

Analysis of determining customer priority complaints by using Analytic Hierarchy Process (AHP) techniques in PDAM Tirtauli Pematangsiantar

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Abstract

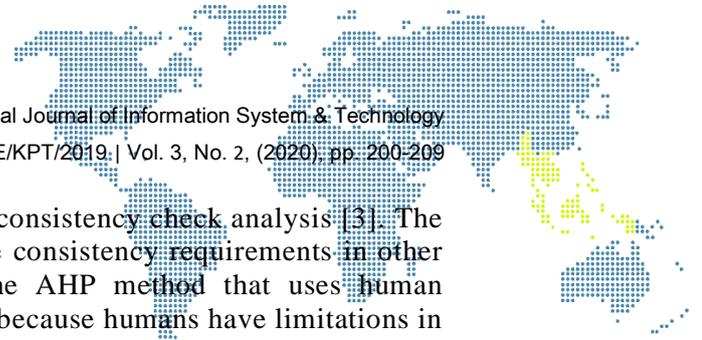
The purpose of this study is to analyze the priority determination of customer complaints by using ranking techniques in decision support systems. Data sources were obtained from PDAM Tirtauli Pematangsiantar by conducting interviews and direct observation. Data obtained directly at PDAM Tirtauli Pematangsiantar. The technique used is the AHP (Analytical Hierarchy Process) method. The assessment criteria used are: Dead Air (K1), Pipeline Damage (K2), Customer Damage Pipeline (K3) and Damage Meter (K4). The results of the study were obtained from 4 criteria, obtained "Dead Water" (K1) with a value (0.502) as the first rank, and "Service pipe damage" (K2) as the second rank.

Keywords: Decision Support System, AHP Method, Customer Complaints, Ranking.

1. Introduction

Complaints are expressions of dissatisfaction with the quality of goods and services provided to customers. These complaints can arise because of the inability to serve all customers. Companies that provide services to accommodate customer complaints and critical customer attitudes, resulting in the number of complaints received by the company increases. Increased customer complaints make it difficult for companies to deal with problems that occur. Sometimes not a few customers return with the same complaint because it has not been handled by the company. Not all complaints expressed by customers are entirely the company's fault but can occur due to negligence of the customer itself. The number of customer complaints every day makes the company overwhelmed and not all can be handled on time, especially damage complaints. As a company that provides direct services to the community, complaints are one of the issues that must be dealt with quickly and appropriately. Delay in the company's work in handling complaints, not only can harm customers but also have an impact on the company. The company may lose customers due to work delays. PDAM Tirtauli manually analyzes customer complaints, which requires a long process. If the number of complaints received is not small, the analysis and division of fieldwork can take a long time. The analysis process carried out manually will produce an inaccurate decision. For this decision making use several criteria or commonly called multi criteria. One method of multi-criteria decision support systems is the Analytical Hierarchy Process (AHP) [1]. AHP method is a functional hierarchy with the main input in the form of human perception [2]. With AHP, complex decision processes can be broken down into smaller decisions that can be handled easily [2].

Here it is necessary to determine priorities and test the consistency of the choices that have been made. The level of importance of a variable is given a numerical value, then it is synthesized to determine which variable has a high priority and plays a role in influencing the results of the system [2]. One of AHP's strengths lies



in the pairwise comparison matrix, performing a consistency check analysis [3]. The consistency check analysis does not use absolute consistency requirements in other words human perception as its input. With the AHP method that uses human perception as input, the inconsistency may occur because humans have limitations in expressing their perceptions consistently, especially when comparing many elements [3]. There are some previous researchers who used the AHP method in solving problems, namely [4] using the AHP method to determine the winner of a contractor tender. In his research using the AHP (Analyticak Hierarchy Process) method, the leader can easily and more objectively assess the performance of the contractor by setting the criteria to be assessed. [5] using the AHP method in determining the location of CCTV placement. By using the AHP method it is very easy to make a decision to place the CCTV location based on the criteria of the highest ranking. The things done in placing CCTV with the AHP method include the process of weighting each criterion from the alternative then taking a percentage value and ranking the final results. The results of AHP calculations are done manually in accordance with the results of AHP calculations using software. With the previous research using the AHP method, the authors wish to use this method because it has many advantages. One of the advantages is that AHP provides a scale in measuring things that are not realized to get priority [2]. Based on the background of determining customer priority complaints need to be resolved by utilizing the Analyticak Hierarchy Process (AHP) technique in PDAM Tirtauli Pematangsiantar so that the results of the research can provide information in handling more targeted and quality can be maintained while improving.

