RESEARCH ARTICLE   OPEN ACCESS

Decision Support System for Determining the Location of New Student Admissions Promotion for STMIK Widuri using Analytical Hierarchy Process (AHP) and Simple Additive Weigthing (SAW) Methods

Ruth Silvia Damaiyanty *, Dedi Susanto**, Nizar Hadi***

*(Master of Computer Science Study Program, Faculty of Information Technology, Universitas Budi Luhur Jl. Raya Ciledug, Petukangan Utara, Kebayoran Lama, South Jakarta 12260
Telp. (0 21) 5853753, Fax. (021) 5869225
E-mail : ruthsilviadn@gmail.com*, dedi.dylen11@gmail.com**, hadi.knapsack@gmail.com***

------------------------------------************************------------------------------

Abstract:

STMIK Widuri is one of the private universities in Jakarta that continues to grow and will always provide the best service for students who continue their education in this place. Problems that occur in the promotion process at STMIK Widuri are the use of a weighting system in each of the criteria used in determining the location of promotion, the absence of a decision-making system for determining the location of promotions, and data processing that still using manual methods and the promotional activities reports that not well documented. The purpose of this study is to produce decision support system on determining the location of promotions that can facilitate the leadership of marketing department PMB STMIK Widuri in carrying out promotional activities. The method that used in this study is the Analytical Hierarchy Process (AHP) method to determine the criteria weights and the Simple Additive Weight (SAW) method to find out the ranking of the non-uniform ratings to determine the priority of the promotion location . The results of this study are the decision support system for determining the location of promotions that have been tested using the User Acceptance Test method with a very good category of user acceptance.

Keywords — Decision Support System ,   Location, Promotion, AHP, SAW, UAT .

------------------------------------************************----------------------------

I. INTRODUCTION

Promotion is a way to let you know about offering a product or service in order to attract potential customers. One of the problems faced by STMIK Widuri in attracting students is the process of determining the location of promotions.
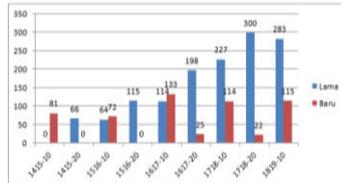

Figure 1. Graphic of the Recap of Students for the Last 5 Years

(Source: PMB STMIK Widuri data)

The problems faced by STMIK Widuri Jakarta in determining the location of promotion, are : the data report from the admission of new students, the ups and downs of students enrolled in the last 5 (five) years, marketing strategy, and the weighting criteria system that has not been used in determining the location of promotions.

This study aims to create a decision support system with Analytical Hierarchy Process (AHP) method because the weighting system has not been used in each criteria, as well as the Simple Additive Weighting (SAW) method for ranking promotional locations because in the assessment of location is not uniform. In the future, this system is expected to be able to assist the New Student Admissions Department (PMB) of STMIK Widuri in determining the location of promotions to recruit new students.

The scope of problem that used in this research is data input (input) , such as the distance of the origin school with STMIK Widuri, total students grade XII in a high school or equivalent , the number of students from high school or equivalent who had achievement in STMIK Widuri , the origin school of the student in STMIK Widuri, and the schools that have similar majors or courses that are provided STMIK Widuri , the system will be tested using UAT (User Acceptance Test) , and the output

(output) of the system is the potential location to get prospective students which are desired. Promotional locations for recruiting new students are limited to high school that located in the DKI Jakarta area.

I. THEORETICAL AND TERMS OF CONCEPT

A. Location

Location is an object in space can explain and can provide clarity on the object or geographic symptoms concerned in more detail [1].

B. Location

Location is an object in space can explain and can provide clarity on the object or geographic symptoms concerned in more detail [1].

C. Promotion

Promotin is Business conducted by the market to influence other parties to participate in exchange activities [2].

D. Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a representation of a complex problem in a multi- level structure where the first level is the goal, followed by the level of factors, criteria, sub- criteria, and so on down to the last level of alternatives. By using AHP, a problem that will be solved in an organized frame of mind so that it can be expressed to make effective decisions on the problem [3].

The explanation of the working principle of the Analytical Hierarchy Process (AHP) method , namely :

The explanation of the working principle of the Analytical Hierarchy Process (AHP) method , namely :

1. Decomposition , is the process of solving or dividing whole problems into elements by compiling a hierarchy by identifying knowledge or information that is being observed starting from complex problems that

are broken down into its main elements which are further broken down into parts again so that it is more hierarchical. A hierarchy is called complete if all elements at one level have a relationship to all elements at the next level, while the incomplete decision hierarchy is opposite.

