion target results for the advancement of STMIK Kaputama development and realizing the vision and mission for the future, apart from that, so that prospective STMIK Kaputama students increase, because of the right promotion targets .

Furthermore, to make decision making effective and efficient, this decision making system was built using the *Promethee method* , which is one of the decision making methods used to obtain a problem solution. *Promethee* is used to determine and produce decisions from several alternatives. The data is combined into one with the assessment weight that has been obtained through assessing the results. So a decision is taken in the form of ranking *leaving flow* , *entering flow* and *net flow* . This method has advantages in the ranking process which uses quantitative data and qualitative data.

So that the results of the research carried out are in accordance with what was built, this research aims to build a decision support system using the *Promethee method* to determine promotion targets for the STMIK Kaputama campus, to find out the application of the *Promethee method* in processing criteria weight data to determine promotion targets for the STMIK campus Kaputama and to implement it in determining promotional targets for the STMIK Kaputama campus using the *Promethee method* .

Based on the objectives above, the benefits of research are that it can help make it easier for the STMIK Kaputama campus in the process of determining promotional targets for the STMIK Kaputama campus, can help speed up the decision-making process and minimize errors in determining promotional targets for the STMIK Kaputama campus, can increase prospective students at STMIK Kaputama Binjai and can be used as information and input to improve quality in determining promotional targets for the STMIK Kaputama campus.

2. Research Methods

2.1 Decision Support Systems

Decision Support Systems (DSS) are parts and computer-based information systems that provide problem-solving capabilities and communication capabilities for problems with semi-structured conditions (Turban, et al., 2005) in the book (Yeni & Anamisa, 2020) . SPK aims to provide information and provide predictions and direct information users so they can make better decisions. In general, SPK is based on three large components, namely data management, basic model and interface (Turban, et al., 2005) in the book (Yeni & Anamisa, 2020) .

Below is an explanation and components of the SPK, namely:

1. Data Management
   Data management is a data sub system that is organized in a database. For SPK purposes, data is needed that is relevant to the problem to be solved through simulation.
2. Model Management
   Management model is a model that represents problems in quantitative format (mathematical models for example) as a basis for simulation or decision making, including objectives and problems, related components, existing constraints (constraints), and related matters other. The *base* model allows decision makers to analyze it completely by developing and comparing alternative solutions.
3. Interface

The interface is a combination of the two previous components, namely database management and model management which are combined in the interface component, after previously being presented in the from of a model that the computer understands. The interface displays system output for the user and accepts input from the user into the decision support system. The interface is referred to as a dialogue subsystem.

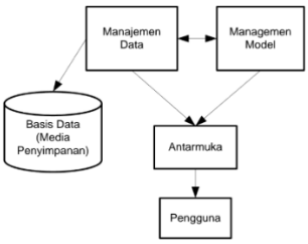

Figure 1 Decision Support System Components

2.2 Promethee Method

According to Edi, et al., (2023, p.151) Promethee (Preference Ranking Organization Method for Enrichment Evaluation) is a multi-criteria decision making method (Multi Criteria Decision Making (MACD)). Like other MACD methods in general, Promethee is a method that uses mathematical analysis and this method has 2 types, namely Promethee I and Promethee II. The difference is that Promethee I provides partial cuts from decision alternatives while Promethee Il produces an overall ranking of the alternatives.

The biggest difference between Promethee and other MACD methods is that in Promethee there are inward connections during dynamic procedures. The Promethee method is easily adapted for decision problems where a limited set of alternatives needs to be outranked and addressed several conflicting criteria. The outranking method is widely used in MCDM. This method compares all alternatives in pairs and determines which one is preferred by comparing these alternatives with each criterion. The Promethee method relies on alternative pairwise correlations against each criterion. There are 3 benefits that can be obtained from using the Promethee method :

1. Easy to use outranking strategy
2. Promethee's success in real-life implementation, and
3. Promethee produces alternative ranking completeness.