2. Research Methodology

2.1. Decision Support System

Decision Support System (hereinafter abbreviated as DSS) is a computer-based information system that produces various alternative decisions to assist management in dealing with various structured problems using data and models [].

2.2. Analyticak Hierarchy Process (AHP) Method

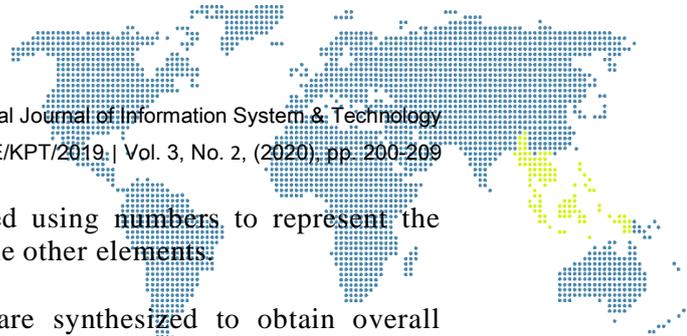
Analytical Hierarchy Process is an excellent mathematical-based procedure that is suitable for the evaluation of qualitative attributes. These attributes are mathematically quantized in a set of pairwise comparisons. The advantages of AHP compared to the others are due to the existence of a hierarchical structure, as a consequence of the selected criteria, to the most detailed sub-criteria. Take into account validity up to the tolerance limit of the inconsistencies of various criteria and alternatives chosen by decision makers.

In solving problems with the AHP method there are some basic principles that must be understood; among others:

- a) Decomposition
- b) Comparative Judgement
- c) Synthesis of Priority
- d) Logical Consistency

The steps to complete the Analyticak Hierarchy Process (AHP) method are as follows:

- a) Identify the problem and determine the desired solution, then arrange the hierarchy of the problems faced. Writing hierarchy is to set goals that are the overall system goals at the top level.
- b) Determine the priority of elements
 - 1) The first step in determining the priority of elements is to make pair comparisons, that is to compare elements in pairs according to the criteria given.



- 2) Pairwise comparison matrices are filled using numbers to represent the relative importance of one element to the other elements.
- c) Synthesis,
 Considerations of pairwise comparisons are synthesized to obtain overall priority. The things done in this step are:
 - 1) Add up the values of each column in the matrix
 - 2) Divide each value from the column by the total column in question to obtain matrix normalization.
 - 3) Add up the values of each row and divide by the number of elements to get the average value.
- d) Measuring Consistency
 In making decisions, it is important to know how good consistency is because we do not want decisions based on considerations with low consistency. The things done in this step are:
 - 1) Multiply each value in the first column with the relative priority of the first element, multiply the value in the second column with the relative priority of the second element and so on
 - 2) Add up each row
 - 3) The result of row addition is divided by the relative priority element in question
 - 4) Add up the quotient above with the number of elements present, the result is called λ_{maks}
- e) Calculate the CI Consistency Index with the formula:

$$CI = (\lambda_{maks} - n) / (n-1) \quad (1)$$
 Where n = many elements
- f) Calculate the Consistency Ratio (CR) with the formula:

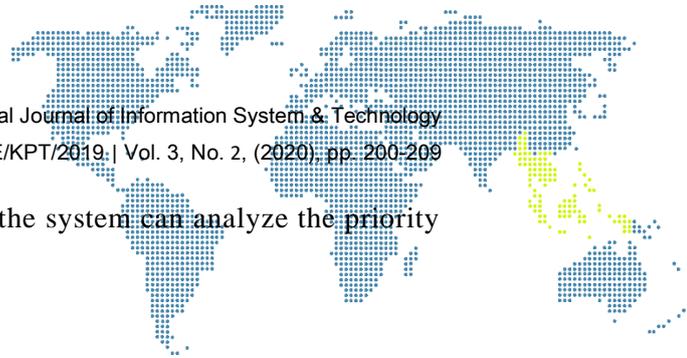
$$CR = CI / IR \quad (2)$$
 Where :
 - CR = Consistency Ratio
 - CI = Consistency Index
 - IR = Random Consistency Index
- g) Check the consistency of the hierarchy.
 If the value is more than 10%, then the judgment data judgment must be corrected. But if the consistency ratio (CI / IR) is less or equal to 0.1, then the calculation results can be declared correct.

2.3. Data source

Regional Water Supply Company (often referred to as PDAM) Tirtauli is a Regionally Owned Enterprise (often referred to as BUMD) of Pematangsiantar city that has the duty and function as a water supply service provider. In its service to meet the needs of clean water in urban communities is done through the process of collecting, processing to the distribution of clean water to customers in the city of Pematangsiantar and part of the Simalungun district. The function of PDAM in addition to profit oriented is also a social function, meaning that in addition to obtaining profits and being able to meet the costs of business continuity, it must also be able to carry out social functions in the midst of the community in accordance with the 1945 Constitution.

2.4. Proposed System Analysis

In this research, we want to make a system that can be used as a comparison in determining complaint priorities. In this case the authors propose a decision support system using AHP techniques that can be used to solve problems by comparing



customer complaint criteria so that the results of the system can analyze the priority of customer complaints.

3. Results and Discussion

3.1. Determine Criteria to Be Benchmarked

To determine the priority of customer complaints, the authors conducted a sampling technique to take data samples related to research. In this study there are 4 criteria as shown in the following table:

Table 1. Customer Complaints Criteria

No	Criteria	Information
1	K1	Dead Air
2	K2	Pipeline Damage
3	K3	Pipeline Customer Damage
4	K4	Damage Meter

Table 2. Value of Customer Complaints Criteria

Criteria	K1	K2	K3	K4
K1	5	21	29	18
K2	29	11	7	13
K3	9	2	2	27
K4	37	6	2	2

In table 2, the criterion values are obtained from data reports on complaints of dead water customers, damage to official pipes, damage to installation pipes and damage to customer meters at PDAM Tirtauli Pematangsiantar. The complaint data is then averaged.

3.2. Calculation of AHP Method

- a) Calculates the pairwise comparison matrix of each criterion. At this stage, a comparison of criteria one with other criteria is performed.

Table 3. Pairwise Comparison Matrix

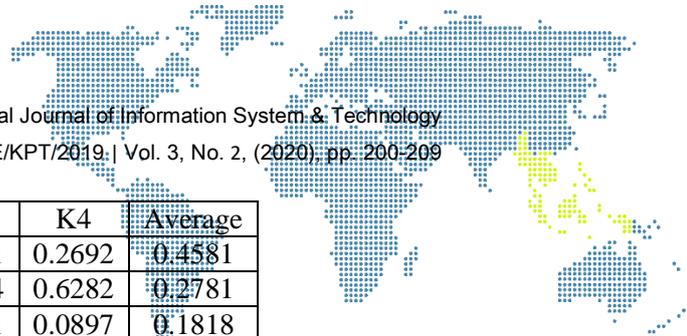
Criteria	K1	K2	K3	K4
K1	1	0.3333	0.333	0.143
K2	3	1	5	3
K3	3	0.200	1	7
K4	7	0.2	0.143	1
Amount	14	1.733	6.476	11.143

The number 1 in the dead water column (K1) and the row in the dead water (K1) means that the level of importance is the same between the criteria, while the number 3 in the dead water column (K1) and the Service Pipe Damage row (K2) means that the importance of the pipe Damage (K2) services are slightly more important than dead water and the other figures are obtained in the same way [1].

