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Comparison of Analytical Hierarchy Process And Technique For Order Preference By Similarity To Ideal Solution Method To Determine Service Quality At Bank

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ABSTRACT : *Service is the main factor in a service company, good service is by paying attention to the needs and needs of the customer. In this study discusses customer satisfaction with services performed by banks. Where satisfaction is not only obtained from the results but also through the quality of services provided by the bank. This selection is based on several criteria applied. This study was conducted to study and compare multi-criteria (MCDM) decision-making methods in the selection of banks that have the best service quality. The method compared in this study is the AHP and TOPSIS methods. The criteria in this study include, focus, solution, accuracy, time, and clarity. The results of the research show that, the comparison of these two methods has different results. Based on the AHP and TOPSIS methods, the method that is more suitable for use in companies is the TOPSIS Method although it does not yet have a Consistent index. The results of the analysis are using the AHP method, the best quality of customer service is 0.153898043, while the results of the analysis with the TOPSIS method is 0.63318302.*
KEYWORDS : *AHP, TOPSIS, MCDM Service Quality At Bank*

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I. INTRODUCTION

The development of the era followed by the progress of science and technology, as well as the world of information has greatly affected the life of the international community in general. Almost every activity and the activities at lives can not be separated from advanced equipment, cutting-edge and modern for example computer. The rapid development of not only hardware and software technology, but also the method of computing. One of the most commonly developed methods of computing today is the Decision Support System (DSS) method. Decision support system is an interactive information system that provides information, modeling, and data manipulation. The system is used to assist decision making in semi-structured situations and unstructured situations [2]

One of the problems that can be raised for the method of decision-making is to determine the quality of service at the bank with several criteria that have been determined by the bank. Service are those separately identifiable, essentially, intangible activity that provide want-satisfaction and that are not necessarily tied to the sale of a product or another service. To produce a service may or may not require the use of tangible goods". (Stanton in Alma, 2004). many methods can be used in decision support systems. such as the AHP and TOPSIS methods. the use of AHP and TOPSIS is very helpful in decision making [14].

The AHP Method, Which was first introduced [9], is an effective method for solving MCDM Problem [8]. Analytical Hierarchy process (AHP) is a functional hierarchy with the main input of human perception [6]. This method was develop by prof. Thomas Lorie Saaty from Warton Business School beginning in 1970, to search for rankings or priority sequences from various alternative in solving a problem [13].

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), developed by Hwang and Yoon is one of the MCDA/MCDM methods for resolving real-world decision problems satisfactorily[16].

II. METHODS

1.1. DECISION SUPPORT SYSTEM (DSS)

Decision Support System (DSS) is an interactive-based system that helps decision making utilize date and models to solve a problem. DSS consists of three components is model management, data management and interface. There are four phases in the development of Decision Support System is intelligence, design, choice and implementation[2]

2.2 ANALYTICALL HIERARCHY PROCESS (AHP)

Analytical Hierarchy Process (AHP) is a decision making too that can help describe the general decision operation by decomposing a complex problem into a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives **[5].**

There are several principles that must be understood for solving the problem with AHP is as follows: [4].

1. Decomposition (Making Hierarchies)

Complex systems can be understood by separating them into smaller and easier to understand elements.

2. Comparative judgment (Assessment criteria and alternative)

Criteria and alternatives are done by pair wise comparisons so that it can be known the scale of importance of each criterion against other criteria. Table 1 is the comparison scale presented by Saaty [6]

3. Synthesis of priority

Determining the priorities of the criterion elements can be viewed as the weight/contribution of those analysis with a pair wise comparison method between two elements so that all elements are sufficient. This priority is determined based on the views of experts and stakeholder on decision-making, either directly (discussed) or directly.

4. Logical Consistency.

Consistency has two meanings. Firstly, similar objects can be grouped according to uniformity and relevance. Second is the level of relationship between object based on certain criteria.

Table 1. The Fundamental Relational Scale For Pair Wish Comparison [13]

Scale	Definition	Explanation
1	Equal Importance	Two Activities Contribute equally to the objective
3	Moderate importance of one over a another	Experience and judgment strongly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between two adjacent judgment	When compromise is needed

The stepwise procedure of AHP is presented as follows [6] :

Activity 1Construct the pair wise comparison matrix

For N criteria the size of the comparison matrix (C1) will be N X N and the entry cij will denote the relative importance of criterion I whit respect to the criterion j. in the matrix, $c_{ij} = 1$ if when i=j and

$C_{ij} = \frac{1}{C_{ij}}$.