The use of Promethee is to determine and produce decisions from several alternatives. The main issues are simplicity, clarity and stability. Promethee functions to process data, both quantitative and qualitative data at the same time. Where all data is combined into one with the weight of the assessment that has been obtained through an assessment or survey . The Promethee method is able to calculate alternatives based on different characteristics. The outranking method compares several possible alternatives (on criteria) with basic criteria. They essentially calculate an index for each pair of eligible alternatives or between the rankings of one relative to another alternative. All parameters involved have a real influence from an economic perspective.

Promethee method is one of the best known and widely applied outranking methods, consisting of the construction of outranking relations through pairwise comparison of alternatives examined on each separate criterion. Promethee provides users to use data directly

in the form of simple multi-criteria tables. Promethee has the ability to handle multiple comparisons, the decision maker simply defines his own scale of measurement without limitations, to indicate his priorities and preferences for each criterion by focusing on the value (value) . The use of the Promethee method can be used as a method for decision making in the fields of marketing, human resources, location selection, or other fields related to alternative selection (raharja.ac.id) .

2.3 Promethee Calculation Phase

There are required steps that must be carried out by decision makers to obtain selection results using the Promethee method .

1. Determine several alternatives
   Alternative here can be interpreted as the object to be selected (selection object). In selecting selection calculations with Promethee, it is necessary to determine several objects to be selected (at least 2 objects), namely that one object will be compared with another object.
2. Determine several criteria
   After determining the object to be selected, in Promethee's selection calculations it is also necessary to determine several criteria, determining the criteria here as terms or conditions for selection.
3. Determine the weight of the criteria
   When determining criteria, the decision maker must determine the weight of each criterion. Each criterion may have the same or different weight values.
4. Determine the type of assessment, namely minimum and maximum
5. Specifies the preference type
   For each criterion, the most suitable one is based on data and considerations from the decision maker. There are six types of preferences (Usual, Quasi, Linear, Level, Linear Quasi and Gaussian).
6. Calculating preference values
7. Calculating multicriteria preference index
8. Calculation of Entering Flow, Leaving Flow and Net Flow .
   a. Entering Flow value is the number of points approaching from a node . So it can be interpreted, the Entering Flow value is a positive value given to a selection object that has an approaching direction from a node .
   b. The Leaving Flow value is the opposite of the Entering Flow value . The Leaving Flow value is the number of directions away from a node . So it can be interpreted, the Leaving Flow value is a negative value given to a selection object that is directed away from a node .
   c. Net Flow value is a complete assessment. Complete here is the assessment obtained from the Entering Flow value minus the Leaving Flow value . So it can be interpreted, the Net Flow value is the final value or result obtained from the positive value minus the negative value of a node .

2.4 Research Methods

Research methods are carried out to search for something systematically using scientific methods from applicable sources. This research process was shown to provide more meaningful results for STMIK Kaputama Binjai, especially in terms of decision making in determining promotion targets for the STMIK K aputama campus . The results of the conceptualization will be translated into a complete research method with a literature study pattern, data collection needed to analyze the system to be created, namely making decisions on determining promotional targets for the STMIK K aputama campus using the Promethee method .

Based on the the Promethee method , it can be explained that there are several stages used in this research, namely as follows:

