NASKAH PUBLIKASI *(MANUSCRIPT)*

ANALISIS PERBANDINGAN PENERAPAN AHP DAN SAW DALAM PEMILIHAN KARYAWAN TERBAIK DI SAMSAT INDUK KOTA SAMARINDA.

COMPARATIVE ANALYSIS OF THE APPLICATION OF AHP AND SAW IN THE SELECTION OF THE BEST EMPLOYEES AT THE MAIN SAMSAT OFFICE, SAMARINDA CITY.

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HALAMAN PENGESAHAN

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Comparative Analysis of the Application of AHP and SAW in the Selection of the Best Employees at the Main Samsat Office, Samarinda City.

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Abstract – **-** Employees are a supporting factor in a company or agency, because with employees who have company qualification standards, the company's productivity will be maintained and will increase. The AHP and SAW methods can be used to determine the best employees. There are 3 criteria and 16 alternatives that are given a value based on the scale of importance and weight for each criterion that has been determined by the Samarinda City Samsat Main Office which will be processed to find a sensitivity value using two methods, namely AHP and SAW. By carrying out the calculation process as much as 6 times the weight addition experiment where each weight is added to the value of 0.5 and 1 which is applied to the two AHP and SAW methods produces the sensitivity values of the two methods and uses two experiments with the first formula (XA – XB) and (XA + XB) then the sensitivity value obtained from the first trial of the AHP method is -2.592705356 and the sensitivity value of the SAW method is -4.522690058. The second experiment added the value (XA + XB) so that the results of the sensitivity values of the two methods were obtained, namely AHP 5.952672848 and SAW method 8.358567251. From the calculations of these two methods, the SAW method was chosen which is more sensitive, so the best employee with the highes score at the Samsat Main Office, Samarinda City, was A1, namely the Selvi Salamah alternative, with a priority value of 0.944444444.

Keywords: Analytical Hierarchy Process (AHP) method, Simple Additive Weighting (SAW), selection of the best employee, sensitivity, and comparison.

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1. Introduction

Employees are a supportive factor in a company or institution because with employees who meet the company's qualification standards, the company's productivity will be maintained and further improved. High employee productivity is influenced by their work enthusiasm [1]. Through this, the Central Office of Samsat in Samarinda city has taken steps to improve the quality, organizational structure, motivation, and service quality to the public. The selection of the best employees is based on Decree Number: 970/K.43/PENDA-V/2021, considering that in order to improve the quality of public services to the community, it is necessary to provide Rewards and Punishments to public service officers in the environment of UPTD PPRD Bapenda in the East Kalimantan region. Therefore, the author conducts calculations using two methods, namely the Analytical Hierarchy Process (AHP) and the Simple Additive Weighting (SAW) The method aims to determine the difference in ranking results and sensitivity values between the two methods. In addition, the comparison of these two methods aims to compare the level of accuracy of the information provided and can provide results for selecting the best employees. The AHP method has advantages such as hierarchical structure, consistency, and the ability to calculate validity up to the limit of inconsistency of various criteria and alternatives. Meanwhile, the SAW method is used because it can determine weight values for each attribute and then proceed with the calculation process. Based on the conducted research, the AHP method produces appropriate weight values for the criteria according to user needs. Additionally, the AHP method includes a consistency test function, which makes the obtained results more[2]. The SAW method (Simple Additive Weighting) is chosen because it is capable of selecting the best alternative from a number of alternatives [3]. Based on the above description, it is necessary to

compare using the two methods, Analytical Hierarchy Process (AHP) and Simple Additive Weighting (SAW), to facilitate the selection of the best employees in the Central Office of Samarinda City in a detailed and more documented manner compared to the previous subjective approach to choosing the best employees.Metode.

2. Research Stages

Samsat Induk Kota Samarinda is used to gather primary data on the mechanism of determining the best employees, criteria, and weight values of the criteria. It also includes secondary data in the form of SK NOMOR: 970/K.43/PENDA-V/2021, which contains criteria for selecting the best employees from previous selections and attendance records of 16 employees who have been selected as alternative options for selecting the best employees.