2. Form of decomposition structure, namely:
   a) First level : Goal decision
   b) Second level : Criteria
   c) Third level : Alternatives

The problem hierarchy is compiled and used to help the decision making process in a system by taking into account all the decision elements involved.

3. Comparative Judgment, is an assessment based on the relative importance of two elements at a certain level in relation to the level above it. Comparative judgment is the core of the use of AHP because it will affect the priority order of the elements. Determination of priorities for each level of the hierarchy, needs to be done by pairwise comparisons to determine priorities. According to Saaty (1988), for various problems, the scale of 1-9 is the best scale in expressing opinions. Scale 1-9 is determined as a consideration in comparing pairs of elements at each level of the hierarchy against an element that is at the top level. A nine-scale scale can represent the degree to which we are able to distinguish the intensity of the relationship between elements.

The values and definitions of qualitative opinions from the current comparison scale can be seen in table 1.

Table 1 . Scale of Pairwise Comparison Saaty

Value	Information
1	The vertical factor is as important as the horizontal factor
3	The vertical factor is more important than the horizontal factor
5	The vertical factor is clearly more important than the horizontal factor
7	The vertical factor is clearly more important than the horizontal factor
9	The vertical factor is absolutely more important than the horizontal factor
2, 4, 6, 8	When in doubt about the value of two adjacent elements
1 / (2-9)	Opposite of the description of values 2 - 9

4. Synthesis of priority (determining priority), i.e. uses the eigen vector method to get a realistic weight for the elements of decision making.

5. Logical Consistency . What is meant is that all elements are logically grouped and ranked consistently according to a logical criterion.

E. Simple Additive Weight (SAW)

Simple Additive Weight (SAW) Method is often also known by the weighted summation

$$R_{ij} = \begin{cases} \dfrac{X_{ij}}{Max\, X_{ij}} & jika\ j\ at\ \text{r\ }ibut\ keuntungan\ (efit) \\[2ex] \dfrac{Min\, X_{ij}}{X_{ij}} & jika\ j\ atribut\ biaya\ (cost) \end{cases}$$

Information :
Max X_{ij} = The biggest of each criteria
Min X_{ij} = The smallest value of each criteria
                   i
X_{ij} = value attributes of each criteria
Benefit = If the biggest value is the best .
Cost = If the smallest value is the best
r $_{ij}$= Performance rating value normalized

F. Use Case Diagrams

"Use cases are the primary drivers for all of the UML diagramming techniques. use case communicates at a high level what

the system needs to do, and each of the UML diagramming techniques build upon this by presenting the functionality in different ways, each view having a different purpose " [5].

G. Problem Solving Thinking Framework

Frameworks are conceptual models of how theories relate to various factors that have been identified as important problems [6].

II. DISCUSSION RESULTS RESEARCH

a. AHP Hierarcchy Structure

Goal of this research is determining the location of sale in new admissions at STMIK Widuri and there are five (5) criterias outlined in the picture hierarchy structure. Meanwhile, the alternative is depicted from A1 to A5, where the promotion locations are explained in 5 (five) regions in DKI Jakarta.

b. Calculate AHP Method Criteria Steps in the Calculation process AHP :

1. Pairwise Comparison Matrix.
2. At this stage, a comparison between one criterion and another criterion is carried out, where data is obtained from the questionnaire as in the appendix and assessment results obtained from interviews with respondents in the STMIK Widuri PMB Determine Priority Value Criteria can be seen in table 3

T able 2 . Pairwise Comparison Matrix

Promotion Location Determination	C1	C2	C3	C4	C5
C1	1/1	3/1	2/1	2/1	2/1
C2	1/3	1/1	2/1	2/1	2/1
C3	1/2	1/2	1/1	2/1	2/1

Next, change the fraction matrix to a decimal number matrix as shown in table 3.

Table 3 . Pairwise Comparison of Decimal Numbers Matrix

Promotion Location Determination	C1	C2	C3	C4	C5

C1	1,00	3.00	2.00	2.00	2.00
C2	0.33	1,00	2.00	2.00	2.00
C3	0.50	0.50	1,00	2.00	2.00
C4	0.50	0.50	0.50	1,00	2.00
C5	0.50	0.50	0.50	0.50	1,00
total	2.83	5.50	6.00	7.50	9.00

3. Normalization of the Criteria Value Matrix . obtine by dividing the value of each criterion comparison with the results of the number can g can be seen in Table 4 .