1. Preparation
   This preparation stage is the beginning of the research process that will be carried out. The preparations carried out are determining the background of the problem. This is done by looking for problems and obstacles that occur, by looking for information directly at STMIK Kaputama Binjai. Formulate what problems have occurred and what the resolution process will be. Providing these limitations is done to provide limitations to this research, namely starting from the data used, variables, the system used and the output that will be produced, namely the decision making system for determining promotional targets for the STMIK K aputama campus using the Promethee method . Determine the objectives, namely what results will be achieved from this research process. Benefits of research, namely what benefits will result from the research that has been carried out.
2. Theoritical review
   At this stage a theoretical study of the existing problem will be carried out. The study was carried out to determine the concepts that will be used in research, especially regarding decision support systems, Promethee methods , campus promotions, flowcharts, databases , MySQL and PHP programming that will be used in the analysis process.
3. Data collection
   This stage is intended to collect supporting data obtained from STMIK Kaputama Binjai by means of direct interviews regarding campus promotion location data. In this research, data collection was carried out by conducting questions and answers with officers or departments who handle campus promotions to make direct observations in collecting data. Then, direct observation and analysis of campus promotion location data is carried out so that the needs of the system being designed can be seen, where this observation includes observation of software, hardware and also includes searching and retrieving data.
4. Data analysis
   At this stage, analysis of supporting data will be carried out, namely promotional data for the STMIK Kaputama campus which was obtained in the previous stage, by carrying out analysis using the Promethee method to obtain ranking results or the best alternative from the existing data. Data analysis is needed in order to find solutions to research problems that are being worked on.
5. Testing and Implementation
   At this stage, testing of data variables and data implementation and system program preparation will be carried out, namely by:
   a. Preparing the data to be analyzed, namely STMIK Kaputama campus promotion location data.

b. Determine what variables will be used, namely the type of school, travel time , number of people interested in computer science majors.
c. Carry out the analysis process using the Promethee method .
d. Implementing manual calculation results with a program built using the PHP programming language.

6. Final Stage r
   This stage is the stage of drawing conclusions and suggestions that can be made in preparing research. With the conclusion, the results of the entire research will be known and suggestions for improvements and benefits for others are expected.

2.5 Research Supporting Data

In making a decision, of course, data is needed that will support the calculation analysis of a method so that later the best alternative can be obtained based on predetermined criteria data. From research conducted at STMIK K aputama. An example of the data obtained can be seen as in Table 1 below:

Table 1: Campus Promotion Target Data

No	Nama Sekolah	Jenis Sekolah	Waktu Tempuh (Menit)	Peminat ILKOM
1	SMA Negeri 2 Binjai	Negeri	7	6
2	SMK Negeri 1 Stabat	Negeri	38	11
3	SMA Negeri 1 Binjai	Negeri	2	5
4	SMK Setia Budi	Swasta	12	6
5	SMK PABA	Swasta	5	12
6	SMA Negeri 6 Binjai	Negeri	14	6
7	SMK Negeri 1 Binjai	Negeri	3	13
8	SMA Negeri 1 Salapian	Negeri	67	3
9	SMK Tunas Pelita	Swasta	13	12
10	SMK Arrasyad Kuala	Swasta	45	3

3. Result And Discussion

From the explanation of the observations that have been made, the following is the calculation process for decision making in determining promotional targets for the STMIK K aputama campus using the Promethee method .

1. Determining Alternatives
   Alternatives in decision making for determining promotional targets for the Stmik Kaputama campus using the Promethee method .

Table 1: Alternative Data

No	Kode	Nama Sekolah
1	A01	SMA N 2 Binjai
2	A02	SMK Negeri 1 Stabat
3	A03	SMA Negeri 1 Binjai
4	A04	SMK Setia Budi
5	A05	SMK PABA
6	A06	SMA Negeri 6 Binjai
7	A07	SMK Negeri 1 Binjai
8	A08	SMA Negeri 1 Salapian
9	A09	SMK Tunas Pelita
10	A10	SMK Arrasyad Kuala

2. Determining Criteria
   Determining decision-making criteria for determining promotion targets for the Stmik Kaputama campus using the Promethee method . The symbols used for the criteria are:

Table 2: Criteria Weight Data

No	Nama Kriteria	Bobot Nilai Kriteria	
1	Jenis Sekolah (K1)	Negeri	1
		Swasta	2
2	Waktu Tempu	Sesuai dengan data waktu	
3	Peminat Ilmu Komputer	Sesuai dengan jumlah peminat	

3. Determining Criteria Weights
   Determine the weight value for decision making in determining promotional targets for the Stmik Kaputama campus using the Promethee method :