After that, a comparison calculation process is performed using the AHP and SAW methods. To determine the ranking values and sensitivity values from both methods, Microsoft Excel is used for implementation. The arrangement scenario can be seen in Figure 1.

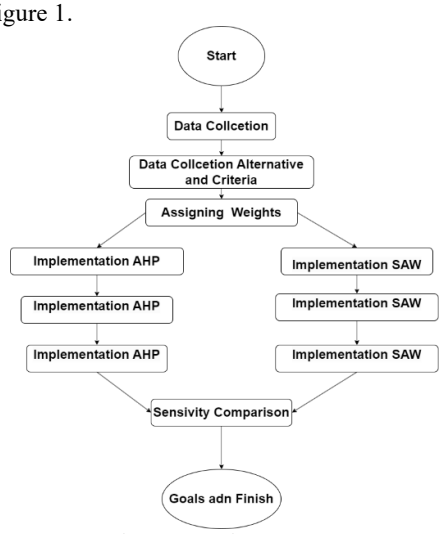

Fig. 1. Research Stages.

3. Collecting Data

The author needs sufficient data and information to support the correct description and analysis of the material when completing this thesis. Before creating this research, the authors had to conduct additional research to enhance their focus. Four data collection methods were used by the author in this research: observation, interviews, literature studies, and other literature studies. Observation.

4. Results and Merging

From the data collection process, it was found that to determine the best employee at the Head Office of Samasat in Samarinda City, the criteria used are Discipline, Sensitivity Level, and Behavior Attitude. After obtaining these criteria, the next step is to weight them using two methods.

4.1. Method AHP.

Based on [4], the research methodology of the Analytical Hierarchy Process (AHP) is a decision model developed by Thomas L. Saaty. A decision support example illustrates different or multiple complex and hierarchical systems. According to Saaty, the hierarchy is defined as a representation of a complex problem with a structured hierarchy at different levels. The first level represents the goal, followed by items, criteria, sub-criteria, and so on, until the final level. Pairwise comparisons are used to evaluate criteria and alternatives. For various issues, the scale from 1 to 9 is considered the best scale to express opinions .

1. Pairwise Comparison

Table 1.
Pairwise Comparison

C1	C2	C3
1	0,333333333	0,5
3	1	1
2	1	1
6	2,333333333	2,5

To calculate the pairwise comparison matrix (Mi), the multiplication of each element in each row of the comparison matrix is performed, as shown in Equation (1):

2. Pairwise Comparison between Normalized Criteria. The following are the results of the normalization between the three predetermined criteria.

Table 2.
Pairwise Comparison between Normalized Criteria.

Criteria	C1	C2	C3
C1	0,166666667	0,1428571	0,2
C2	0,5	0,4285714	0,4
C3	0,333333333	0,4285714	0,4
	1	1	1

This normalization process involves multiplying the values in each column by the sum of each column. For example, C1 = 1/6 = 0.166666667, and so on until C3.

3. Determination of Priority Values or Lambda (λ_max). The following are the results of the normalization between the three predetermined criteria.

Table 3.
Priority Value

Priority Value
0,16984127
0,44285714
0,38730159
1

4. The next calculation is to determine the maximum eigenvalue (λ_max), as seen in Equation (3). The subsequent calculation is to determine the Eigen Value, as shown in the following equation.

Table 4.
Eigen Value

Eigen Value
1,019047619
1,033333333
0,968253968
3,020634921

5. The next calculation is to determine the Consistency Index (CI), as shown in Equation (4).

CI	0,01031746

6. The next calculation is to determine the Consistency Ratio (CR), as shown in Equation (6).

Table 5.
Consistency Ratio

CI	0,01031746
RI	0,58
CR	0,017788725

Next, we will perform the same process to find the priority weights for each criterion. The following are the results of the weighting of pairwise comparisons between the three predetermined criteria.

1. Pairwise Priority Weight Values for Criteria.

Priority Weights of Criteria From the pairwise comparison process and successfully testing the Consistency Ratio, the values of each criterion are consistent. The following are the results of the CR (Consistency Ratio) values for each criterion comparison, as well as the values of the alternative criteria.