Attribute

$$C_1 = \begin{bmatrix} 1 & C_{12} & \cdots & C_{1N} \\ C_{21} & 1 & & \\ \cdots & \cdots & 1 & \cdots \\ C_{N1} & C_{N1} & \cdots & 1 \end{bmatrix}$$

Activity 2 Construct normalized decision matrix

$$Ai_j = \frac{Ci_j}{\sum_{j=1}^{n} a_{ij}}$$

i=1,2,3,…….,n,j=1,2,3,……,n

Activity 3 Construct the Weighted, Normalized decision matrix

$$w_i = \sum_{j=1}^{n} c_{ij} \,/n, i=1,2,3,\ldots..,n$$

$$w = \begin{bmatrix} w_1 \\ w_2 \\ . \\ ; \\ w_n \end{bmatrix}$$

Activity 4Calculate Eigenvector & Row Matric

$$E = N^{th} rootvalue / \sum N^{th} rootvalue$$

$$Rowmatrix = \sum_{j=i}^{n} aij * eji$$

Activity 5 Calculate the Maximum Eigen value, $\lambda_{\max}$

$$\lambda_{Max} = Rowmatrix / \mathrm{E}$$

Activity Calculate the consistency index & consistency

$$CI = \left(\lambda \max - n \big/ n - 1 \right)$$

Pattern Of Ratio Consistency : $CR = \dfrac{CI}{RI}$

CR is parameter for check if the pair wise comparison has been done consequently or not. The value of RI is the random value of the index issued by Oakridge Laboratory such as table below [15]

Table2 . RCI Values for Different numbers of alternative (M)

M	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RCI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

2.3 Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS)

TOPSIS is one of the major techniques in dealing with multiple Criteria Decision Making (MCDM) Problems[1]. It is a practical and useful technical for ranking and selection of a number of externally determined alternatives through distance measures [7]. The underlying logic of TOPSIS method is to define the positive-ideal solution(PIS) and the negative-ideal solution (NIS) ([8]. The optimal from the negative solution[8], and preference order is ranked according to their relative closeness combining two distance measures[1].

General TOPSIS Process with six activities is listed below [3]

Activity 1 Establish a decision matrix for the ranking. The structure of the matrix can be expressed as follows

$$V = \begin{bmatrix} w_{11}r_{11} & \cdots & w_{1n}r_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1}r_{m1} & \cdots & w_{mn}r_{mn} \end{bmatrix}$$

Where $i=1,2,3, \ldots\ldots, m$

$j=1,2,3,\ldots\ldots,n$

Activity 2 Calculate the normalized decision matrix R(=[r_{ij}]). The normalized value r_{ij} is calculated as :

$$rij = \frac{aij}{\left[\sum_{i=1}^{M} (a_{ij})^2 \right]}$$

Activity 3 Calculate the weighted normalized decision matrix by multiplying the normalized decision matix by its associated weights. The weighted normalized value Vij is calculate as :

$V_{ij}=w_j.r_{ij}$ i=1,2,…,nj=1,2,….,m

Where wj is the relative weight of the jth criterion/attribute.

Activity 4Determine the positive ideal A^{+and} negative ideal solution A^- as below :

$$A^* = \{(\max v_{ij} / j \in J), (\min v_{ij} / j \in J), \; for i = 1,2,3,....M\} = \{v_1^*, v_2^*, ...V_N^*\}$$

$$A^- = \{(\min v_{ij} / j \in J), (\max v_{ij} / j \in J), \; for i = 1,2,3,....M\} = \{v_1^-, V_2^-, ...V_N^-\}$$

And $J=\{j=1,2,\ldots\ldots\ldots N/j$ associated with cost or negative criteria$\}$

For the benefit criteria, the decision maker wants to have the maximum value among the alternatives. Therefore, A^* indicates the positives ideal solution, similarly ,A^- indicates the positive ideal solution. Similarly, A^- indicates the negatives ideal solution.

Activity 5 Calculate separation measures this is the distance form an alternative positive ideal solution and a negative ideal solution.

Separation measures for alternative positive ideal

$$S_i^+ = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^+\right)^2}$$, whit $i = 1, 2, 3, \ldots, n$

Separation measures for alternative negative ideal

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2}$$, whit $i = 1, 2, 3, \ldots, n$

Activity 6 Calculate relative closeness to the solution ideal. The relative closeness of the alternative A_{ij} whit respect to A^* is defined as follows

$$C_i = \frac{S_i^-}{S_i^- + S_i^+}$$, whit $0 < C_i < 1$ and $i = 1, 2, 3, \ldots, m$

III. RESULTS AND DISCUSSION

To determine customer satisfaction on the quality of service at the PT, Bank Central Asia, TBK Pekanbaru, used some criteria that is Focus to costumer, solution provided to costumer, accuracy in conveying various information, service time, and can explain the various information.

While the data that is proposed to determine customer satisfaction on the quality of service can be seen in the following in table 3.