Table 4: Alternative Weight Value Data

No	Nama Sekolah	K1	K2	K3
1	SMA N 2 Binjai	1	7	6
2	SMK Negeri 1 Stabat	1	38	11
3	SMA Negeri 1 Binjai	1	2	5
4	SMK Setia Budi	2	12	6
5	SMK PABA	2	5	12
6	SMA Negeri 6 Binjai	1	14	6
7	SMK Negeri 1 Binjai	1	3	13

No	Nama Sekolah	K1	K2	K3
8	SMA Negeri 1 Salapian	1	67	3
9	SMK Tunas Pelita	2	13	12
10	SMK Arrasyad Kuala	2	45	3

4. Types of Basic Criteria for Preference Functions
   Determine the basic criteria value of the preference function with the following data:

Table 3: Criteria Preference Value Data

No	Criterion Name	Preference Type	Parameter		
			p	q	s
1	Jenis Sekolah	Level Type (Level Criterion)	0	1	0
2	Waktu Tempuh	Linear Type (Linear Criterion or V-Shape)	0	20	0
3	Peminat Ilmu Komputer	Quasi Type (Quasi Criterion or U-Shape)	40	0	0

The following is the weight of each criterion :

Table 6: Weight of Assessment Criteria

No	Nama Kriteria	Nilai Bobot
1	Jenis Sekolah	0,2
2	Waktu Tempu	0,4
3	Peminat Ilmu Komputer	0,4

5. Calculating the difference in Preference Values
   Untuk menghitung nilai preferensi dilakukan dengan cara:
   SMA N 2 BINJAI,SMK NEGERI 1 STABAT = 1 – 1 = 0
   SMA N 2 BINJAI,SMA NEGERI 1 BINJAI = 1 – 1 = 0
   Untuk nilai d (jarak) diperoleh dari a-b, nilai |d| merupakan hasil dari nilai d jika hasil (-) maka di (+) kan, nilai P diperoleh darinilai parameter d(jarak) = 0 dibagi K1 pada alteranatif A01 = 1dengan sehinggan0/ 1 = 0. Nilai PI diperoleh dari dariP pada alteranatif A01 = 0 dikali dengan nilai bobot pada kriteria = 0.2 sehingga hasilnya 0.

6. Alternative Comparison
   From the data above, the following are the results of the comparison of each alternative as in the table below.

Table 7: Alternative Comparison Values

Alternative	**A01**	**A01**	**A03**	**A04**	**A05**	**A06**	**A07**	**A08**	**A09**	**A10**
A01	0	0	0.1	0	0.04	0	0.08	0	0	0
A02	0.4	0	0.4	0.4	0.4	0.4	0.4	0	0.4	0
A03	0	0	0	0	0	0	0	0	0	0
A04	0.2	0.1	0.3	0	0.14	0.1	0.28	0.1	0	0
A05	0.1	0.1	0.16	0	0	0.1	0.14	0.1	0	0
A06	0.14	0	0.24	0.04	0.18	0	0.22	0	0.02	0
A07	0	0	0.02	0	0	0	0	0	0	0
A08	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0	0.4	0.4
A09	0.22	0.1	0.32	0.02	0.16	0.1	0.3	0.1	0	0
A10	0.5	0.24	0.5	0.4	0.4	0.5	0.5	0.1	0.4	0

7. Leaving Flow , Entering Flow and Net Flow
   Types of preferences used in decision making for determining promotional targets for the Stmik Kaputama campus using the Promethee method.
   a. Leaving Flow