Table 6.
Pairwise Priority Weight Values for Criteria

DISCIPLINE	0,16984127
LEVEL OF SENSITIVITY	0,442857143
ATTITUDE	0,387301587

2. Pairwise Comparison of Priority Weights for Discipline Criterion Alternatives.

Table 7.
Discipline Criterion Alternatives

<21	0,126322751
22-24	0,457671958
>25	0,416005291

3. Pairwise Comparison of Priority Weights for Sensitivity Level Criterion Alternatives.

Table 8.
Sensitivity Level Criterion Alternatives

<10	0,089277389
11-15	0,323776224
>16	0,586946387

4. Pairwise Comparison of Priority Weights for Behavior Attitude Criterion Alternatives.

Table 9.
Behavior Attitude Criterion Alternatives

<9	0,079643685
10-15	0,264811301
>16	0,655545014

4.2. Pairwise Comparison of Alternatives for each criterion.

Pairwise Comparison of Alternatives for Discipline, Sensitivity Level, and Behavior Attitude Criteria. Where the result of the Priority Weighting for each criterion is multiplied by the Alternative Criteria values. There are sixteen alternatives and three criteria. Here are the results of the Pairwise Comparison of Alternatives with Criteria.

Table 10.
Pairwise Comparison of Alternatives for each criterion

ALTERNATIF	C1	C2	C3
A1	0,126323	0,586946	0,655545
A2	0,416005	0,323776	0,264811
A3	0,416005	0,323776	0,655545
A4	0,457672	0,323776	0,264811
A5	0,457672	0,586946	0,173596
A6	0,416005	0,323776	0,655545
A7	0,416005	0,323776	0,655545
A8	0,416005	0,323776	0,655545
A9	0,416005	0,586946	0,264811
A10	0,416005	0,323776	0,264811
A11	0,416005	0,089277	0,079644
A12	0,416005	0,586946	0,655545
A13	0,457672	0,586946	0,655545
A14	0,416005	0,323776	0,264811
A15	0,126323	0,323776	0,655545
A16	0,457672	0,323776	0,264811

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4.3. Alternative Ranking.

From the multiplication of alternative weights with criterion priority weights, the totals for each alternative are summed up to determine the ranking of each alternative. Here are the results of the ranking of the alternative values with the criteria.

Table 11.
Alternative Ranking

ALTERNATIVE	C1	C2	C3	TOTAL	Rank
A13	0,0777	0,259933	0,253894	0,59156	1
A12	0,0707	0,259933	0,253894	0,58448	2
A1	0,0215	0,259933	0,253894	0,53528	3
A5	0,0777	0,259933	0,173596	0,51126	4
A3	0,0707	0,143387	0,253894	0,46794	5
A6	0,0707	0,143387	0,253894	0,46794	6
A7	0,0707	0,143387	0,253894	0,46794	7
A8	0,0707	0,143387	0,253894	0,46794	8
A9	0,0707	0,259933	0,102562	0,43315	9
A15	0,0215	0,143387	0,253894	0,41874	10
A16	0,0777	0,143387	0,102562	0,32368	11
A4	0,0777	0,143387	0,102562	0,32368	12
A14	0,0707	0,143387	0,102562	0,3166	13
A10	0,0707	0,143387	0,102562	0,3166	14
A2	0,0707	0,143387	0,102562	0,3166	13
A11	0,0707	0,015163	0,030846	0,11666	16

4.4. Method SAW

1. In the Saw method, where the criterion weights must have a maximum total value of 1, if the table initially has a total weight of 6, normalization should be performed using the following formula. (7).

$$r_{ij} = \frac{1}{(1+3+2)} = 0{,}166667$$

$$r_{ij} = \frac{3}{(1+3+2)} = 0{,}5$$

$$r_{ij} = \frac{2}{(1+3+2)} = 0{,}33333$$

Table 12.
Method Saw

TYPE	CRITERIA	WEIGHT	
COST	K1	1	0,166666667
BENEFIT	K2	3	0,5
BENEFIT	K3	2	0,333333333
TOTAL		6	1

2. Normalization of Criteria and Alternatives.
   In this step, we determine the cost and benefit values for the criteria. From the table above, the cost value is assigned to K1 or Discipline, while the benefit values are assigned to criteria K2 (Sensitivity Level) and K3 (Behavior Attitude). To calculate the normalization values for the criteria and alternative values, we use equations (6) and (7).
3. Discipline Criterion (Cost).