Table 4 . Normalization Matrix Comparison of Criteria Values

Promotion Location Determination	C1	C2	C3	C4	C5	Total
C1	0.35	0.55	0.33	0.27	0.22	1.72
C2	0.12	0.18	0.33	0.27	0.22	1.12
C3	0.18	0.09	0.17	0.27	0.22	0.92
C4	0.18	0.09	0.08	0.13	0.22	0.71
C5	0.18	0.09	0.08	0.07	0.11	0.53
Total	1,00	1,00	1,00	1,00	1,00	5,00

4. Priority is the average value of criteria which can be calculated by dividing the number of comparison matrix values of each criterion by the number of criteria, which are listed in table 5.

5. Table 5 . Criteria Priority Value

Criteria	Total	Priority Value
Distance high school equivalent to STMIK Thistle	1.72	.34
The number of class XII students in a senior high school or equivalent	1.12	.22
The number of students from high school and equivalent who are achieving in STMIK	0.92	.18
The number of students from high school and equivalent who become students at STMIK Widuri	0.71	0.14
Senior High School which has a similarity in the department provided by STMIK Widuri	0.53	.11

c. Calculate the Value of Consistency Ratio.

This stage is carried out to determine whether the comparative assessment criteria

are consistent or not. The following steps are taken to get the consistency ratio as follows:

a) Make a Row Addition Matrix . This matrix is made by multiplying the paired comparison matrix in table 2 . with the priority values in table 5 . The calculation results can be selected at table 6.

Table 6 . Addition Matrix for Each Line

Promotion Locatio	C1	C2	C3	C4	C5	total
C1	0.34	0.67	0.37	0.28	0.21	1.88
C2	0.11	0.22	0.37	0.28	0.21	1.20
C3	0.17	0.11	0.18	0.28	0.21	0.96
C4	0.17	0.11	0.09	0.14	0.21	0.73
C5	0.17	0.11	0.09	0.07	0.11	0.55

b) Calculate the consistency vector by determining the average value of the Weighted Sum Vector .

$$
\begin{aligned}
1.88 &: 0.34 = 5.46 \\
1.20 &: 0.22 = 5.36 \\
0.96 &: 0.18 = 5.22 \\
0.73 &: 0.14 = 5.16 \\
0.55 &: 0.11 = 5.23
\end{aligned}
$$

c) Calculate the average value of the consistency vector as follows:

$$\lambda = \frac{(5.46 + 5.36 + 5.22 + 5.16 + 5.23)}{5} = 5.29$$

d) Calculate the Consistency Index

$$CI = \frac{\lambda\,\max - n}{n - 1}, \, n : Ordo\ matriks$$

$$CI = \frac{5.29 - 5}{5 - 1}$$

$$CI = \frac{0.29}{4}$$

$$CI = 0.07$$

e) Calculate the Consistency Ratio (CR) . The CR value is calculated by dividing the CI value by the IR value (CI / RI).

$$CR = \frac{CI}{RI}$$

RI values are obtained based on the ratio index list value (RI) in table 8 . for the number of criteria (n)

Table 7 . Random Index Value (RI)

n	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.48

Because the number of location determination criteria used is 5 (five), the IR value is 1.12, so:

$$CR = \frac{CI}{RI}$$

$$CR = \frac{0.07}{1.12}$$

$$CR = 0.06$$

CR value <0.1, means that the weighting preference criteria is consistent or acceptable.

d. Ranking Determination of Promotion Location With SAW

The process of determining the ranking method SAW is determining the Benefit and Cost function . The benefit function , in the sense that higher the better value. While the cost function , the lower the better value of each decision support system criteria for determining the location of PMB promotion and can be seen in table 8 .

Table 8 . Function of Determination of Promotion Location Criteria

No	Criteria	Function
1	Distance high school equivalent to STMIK Widuri	Cost (-)
2	The number of class XII students in a senior high school or equivalent	Benefit (+)
3	The number of students from high school and equivalent who are achieving in STMIK Widuri	Benefit (+)
4	The number of students from high school and equivalent who become students at STMIK Widuri	Benefit (+)
5	Schools that have similarities in the departments provided by STMIK Widuri	Benefit (+)

Table 9 . explain the alternative value matrix of decision support systems for determining the location of promotion of PMB STMIK Widuri.