$A01 = \frac{1}{10-1}(0 + 0 + 0.1 + 0 + 0.04 + 0 + 0.08 + 0 + 0 + 0)$

$= \frac{1}{9} * 0.22 = 0.0244$

$A02 = \frac{1}{10-1}(0.4 + 0 + 0.4 + 0.4 + 0.4 + 0.4 + 0.4 + 0 + 0.4 + 0)$

$= \frac{1}{9} * 2.8 = 0.3111$

$A03 = \frac{1}{10-1}(0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0)$

$= \frac{1}{9} * 0 = 0$

$A04 = \frac{1}{10-1}(0.2 + 0.1 + 0.3 + 0 + 0.14 + 0.1 + 0.28 + 0.1 + 0 + 0)$

$= \frac{1}{9} * 1.22 = 0.1156$

$A05 = \frac{1}{10-1}(0.1 + 0.1 + 0.16 + 0 + 0 + 0.1 + 0.14 + 0.1 + 0 + 0)$

$= \frac{1}{9} * 0.7 = 0.0778$

$A06 = \frac{1}{10-1}(0.14 + 0 + 0.24 + 0.04 + 0.18 + 0 + 0.22 + 0 + 0.02 + 0)$

$= \frac{1}{9}$* 0.84 = 0.0933

A07 = $\frac{1}{10-1}$(0 + 0 + 0.02 + 0 + 0 + 0 + 0 + 0 + 0 + 0)

$= \frac{1}{9}$* 0.02 = 0.0022

A08 = $\frac{1}{10-1}$(0.4 + 0.4 + 0.4 + 0.4 + 0.4 + 0.4 + 0.4 + 0 + 0.4 + 0.4)

$= \frac{1}{9}$* 3.6 = 0.4

A09 = $\frac{1}{10-1}$(0.22 + 0.1 + 0.32 + 0.02 + 0.16 + 0.1 + 0.3 + 0.1 + 0 + 0)

$= \frac{1}{9}$* 1.32 = 0.1467

A10 = $\frac{1}{10-1}$(0.5 + 0.24 + 0.5 + 0.4 + 0.4 + 0.5 + 0.5 + 0.1 + 0.4 + 0)

$= \frac{1}{9}$* 3.54 = 0.3933

b. Entering Flow

A01 = $\frac{1}{10-1}$(0 + 0.4 + 0 + 0.2 + 0.1 + 0.14 + 0 + 0.4 + 0.22 + 0.5)

$= \frac{1}{9}$* 1.96 = 0.2178

A02 = $\frac{1}{10-1}$(0 + 0 + 0 + 0.1 + 0.1 + 0 + 0 + 0.4 + 0.1 + 0.24)

$= \frac{1}{9}$* 0.94 = 0.1044

A03 = $\frac{1}{10-1}$(0.1 + 0.4 + 0 + 0.3 + 0.16 + 0.24 + 0.02 + 0.4 + 0.32 + 0.5)

$= \frac{1}{9}$* 2.44 = 0.2711

A04 = $\frac{1}{10-1}$(0 + 0.4 + 0 + 0 + 0 + 0.04 + 0 + 0.4 + 0.02 + 0.4)

$= \frac{1}{9}$* 1.26= 0.14

A05 = $\frac{1}{10-1}$(0.04 + 0.4 + 0 + 0.14 + 0 + 0.18 + 0 + 0.4 + 0.16 + 0.4)

$= \frac{1}{9}$* 1.72 = 0.1911

A06 = $\frac{1}{10-1}$(0 + 0.4 + 0 + 0.1 + 0.1 + 0 + 0 + 0.4 + 0.1 + 0.5)

$= \frac{1}{9}$* 1.6 = 0.1778

A07 = $\frac{1}{10-1}$(0.08 + 0.4 + 0 + 0.28 + 0.14 + 0.22 + 0 + 0.4 + 0.3 + 0.5)

$= \frac{1}{9}$* 2.32 = 0.2578

A08 = $\frac{1}{10-1}$(0 + 0 + 0 + 0.1 + 0.1 + 0 + 0 + 0 + 0.1 + 0.1)

$= \frac{1}{9}$* 0.4 = 0.0444

A09 = $\frac{1}{10-1}$(0 + 0.4 + 0 + 0 + 0 + 0.02 + 0 + 0.4 + 0 + 0.4)

$= \frac{1}{9}$* 1.22 = 0.1356

A10 = $\frac{1}{10-1}$(0 + 0 + 0 + 0 + 0 + 0 + 0 + 0.4 + 0 + 0)