Table 3. Table Criteria, Weight, and Value

Criteria	Weight	Value
N1	5	Excellent
	4	Very Good
	3	Good
	2	Average
	1	Poor
N2	5	Excellent
	4	Very Good
	3	Good
	2	Average
	1	Poor
N3	5	Excellent
	4	Very Good
	3	Good
	2	Average
	1	Poor
N4	5	Excellent
	4	Very Good

	3	Good
	2	Average
	1	Poor
N5	5	Excellent
	4	Very Good
	3	Good
	2	Average
	1	Poor

Table criteria made on the results of interviews with the bank

3.1 Discussion With AHP Methods

Determination Of Criteria Weights

The pair wise comparison matrix of five criteria with respect the overall objective of the problem is given in table.4

Table 4. Pair wise Comparison Matrix of Criteria with Respect to Objective

Criteria	**N1**	**N2**	**N3**	**N4**	**N5**
N1	1	0.5	0.25	0.125	0.0625
N2	5	1	0.5	0.25	0.125
N3	4	3	1	0.3333	0.25
N4	8	4	2	1	0.2
N5	16	8	4	2	1
Tot	**34**	**16.5**	**7.75**	**3.7083**	**1.6375**

Table 5. Priority Criteria and Criteria Values

Criteria	**N1**	**N2**	**N3**	**N4**	**N5**	**EF**
N1	0.029411765	0.03030303	0.032258065	0.033708168	0.038167939	0.032769793
N2	0.147058824	0.060606061	0.064516129	0.067416336	0.076335878	0.083186645
N3	0.117647059	0.181818182	0.129032258	0.08987946	0.152671756	0.134209743
N4	0.235294118	0.242424242	0.258064516	0.269665345	0.122137405	0.225517125
N5	0.470588235	0.484848485	0.516129032	0.539330691	0.610687023	0.524316693
Tot	1	1	1	1	1	1

Table 6 . Pair wise Comparison Matrix of Criteria N1

AlT	B1	B2	B3	B4	B5	B6	B7	B8
B1	1	0.5	0.3333	0.3333	0.25	0.5	0.125	0.2
B2	2	1	0.125	0.5	0.3333	0.2	0.5	0.25
B3	3	8	1	0.25	0.3333	0.2	0.125	0.5
B4	3	2	4	1	0.5	0.25	0.2	0.125
B5	4	3	3	2	1	0.3333	0.125	0.25
B6	2	5	5	4	3	1	0.2	0.5
B7	8	2	8	5	8	5	1	0.2
B8	5	4	2	8	4	2	5	1
Total	**28**	**25.5**	**23.4583**	**21.0833**	**17.4166**	**9.4833**	**7.275**	**3.025**

Table 7. Priority Pair wise Comparison Matrix of Criteria N1

Al	B1	B2	B3	B4	B5	B6	B7	B8	EF
B1	0.0357143	0.0196078	0.0142082	0.0158087	0.0143541	0.0527243	0.0171821	0.0661157	0.0294644
B2	0.0714286	0.0392157	0.0053286	0.0237155	0.0191369	0.0210897	0.0687285	0.0826446	0.0414110
B3	0.1071429	0.3137255	0.0426288	0.0118577	0.0191369	0.0210897	0.0171821	0.1652893	0.0872566
B4	0.1071429	0.0784314	0.1705153	0.0474309	0.0287082	0.0263621	0.0274914	0.0413223	0.0659253
B5	0.1428571	0.1176471	0.1278865	0.0948618	0.0574165	0.0351460	0.0171821	0.0826446	0.084455
B6	0.0714286	0.1960784	0.2131442	0.1897236	0.1722495	0.1054485	0.0274914	0.1652893	0.1426067
B7	0.2857143	0.0784314	0.3410307	0.2371545	0.4593319	0.5272426	0.1374570	0.0661157	0.2665598
B8	0.1785714	0.1568628	0.0852577	0.3794472	0.2296660	0.2108970	0.6872852	0.3305785	0.2823207
Tot	1	1	1	1	1	1	1	1	1

for the next step, do the same until all the criteria. so get Value Matrix table criteria with alternative this table is filled based on the value of the eigen vector of each criterion

Table 8. Value Matrix criteria with alternative

	N1	N2	N3	N4	N5
B1	0.0294644	0.1471434	0.1185676	0.1414274	0.1478525
B2	0.0414110	0.1144794	0.1272269	0.1382537	0.1018337
B3	0.0872566	0.1642530	0.1072420	0.1737615	0.1521059
B4	0.0659256	0.0836594	0.1349489	0.0994519	0.1223659
B5	0.084455	0.102737	0.1213233	0.1467141	0.177783
B6	0.1426067	0.0891458	0.1078113	0.1065988	0.0944207
B7	0.2665598	0.1581664	0.1434136	0.0880748	0.1198343
B8	0.2823207	0.1404154	0.1394664	0.1057178	0.0838036
Total	1	1	1	1	1

Table 9: The final Result

Nu	Alt	Value
1	B1	0.138534677
2	B2	0.112526964
3	B3	0.149853825
4	B4	0.113817773
5	B5	0.153898043
6	B6	0.100104454
7	B7	0.123833449
8	B8	0.107430816

Based on calculation with the AHP Methods then selected of five alternative (B5) which has the best service quality.