Table 9 . Alternative Value Matrix Determination of Promotion Location

Alternative	School name	C1	C2	C3	C4	C5
west Jakarta	Assa'adatul Abadiyah Islamic Vocational School	5.2	30	0	6	2
	Muhammadiyah High School 13	7.3	25	0	5	1
	Muhammadiyah 15 High School	3.5	35	0	5	1
	ARI TRI VOCATIONAL SCHOOL 2	5.6	25	5	9	2
	Josua Vocational School	5.7	30	2	4	1
Alternative	School name	C1	C2	C3	C4	C5
South Jakarta	Harnasto Institute Vocational School	5.6	25	0	1	1
	SMAN 63 Jakarta	10.4	35	0	1	1
	Vocational Media Informatics	10.7	35	0	2	3
	29th Vocational School Jakarta	5.9	30	1	2	1
	SMA N 82 High School	4.7	35	0	1	1
Central Jakarta	Jakarta 24 High School	1,2	30	0	1	1
	Bethel Vocational School	3.1	15	0	2	1
	SMK N 1	9.8	30	0	1	2
	SMAN 7 Jakarta	4.2	30	0	4	1
	SMKN 19 Jakarta	3,4	35	0	4	2
North Jakarta	Harapan Kasih High School Jakarta	13.9	32	0	1	1
	11th PGRI Jakarta Vocational School	38.2	40	0	1	2
	N 40 High School	17.2	30	0	1	1
	SMAN 110 Jakarta	27.6	35	0	0	1
	SMAN 111 Jakarta	14.7	35	0	0	1
East Jakarta	SMKN 5 Jakarta	17.4	30	0	1	1
	Development Dynamics Vocational School 1 Jakarta	29.3	50	0	1	1
	PURE BUDI VOCATIONAL SCHOOL 1	16.6	35	0	0	2
	Bina Pangudi Luhur Vocational School	19.2	35	0	0	1
	Garuda Vocational School	21.5	20	0	0	1
Weight		.34	.22	.18	0.14	.11

After that the calculation of the value of each alternative is done by multiplying the results of the normalization matrix value of each alternative per criterion with the weight per criterion that has been generated from the AHP method calculation process which can be   seen in table 10.

Table 1 0 . Initial Normalization Matrix for Alternative Determination of Promotion Location

Alternative	School name	C1	C2	C3	C4	C5
west Jakarta	Assa'adatul Abadiyah Islamic Vocational School	0.60	0.60	0.00	.67	.67
	Muhammadiyah High School 13	0.42	0.50	0.00	0.56	0.33
	Muhammadiyah 15 High School	.89	0.70	0.00	0.56	0.33
	ARI TRI VOCATIONAL SCHOOL 2	0.55	0.50	1,00	1,00	.67
	Josua Vocational School	0.54	0.60	0.40	0.44	0.33
South Jakarta	Harnasto Institute Vocational School	0.55	0.50	0.00	.11	0.33
	SMAN 63 Jakarta	0.30	0.70	0.00	.11	0.33
	Vocational Media Informatics	0.29	0.70	0.00	.22	1,00
	29th Vocational School Jakarta	0.53	0.60	0.20	.22	0.33
	N 82 High School	0.66	0.70	0.00	.11	0.33
Central Jakarta	Jakarta 24 High School	2.58	0.60	0.00	.11	0.33
	Bethel Vocational School	1,00	0.30	0.00	.22	0.33
	SMK N 1	0.32	0.60	0.00	.11	.67
	SMAN 7 Jakarta	.74	0.60	0.00	0.44	0.33
	SMKN 19 Jakarta	.91	0.70	0.00	0.44	.67
North Jakarta	Harapan Kasih High School Jakarta	.22	0.64	0.00	.11	0.33
	11th PGRI Jakarta Vocational School	0.08	0.80	0.00	.11	.67
	N 40 High School	.18	0.60	0.00	.11	0.33
	SMAN 110 JAKARTA	.11	0.70	0.00	0.00	0.33
	SMAN 111 JAKARTA	.21	0.70	0.00	0.00	0.33
	SMKN 5 Jakarta	.18	0.60	0.00	.11	0.33
	Development Dynamics					

Whereas table 11. Explain the final normalization of the total value and ranking obtained to find out which promotion locations get priority to be targeted for the promotion of PMB STMIK Widuri .