$= \frac{1}{9}$* 0.4 = 0.0444

c. Net Flow

SMA N 2 Binjai = 0.244 0 – 0.2178= -0.1933
State Vocational School 1 Stabat = 0.3111 – 0.1044= 0.2067
Binjai 1 Public High School = 0 .0000 – 0.2711 = -0.2711
Setia Budi Vocational School = 0.1356 – 0.14 = -0.0044
PABA Binjai Vocational School = 0.0778 – 0.1911 = -0.1133
SMA Negeri 6 Binjai = 0.0933 – 0.1778 = -0.0844
Binjai 1 State Vocational School = 0.0022 – 0.2578 = -0.2556
Salapian 1 Public High School = 0.4 000 – 0.0444 = 0.3556
Tunas Pelita Vocational School = 0.1467 – 0.1356 = 0.0111
Arrasyad Kuala Vocational School = 0.3933 – 0.0444 = 0.3489

From the results of net flow calculations in decision making for determining promotional targets for the Stmik Kaputama campus using the Promethee method , the results obtained are as in the following table:

Table 8: Alternative Ranking

No.	Alternatif	Nilai	Rank
1	SMA Negeri 1 Salapian	0,3556	1
2	SMK Arrasyad Kuala	0,3489	2
3	SMK Negeri 1 Stabat	0,2067	3
4	SMK Tunas Pelita	0,0111	4
5	SMK Setia Budi	-0,0044	5
6	SMA Negeri 6 Binjai	-0,0844	6
7	SMK PABA	-0,1133	7
8	SMA N 2 Binjai	-0,1933	8
9	SMK Negeri 1 Binjai	-0,2556	9

No.	Alternatif	Nilai	Rank
10	SMA Negeri 1 Binjai	-0,2711	10

From the data above, the following graphic results are obtained:

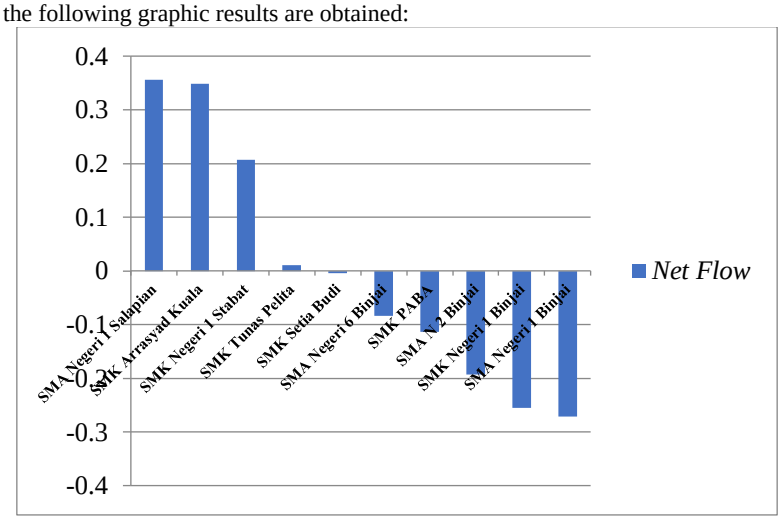

Figure 2: Promethee Method Decision Results

Based on the results of calculations using the Promethee method above, it is found that The final value of the highest method was found at SMA NEGERI 1 SALAPIAN with a value of 0.3556; then the school becomes a recommendation for promotion of STMIK Kaputama Binjai.

4. Conclusion

In the discussion of research that has been carried out, the appropriate criteria to be used to support the final results of decisions that have been successfully analyzed and applied to the system are the type of school , travel time and ILKOM interest. application of the Promethee method This research was successful in determining the school promotion targets that will be carried out by STMIK Kaputama Binjai. Furthermore, in the future it is hoped that the criteria used can be added and adapted to the needs and objectives of the system and in further research it is also hoped that the system can be further developed to be more efficient and more effective for mapping data in the future.

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