- b) Make a Criteria Value Matrix. The matrix value is obtained from normalization by the formula $w_j = \frac{1}{n} \sum_j a_{ij}$ (normalization = row value / number of each criterion). Can be seen in the table below:

Table 4. Normalization Matrix Between Criteria

Criteria	K1	K2	K3	K4	Average
K1	0.0714	0.1923	0.0515	0.0128	0.082



Criteria	K1	K2	K3	K4	Average
K2	0.2143	0.5769	0.7721	0.2692	0.4581
K3	0.2143	0.1154	0.1544	0.6282	0.2781
K4	0.5000	0.1154	0.0221	0.0897	0.1818

The value of 0.0714 in column K1 and row K1 is obtained from table 3. An example is Normalization = $1/14 = 0.0714$, and other numbers are obtained from the same method. Then the value of each criterion line is added up and divided by the number of criteria. For example: $K1 = (0.0714 + 0.1923 + 0.0515 + 0.0128) / 4 = 0.082$.

- c) Make an average matrix of each row. At this stage the comparison matrix multiplied by the average value can be seen as the table below:

Table 5. Matrix Multiplication Results

K1	K2	K3	K4	Average	Results of Multiplication
1	0.333	0.333	0.143	0.082	0.3339
3	1	5	3	0.4581	2.2309
3	0.2	1	7	0.2781	0.9339
7	0.2	0.143	1	0.1818	0.7508

After getting the average value for each criterion, the next step is to make a matrix multiplication. The value for each criterion is taken from table 4.3 and the average value is taken from table 4.4. Then each row of criteria is multiplied by the average value. For example: $K1 = ((1 * 0.082) + (0.333 * 0.4581) + (0.333 * 0.2781) + (0.143 * 0.1818)) = 0.3339$. Other values are obtained from the same method.

- d) After obtaining the results of the matrix multiplication, the next step is the calculation of the consistency ratio (CR). If the CR is greater than 0.1 then the results of the pairwise comparison matrix are not consistent.

$$\lambda = \frac{1}{4} \left(\frac{0.3339}{0.0820} + \frac{2.2309}{0.4581} + \frac{0.9339}{0.2781} + \frac{0.7508}{0.1818} \right) = 4.1074$$

$$n = (\text{jumlah kriteria})$$

$$CI = \frac{\lambda_{maksimum} - n}{n - 1}$$

$$CI = \frac{4.1074 - 4}{3} = 0.0358$$

After getting the CI value, then it is calculated by CR (Consistency Ratio), that is by sharing the CI value with the Random index, following the Random index value

Table 6. Consistency Value Index (CI)

No	Number of n (criteria)	RI _n
1	2	0
2	3	0.58
3	4	0.90
4	5	1.12
5	6	1.24
6	7	1.32
7	8	1.41
8	9	1.45

Based on the table above, we get a Random index for n which is 4, which is 0.90. $n = 4$; $RI_4 = 0.90$ then obtained $CR = 0.0358/0.90 = 0.0398$, from the results $CR \leq 0.1$, the value of the above calculation is consistent.

- e) Calculates the value in the comparison matrix for each criterion. To get a comparison value of each criterion using existing data.



Table 7. Criteria for "Dead Water" (K1)

Criteria	K1	K2	K3	K4
K1	1	5/29	5/9	5/37
K2	29/5	1	29/9	29/37
K3	9/5	9/29	1	9/37
K4	37/5	37/29	37/9	1

The values in table 7. are obtained from table 1. that is the data for each criterion. The values in the above table are specific to dead water criteria. Following is the transformation of the pairwise comparison matrix from the comparison matrix above:

Table 8. Transformation Matrix Comparison of "Dead Water" (K1)

Criteria	K1	K2	K3	K4
K1	1.0000	0.1724	0.5556	0.1351
K2	5.8000	1.0000	3.2222	0.7838
K3	1.8000	0.3103	1.0000	0.2432
K4	7.4000	1.2759	4.1111	1.0000
Amount	16.0000	2.7586	8.8889	2.1622

Transformation matrix of dead water comparison is normalization from table 7. Can be seen the value of 5.8000 obtained from 29/5 contained in row K2 and column K2 in table 7.