   The cost value for the Discipline criterion is 21. Here is the calculation for the normalization of the Discipline criterion value.

A1 $r_{ij} = \frac{21}{21} = 1$
A2 $r_{ij} = \frac{25}{21} = 0{,}84$
A3 $r_{ij} = \frac{25}{21} = 0{,}84$
A4 $r_{ij} = \frac{24}{21} = 0{,}875$
A5 $r_{ij} = \frac{25}{21} = 0{,}9130$

4. Sensitivity Level Criterion (Benefit).

   The benefit value for the Sensitivity Level criterion is 18. Here is the calculation for its normalization.

A1 $r_{ij} = \frac{16}{18} = 0{,}88889$
A2 $r_{ij} = \frac{12}{18} = 0{,}6667$
A3 $r_{ij} = \frac{14}{18} = 0{,}77778$
A4 $r_{ij} = \frac{14}{18} = 0{,}77778$
A5 $r_{ij} = \frac{17}{18} = 0{,}94444$

5. Behavior Attitude Criterion (Benefit). The benefit value for the Behavior Attitude criterion is 19. Here is the calculation for its normalization.

A1 $r_{ij} = \frac{19}{19} = 1$
A2 $r_{ij} = \frac{12}{19} = 0{,}6315$
A3 $r_{ij} = \frac{18}{19} = 0{,}9473$
A4 $r_{ij} = \frac{14}{19} = 0{,}7368$
A5 $r_{ij} = \frac{11}{19} = 0{,}5789$

Here is the overall normalization table of the SAW method.

Table 13.
normalization table of the SAW method.

COST	BENEFIT	BENEFIT
K1	K2	K3
1	0,888888889	1
0,84	0,666666667	0,631578947
0,84	0,777777778	0,947368421
0,875	0,777777778	0,736842105
0,91304348	0,944444444	0,578947368
0,84	0,833333333	0,842105263
0,84	0,833333333	0,842105263
0,84	0,777777778	0,842105263
0,84	0,888888889	0,789473684
0,84	0,833333333	0,789473684
0,84	0,555555556	0,473684211
0,84	1	0,947368421
0,91304348	0,888888889	0,842105263
0,84	0,833333333	0,789473684
1	0,777777778	0,947368421
0,95454545	0,833333333	0,578947368

6. 2. Alternative Ranking Values.

Table 14.
Alternative Ranking Values

VALUE	RANK	CRITERIA
0,944444444	1	A1
0,683859649	14	A2
0,844678363	5	A3
0,780336257	12	A4
0,817378591	10	A5
0,837368421	6	A6
0,837368421	13	A7
0,809590643	11	A8
0,847602339	4	A9
0,819824561	8	A10
0,575672515	15	A11
0,955789474	0	A12
0,877320112	2	A13
0,819824561	17	A14
0,871345029	3	A15
0,768740032	13	A16

To calculate the ranking using formula (11).

5. Sensitivity Analysis

The first step in comparing sensitivity values is to determine the initial weights before adding values from 0.5 to 1.