3.2 With TOPSIS Methods

Activity 1 Establish a decision matrix for the ranking.

Table 10. Preliminary weighted data

		Criteria				
Nu	Alt	N1	N2	N3	N4	N5
1	B1	5	3	4	2	4
2	B2	4	5	4	3	3
3	B3	3	4	5	4	2
4	B4	4	4	3	2	5
5	B5	5	2	4	3	3
6	B6	4	3	5	5	2
7	B7	3	5	3	4	4
8	B8	5	4	3	4	5

Table 11. Table Criteria and Weigh

Crit	Weigh
N1	4
N2	5
N3	4
N4	3
N5	2

Activity 2 Calculate the normalized decision matrix R(=[r_{ij}]

Table 12. Normalized Decision Matrix

Nu	Alt	Criteria				
		N1	N2	N3	N4	N5
1	B1	0.421075961	0.273861279	0.357770876	0.20100756	0.384900179
2	B2	0.336860768	0.456435465	0.357770876	0.30151134	0.288675135
3	B3	0.252645576	0.365148372	0.447213595	0.40201513	0.19245009
4	B4	0.336860768	0.365148372	0.268328157	0.20100756	0.481125224
5	B5	0.421075961	0.182574186	0.357770876	0.30151134	0.288675135
6	B6	0.336860768	0.273861279	0.447213595	0.50251891	0.19245009
7	B7	0.252645576	0.456435465	0.268328157	0.40201513	0.384900179
8	B8	0.421075961	0.365148372	0.268328157	0.40201513	0.481125224

Activity 3 the weighted normalized decision matrix by multiplying the normalized decision matrix by its associated weights

Table 13. Normalized Weighting

Nu	Alt	Criteria				
		N1	N2	N3	N4	N5
1	B1	1.684303842	1.369306394	1.431083506	0.60302269	0.769800359
2	B2	1.347443074	2.282177323	1.431083506	0.90453403	0.577350269
3	B3	1.010582305	1.825741858	1.788854382	1.20604538	0.384900179
4	B4	1.347443074	1.825741858	1.073312629	0.60302269	0.962250449
5	B5	1.684303842	0.912870929	1.431083506	0.90453403	0.577350269
6	B6	1.347443074	1.369306394	1.788854382	1.50755672	0.384900179
7	B7	1.010582305	2.282177323	1.073312629	1.20604538	0.769800359
8	B8	1.684303842	1.825741858	1.073312629	1.20604538	0.962250449

Activity 4 Determine the positive ideal A^+ And negative ideal solution A^- .

Table 14. Positive Ideal A^* and Negative Ideal A^-

Cri	N1	N2	N3	N4	N5
A^*	1.684303842	2.282177323	1.788854382	1.50755672	0.962250449
A^-	1.010582305	0.912870929	1.073312629	0.60302269	0.384900179

Activity 5 Calculate separation measures this is the distance form an alternative positive ideal solution and a negative ideal solution. Separation measures for alternative positive ideal

Table 15 Distance Positive Ideal Solution and a Negative Ideal Solution

NO	Alt	A*	A^-
1	B1	1.347795305	0.96870129
2	B2	0.867905344	1.49813928
3	B3	1.042341818	1.30727568
4	B4	1.285297757	1.13143354
5	B5	1.58580721	2.01076607
6	B6	1.131433535	1.28529776
7	B7	1.045871328	1.54492217
8	B8	0.90068997	1.40861767

Table 16 Score Of each

Alt	S
B1	0.418175141
B2	0.63318302
B3	0.556378083
B4	0.468166874
B5	0.559078298
B6	0.531833126
B7	0.596312354
B8	0.609974022

Based on the calculation results determine the best service quality in the bank with TOPSIS method, then got the second alternative (B2) that has the best service with a value of 0.63318302.

IV. CONCLUTION

From the research that has been done, it can be concluded as follows:

1. The MCDM method with a combination of AHP and TOPSIS has been appropriately used in the selection process, in this study the selection of banks that perform the best servant quality.
2. With AHP and TOPSIS method can be built a sistem decision support to assist the selection process based on criteria determined so that the calculation process can be done more effectively and efficiently.
3. By using the AHP and TOPSIS methods can help companies to make more precise decisions quickly and accurately, which has an impact on the company's progress.
4. In this study the method that is suitable for use is the TOPSIS method because it has the highest value even though it does not reach the consistency value.

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