Table 9. Normalization Results and Average Value

Criteria	K1	K2	K3	K4
K1	0.0625	0.0625	0.0625	0.0625
K2	0.3625	0.3625	0.3625	0.3625
K3	0.1125	0.1125	0.1125	0.1125
K4	0.4625	0.4625	0.4625	0.4625

For the normalized value obtained from the row value divided by the number of each column criteria. For example: $1.0000 / 16,000 = 0.0625$. From table 9. the weights of each criterion are (0.0625; 0.3625; 0.1125; 0.4625).

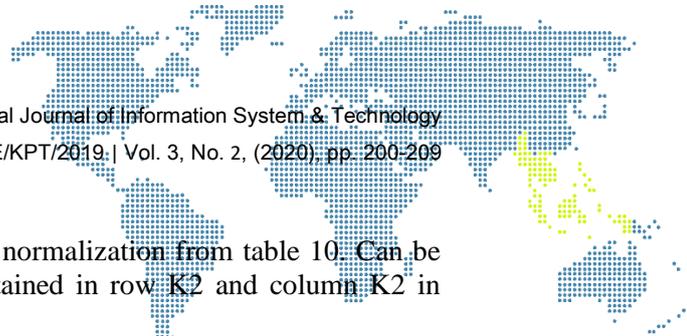
Table 10. Criteria "Service Pipe Damage" (K2)

Criteria	K1	K2	K3	K4
K1	1	21/11	21/2	21/6
K2	11/21	1	11/2	11/6
K3	2/21	2/11	1	2/6
K4	6/21	6/11	6/2	1

The values in table 10. are obtained from table 1. that is the data for each criterion. The values in the above table are specific to the service pipeline criteria. Following is the paired comparison matrix transformation of the comparison matrix above:

Table 11. Transformation Matrix Comparison of "Damage to the Pipeline Service" (K2)

Criteria	K1	K2	K3	K4
K1	1.0000	1.9091	10.5000	3.5000
K2	0.5238	1.0000	5.5000	1.8333
K3	0.0952	0.1818	1.0000	0.3333
K4	0.2857	0.5455	3.0000	1.0000
Amount	1.9048	3.6364	20.0000	6.6667



Transformation matrix of dead water comparison is normalization from table 10. Can be seen the value of 0.5238 obtained from 11/21 contained in row K2 and column K2 in table 11.

Table 12. Normalization Results and Average Value

Criteria	K1	K2	K3	K4
K1	0.5250	0.5250	0.5250	0.5250
K2	0.2750	0.2750	0.2750	0.2750
K3	0.0500	0.0500	0.0500	0.0500
K4	0.1500	0.1500	0.1500	0.1500

For the normalized value obtained from the row value divided by the number of each column criteria. Example: $1.0000 / 1.9048 = 0.5250$. From table 12. the weight values of each criterion are (0.5250; 0.2750; 0.0500; 0.1500).

Table 13. Criteria "Damage to the Customer Installation Pipe" (K3)

Criteria	K1	K2	K3	K4
K1	1	29/7	29/2	29/2
K2	7/29	1	7/2	7/2
K3	2/29	2/7	1	2/2
K4	2/29	2/7	2/2	1

The values in table 13. are obtained from table 1. that is the data for each criterion. The values in the table above are specific to the customer installation pipeline criteria. Next is the pairwise comparison matrix transformation from the comparison matrix above:

Table 14. Transformation of the Matrix "Damage to the Customer Installation Pipe" (K3)

Criteria	K1	K2	K3	K4
K1	1.0000	4.1429	14.5000	14.5000
K2	0.2414	1.0000	3.5000	3.5000
K3	0.0690	0.2857	1.0000	1.0000
K4	0.0690	0.2857	1.0000	1.0000
Amount	1.3793	5.7143	20.0000	20.0000

Transformation matrix of dead water comparison is normalization from table 13. It can be seen the value of 0.2414 is obtained from 7/29 found in row K2 and column K2 in table 13.