Table 15.
Sensitivity Analysis

BEFORE WEIGHTS ARE CHANGED		
ALTERNATIF	**AHP**	**SAW**
A1	0,535281841	0,944444444
A2	0,316603318	0,683859649
A3	0,467935105	0,844678363
A4	0,323680037	0,780336257
A5	0,511260715	0,817378591
A6	0,467935105	0,837368421
A7	0,467935105	0,837368421
A8	0,467935105	0,809590643
A9	0,433150104	0,847602339
A10	0,316603318	0,819824561
A11	0,116663978	0,575672515
A12	0,584481891	0,955789474
A13	0,591558611	0,877320112
A14	0,316603318	0,819824561
A15	0,418735054	0,871345029
A16	0,323680037	0,768740032
MAX	0,584481891	0,944444444

Then, weights are added to one parameter with the weight increment process starting from 0.5 to 1, while the other weights remain constant. This is applied to the table below:

Table 16.
WEIGHTS INCREASED C1 (0.5)

WEIGHTS INCREASED C1 (0.5)		
ALTERNATIVE	**AHP**	**SAW**
A1	0,59844322	1,444444444
A2	0,52460596	1,103859649
A3	0,67593775	1,264678363
A4	0,55251602	1,217836257
A5	0,74009669	1,273900331
A6	0,67593775	1,257368421
A7	0,67593775	1,257368421
A8	0,67593775	1,229590643
A9	0,64115275	1,267602339
A10	0,52460596	1,239824561
A11	0,36930532	0,995672515
A12	0,79248454	1,375789474
A13	0,82039459	1,333841851
A14	0,52460596	1,239824561
A15	0,48189643	1,371345029
A16	0,55251602	1,246012759
MAX	0,82039459	1,444444444
SENSIVITY 1	-0,2359127	-0,5
SENSIVITY 2	0,99467919	0,222222222

Next, let's compare the AHP and SAW methods on the weights that have been increased by a value of 1. C1 + 1.

Table 17.
WEIGHTS INCREASED C1 (1)

WEIGHTS INCREASED C1 (1)		
ALTERNATIVE	**AHP**	**SAW**
A1	0,661604592	1,944444444
A2	0,732608609	1,523859649
A3	0,883940396	1,684678363
A4	0,781351995	1,655336257
A5	0,968932673	1,73042207
A6	0,883940396	1,677368421
A7	0,883940396	1,677368421
A8	0,883940396	1,649590643
A9	0,849155395	1,687602339
A10	0,732608609	1,659824561
A11	0,621946658	1,415672515
A12	1,000487182	1,795789474
A13	1,049230569	1,79036359
A14	0,732608609	1,659824561
A15	0,545057805	1,871345029
A16	0,781351995	1,723285486
MAX	1,049230569	1,944444444
SENSIVITY 1	-0,464748678	-1
SENSIVITY 2	1,109097176	1,916666667

Next, let's compare the AHP and SAW methods on the weights that have been increased by a value of 0.5. Wc2 + 0.5.

Table 18.
WEIGHTS INCREASED C2 (0,5)

WEIGHTS INCREASED C2 (0,5)		
ALTERNATIVE	**AHP**	**SAW**
A1	0,828755034	1,388888889
A2	0,47849143	1,017192982
A3	0,629823217	1,233567251
A4	0,485568149	1,169225146
A5	0,804733908	1,289600814
A6	0,629823217	1,254035088
A7	0,629823217	1,254035088
A8	0,629823217	1,198479532
A9	0,726623298	1,292046784
A10	0,47849143	1,236491228
A11	0,116663978	0,853450292
A12	0,877955085	1,455789474
A13	0,885031804	1,321764556
A14	0,47849143	1,236491228
A15	0,580623166	1,260233918
A16	0,485568149	1,185406699
MAX	0,885031804	1,455789474
SENSIVITY 1	-0,300549913	-0,51134503
SENSIVITY 2	1,026997793	1,672339181

Next, let's compare the AHP and SAW methods on the weights that have been increased by a value of 1. Wc2 + 1.

Table 19.
WEIGHTS INCREASED C2 (1).

WEIGHTS INCREASED C2 (1)		
ALTERNATIVE	**AHP**	**SAW**
A1	1,12222823	1,833333333
A2	0,64037954	1,350526316
A3	0,79171133	1,62245614
A4	0,64745626	1,558114035
A5	1,0982071	1,761823036
A6	0,79171133	1,670701754
A7	0,79171133	1,670701754
A8	0,79171133	1,587368421
A9	1,02009649	1,736491228

A10	0,64037954	1,653157895
A11	0,11666398	1,13122807
A12	1,17142828	1,955789474
A13	1,178505	1,766209001
A14	0,64037954	1,653157895
A15	0,74251128	1,649122807
A16	0,64745626	1,602073365
MAX	1,178505	1,955789474
SENSIVITY 1	-0,59402311	-1,011345029
SENSIVITY 2	1,17373439	1,922339181

Next, let's compare the AHP and SAW methods on the weights that have been increased by a value of 0.5. Wc3 + 0.5.