Table 11 Final Normalization Matrix Alternative Determination of Promotion Location

Alternative	School name		C1	C2	C3	C4	C5	Total value	Average	Rank
west Jakarta	Assa'adat ul Abadiyah Islamic Vocation al School		0.20	.13	0.00	0.09	0.07	0.50	0.39	2
	Muhamm adiyah High School 13		0.14	.11	0.00	0.08	0.04	.37		
	Muhamm adiyah 15 High School		0.30	.15	0.00	0.08	0.04	0.57		
	ARI TRI VOCATI ONAL SCHOO L 2		0.00	0.00	0.00	0.00	0.00	0.00		
	Josua Vocation al School		.18	.13	0.07	0.06	0.04	0.49		
South Jakarta	Harnasto Institute Vocation al School		.19	.11	0.00	0.02	0.04	0.35	0.38	3
	SMAN 63 Jakarta		.10	.15	0.00	0.02	0.04	0.31		
	Vocation al Media Informati cs		.10	.15	0.00	0.03	.11	0.39		
	29th Vocation al School Jakarta		.18	.13	0.04	0.03	0.04	0.41		
	N 82 High School		.22	.15	0.00	0.02	0.04	0.43		
Centra l Jakarta	Jakarta 24 High School		0.88	.13	0.00	0.02	0.04	1.06	0.59	1
	Bethel Vocation al School		.34	0.07	0.00	0.03	0.04	0.47		
	SMK N 1		.11	.13	0.00	0.02	0.07	0.33		
	SMAN 7 Jakarta		0.25	.13	0.00	0.06	0.04	0.48		
	SMKN 19 Jakarta		0.31	.15	0.00	0.06	0.07	0.60		
North Jakarta	Harapan Kasih High School Jakarta		0.08	0.14	0.00	0.02	0.04	0.27	0.26	4
	11th PGRI Jakarta Vocation al School		0.03	.18	0.00	0.02	0.07	0.29		
	N 40 High School		0.06	.13	0.00	0.02	0.04	0.25		
	SMAN 110 JAK ARTA		0.04	.15	0.00	0.00	0.04	0.23		
	SMAN 111 JAK ARTA		0.07	.15	0.00	0.00	0.04	0.26		
	SMKN 5 Jakarta		0.06	.13	0.00	0.02	0.04	.24		
East Jakarta	Develop ment Dynamic s Vocation al School 1 Jakarta		0.04	.22	0.00	0.02	0.04	0.31	.24	5
	PURE BUDI VOCATI ONAL SCHOO L 1		0.06	.15	0.00	0.00	0.07	0.29		

Based on the above simulation, the location that got first rank is West Jakarta, meaning that the location gets first priority to be used as the location determination for the promotion of PMB STMIK Widuri.

III. CONCLUSION

Based on the results of research, the conclusion of the research is the decision support system for determining the location of the promotion of admission of new students department (PMB) Widuri with Analytical Hierarchy Process (AHP) and web-based Simple Additive Weighting (SAW) methods can facilitate the performance of the Admissions section (PMB) STMIK widuri, to determine the location of promotion with 5 (five) criteria. The criteria is distance of senior high school to STMIK Widuri has a weight of 0.34 %, the number of high school students grade XII has a weight of 0.22 %, the number of high school students that get achievement at STMIK Widuri have a weight of 0.18 %, the number of high school equivalent students who become students at STMIK Widuri has a weight of 0.14 %, and high school equivalents who have similar departments with STMIK Widuri have a weight of 0.11 % , and the result testing system using User acceptance test are, the quality of information (information quality) with a value of 80% , the quality aspects of the system (system quality) with a value of 78% , the quality aspect of service (service quality) 79% , aspects of user (use) with a value of 73% , the aspect of user satisfaction (user satisfaction) with a value of 75% , and aspects of the results obtained (net benefit) with a value of 79% and the

average value obtained is 77% or get a
good acceptance rate from user.

IV. BIBLIOGRAPHY

[1] Sumaatmadja, Nursid. 1981. Geography Study: A Spatial Approach and Analysis. Bandung Alumni.

[2] Kismono, Nervous. 2001. Introduction to Business. Edition I. Prints I. BPFE. Yogyakarta.

[3] Marimin. 2017. Retrieval Support System Decision and Expert System. IPB Press .

[4] Nofriansyah, Dicky. 2015. Concept of Data Mining Vs Decision Support System. Deepublish, Yogyakarta.

[5] Dennis, Alan., Barbara Haley Wixom., Roberta M. Roth. 2013. System Analysis and Design 5 th edition . New Jersey: John Wiley & Sons, Inc.

[6] Sugiyono. 2016. Quantitative Research Methods, Qualitative and R&D. Bandung: Alfabeta.