Table 15. Normalization Results and Average Value

Criteria	K1	K2	K3	K4
K1	0.7250	0.7250	0.7250	0.7250
K2	0.1750	0.1750	0.1750	0.1750
K3	0.0500	0.0500	0.0500	0.0500
K4	0.0500	0.0500	0.0500	0.0500

For the normalized value obtained from the row value divided by the number of each column criteria. For example: $1.0000 / 1.3793 = 0.7250$. From table 15. the weight values of each criterion are (0.7250; 0.1750; 0.0500; 0.0500).

Table 16. Criteria "Meter Damage" (K4)

Criteria	K1	K2	K3	K4
K1	1	18/13	18/27	18/2
K2	13/18	1	13/27	13/2



Criteria	K1	K2	K3	K4
K3	27/18	27/13	1	27/2
K4	2/18	2/13	2/27	1

The values in table 16. are obtained from table 1. that is the data for each criterion. The values in the above table are specific to the meter damage criteria. Next is the pairwise comparison matrix transformation from the comparison matrix above:

Table 17. Transformation of "Meter Damage" Matrix (K4)

Criteria	K1	K2	K3	K4
K1	1.0000	1.3846	0.6667	9.0000
K2	0.7222	1.0000	0.4815	6.5000
K3	1.5000	2.0769	1.0000	13.5000
K4	0.1111	0.1538	0.0741	1.0000
Amount	3.3333	4.6154	2.2222	30.0000

Transformation matrix of dead water comparison that is normalization from table 16. Can be seen the value of 0.7222 obtained from 13/18 contained in row K2 and column K2 in table 16

Table 18. Normalization Results and Average Value

Criteria	K1	K2	K3	K4
K1	0.3000	0.3000	0.3000	0.3000
K2	0.2167	0.2167	0.2167	0.2167
K3	0.4500	0.4500	0.4500	0.4500
K4	0.0333	0.0333	0.0333	0.0333

For the normalized value obtained from the row value divided by the number of each column criteria. For example: $1.0000 / 3.3333 = 0.3000$. From table 15. the weight values of each criterion are (0.3000; 0.2167; 0.4500; 0.0333).

f) Calculate the value of the multiplication of criteria weights

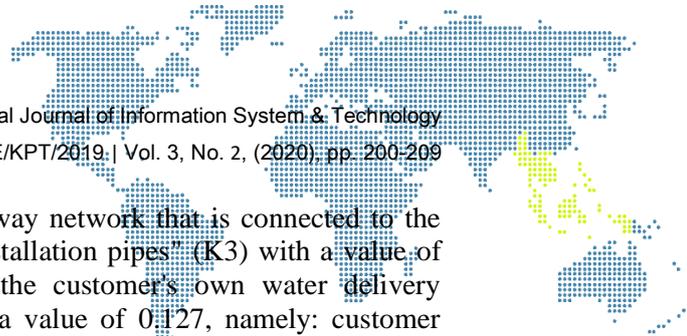
$$\begin{pmatrix} 0.063 & 0.525 & 0.725 & 0.300 \\ 0.363 & 0.275 & 0.175 & 0.217 \\ 0.113 & 0.050 & 0.050 & 0.450 \\ 0.463 & 0.150 & 0.050 & 0.033 \end{pmatrix} \begin{pmatrix} 0.0820 \\ 0.4581 \\ 0.2781 \\ 0.1818 \end{pmatrix} = \begin{pmatrix} 0.502 \\ 0.244 \\ 0.128 \\ 0.127 \end{pmatrix}$$

The value in the matrix above is obtained from the weight value of each criterion multiplied by the average pairwise comparison matrix. Example $K1 = ((0.063 * 0.0820) + (0.525 * 0.4581) + (0.725 * 0.2781) + (0.300 * 0.1818)) = 0.502$. The other values are obtained from the same method. From the matrix above, the ranking results are as follows:

Table 19. Ranking Results

No	Criteria	Final score	Information
1	K1	0.502	Rank 1
2	K2	0.244	Rank 2
3	K3	0.128	Rank 3
4	K4	0.127	Rank 4