Table 20.
WEIGHTS INCREASED C3 (0,5)

WEIGHTS INCREASED C3 (0,5)		
ALTERNATIF	**AHP**	**SAW**
A1	0,863054348	1,444444444
A2	0,449008968	0,999649123
A3	0,795707612	1,318362573
A4	0,456085688	1,14875731
A5	0,511260715	1,106852276
A6	0,795707612	1,258421053
A7	0,795707612	1,258421053
A8	0,795707612	1,230643275
A9	0,565555755	1,242339181
A10	0,449008968	1,214561404
A11	0,15648582	0,81251462
A12	0,912254398	1,429473684
A13	0,919331118	1,298372743
A14	0,449008968	1,214561404
A15	0,746507561	1,34502924
A16	0,456085688	1,058213716
MAX	0,919331118	1,444444444
SENSIVITY 1	-0,334849227	-0,5
SENSIVITY 2	1,04414745	1,666666667

And finally, for criterion C3, let's compare the sensitivity of the AHP and SAW methods on the weights that have been increased by a value of 1. Wc3 + 1.

Table 21.
WEIGHTS INCREASED C3(1)

WEIGHTS INCREASED C3(1)		
ALTERNATIF	**AHP**	**SAW**
A1	1,190826855	1,944444444
A2	0,581414619	1,315438596
A3	1,123480119	1,792046784
A4	0,588491338	1,517178363
A5	0,511260715	1,39632596
A6	1,123480119	1,679473684
A7	1,123480119	1,679473684
A8	1,123480119	1,651695906
A9	0,697961405	1,637076023
A10	0,581414619	1,609298246
A11	0,196307663	1,049356725
A12	1,240026905	1,903157895
A13	1,247103625	1,719425375
A14	0,581414619	1,609298246
A15	1,074280068	1,81871345
A16	0,588491338	1,3476874
MAX	1,247103625	1,944444444
SENSIVITAS 1	-0,662621734	-1
SENSIVITAS 2	1,208033704	1,916666667

6. Results of Sensitivity Test.

Next, to calculate the change with the maximum value for each method, subtract the initial weight value from the maximal value. The results of the sensitivity values are as follows:

First Experiment, using the formula (XA-XB), obtained the following results.

Table 22.
Results of Sensitivity

Results of Sensitivity	
AHP	SAW
-2,592705356	-4,522690058

The first experiment, using the formula (XA + XB), obtained the following results.

Table 23.
Results of Sensitivity

Results of Sensitivity	
AHP	SAW
5,952672848	8,358567251

Based on the 6 experiments conducted, it is known that the highest sensitivity value is obtained in the AHP method with a sensitivity value of -2.592705356, and the SAW method with a value of -4.522690058. Therefore, the suitable method for determining the barbershop is the AHP method.

7. Discussion

In the 6 experiments, it was found that the highest sensitivity value was obtained in the AHP method with a sensitivity value of -2.592705356, and the SAW method with a sensitivity value of -4.522690058. The second highest sensitivity values were AHP 5.952672848 and SAW 8.358567251. Based on the selected method, which is the SAW method, the best employee with the highest score at the Samsat Kota Samarinda Main Office is A1, which is Selvi Salamah, with a priority value of 0.944444444.

8. Recommendations.

1. This AHP and SAW methods can be used in collaboration or comparison with other Multiple Attribute Decision Making (MADM) methods.
2. These results can be used as a reference and decision-making tool for selecting the best employee at the Samsat Kota Samarinda Main Office based on mathematical analysis.

9. References

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Wassalamu'alaikum Warahmatullahi wabarakatuh

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