From the results of the study can be seen in table 19 on each criterion has a final value of each. In the criterion "Dead water" (K1) produces a final value of 0.502, the criterion "Dead water" is: complaints that lead to many sub-criteria such as blocked dead water, total dead water. Criteria "Damage to official pipes" (K2) with a value of 0.244, namely:



complaint criteria that lead to damage to the waterway network that is connected to the customer pipe. Criteria for "damage to customer installation pipes" (K3) with a value of 0.128, namely damage that leads to damage to the customer's own water delivery network. The criterion "meter damage" (K4) gets a value of 0.127, namely: customer meter damage complaints such as meter jam, meter blur, meter thunder. The results of the study stated that "complaints of dead water" (K1) were ranked first.

4. Conclusion

The following conclusions can be drawn in determining the priority of the customer's customer complaints:

- a) Decision Support System determining the priority of customer complaints using the AHP (Analytical Hierarchy Process) method can be applied in solving problems so that the decisions obtained by PDAM Tirtauli Pematangsiantar become more accurate.
- b) Determining the priority of customer complaints using the AHP method has obtained results with the provisions of 4 assessment criteria, obtained "Dead Water" (K1) with a value of 0.502 as the first rank and "Damage to the official service pipe" (K2) as the second rank.

References

- [1] A. Putrama and A. P. Windarto, "Analisis dalam menentukan produk bri syariah terbaik berdasarkan dana pihak ketiga menggunakan ahp," *CESS (Journal Comput. Eng. Syst. Sci.*, vol. 3, no. 1, pp. 60–64, 2018.
- [2] D. Setiyadi, "Penilaian Kinerja Dosen Dengan Menggunakan Metode Analytic Hierarchy Process (AHP) Pada STIE Ahmad Dahlan Jakarta," vol. VIII, no. 02, pp. 1–17, 2012.
- [3] K. Yustian Servanda, "Analisis Penentuan Prioritas Media Promosi Perguruan", vol. 2, no. 2, 2018.
- [4] R. Hardianto and R. Muzawi, "Sistem Pendukung Keputusan Untuk Menentukan Pemenang Tender Kontraktor Menggunakan Metode AHP (Studi Kasus Di Dinas Pekerjaan Umum Kabupaten Agam)," 2016.
- [5] C. B. Harahap, "CCTV," Penerapan Metod. AHP Dalam Menentukan Lokasi Penempatan CCTV, vol. 4, no. 2, pp. 95–110, 2016.
- [6] D. Wira, T. Putra, and M. Epriyano, "Sistem Pendukung Keputusan Pemilihan Sepeda Motor Jenis Sport 150cc Berbasis Web Menggunakan Metode Analytical Hierarchy Process (AHP)," vol. 5, no. 2, pp. 16–24, 2017, doi: 10.21063/JTIF.2017.V5.2.16-24.
- [7] H. Nurdiyanto and H. Meilia, "Sistem Pendukung Keputusan Penentuan Prioritas Pengembangan Industri Kecil Dan Menengah Di Lampung Tengah Menggunakan Analitical Hierarchy Process (AHP) Industri Kecil Dan Menengah Di Lampung Tengah," no. April, pp. 1–7, 2016.
- [8] A. S. Teuku Mufizar, Teten Nuraen, "Sistem Pendukung Keputusan Dalam Penentuan Pertukaran Pelajar Di Sma Negeri 2 Tasikmalaya Dengan Metode Analytical Hierarchy Process (AHP)," *Sist. Pendukung Keputusan Dalam Penentuan Pertukaran Pelajar Di Sma Negeri 2 Tasikmalaya Dengan Metod. Anal. Hierarchy Process*, vol. 3, pp. 68–82, 2017.
- [9] S. Desi Ratna Sari, Agus Perdana Windarto, Dedy Hartama, "Sistem Pendukung Keputusan untuk Rekomendasi Kelulusan Sidang," *Sist. Pendukung Keputusan untuk Rekom. Kelulusan Sidang Skripsi Menggunakan Metod. AHP-TOPSIS*, vol. 6, no. November 2017, pp. 1–6, 2018, doi: 10.14710/jtsiskom.6.1.2018.1-6.



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