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JL.Surya Kencana No.1 Pamulang, Tangerang Selatan – Banten
Telp. (021) 7412566, Fax (021) 7412491
Email : humanismanajemen@gmail.com

Website. :
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Analytic Hierarchy Process (AHP) Method for Determining the Best Employee (A Study at the Population and Civil Registration Office of South Tangerang City)

Sewaka[1)];
Iwan Setiawan[2)]; Muhammad Wahyudi[3)]; and Sri Wahyuni[4)] Yoyoh Cikayanti[5)]

Universitas Pamulang, Kota Tangerang Selatan Banten, 15310, Indonesia

Email: [a)]dosen00120@unpam.ac.id
[b)]aa.iwan.setiawan@gmail.com; [c)]omartampandanrupawan@gmail.com;
[d)]wahyunis281@gmail.com; [d)]yoyohcikayanti1997@gmail.com

Abstract: Determining the best employees is very important to increase work motivation. Selection subjectivity is a prevalent issue that might impact employee motivation. For objective assessment, this work intends to create a Decision Support System (DSS) based on the Analytical Hierarchy Process (AHP). The accuracy of the judgment is guaranteed by the test results, which indicate that the Consistency Ratio (CR) and Consistency Index (CI) values are less than 0.1.

Keywords: Best Employees, Work Motivation, Decision Support System, Analytical Hierarchy Process, Consistency Index, Consistency Ratio.

INTRODUCTION

In the era of the industrial revolution 4.0 and digital transformation 2024, the ability to make intelligentdecisions is increasingly important. Decision Support Systems (DSS) are the main tool in overcoming the complexity of business and decision making. A computer-based system called a Decision Support System (DSS) stores data, creates models, and makes reasoning to assist decision making. DSS consists of three main parts: DBMS for storing and accessing data, MBMSS for processing data into information, and DGMS to provide a user-friendly user interface. DSS is widely used in business management, healthcare, and military to solve complex problems. "*DSS supports framing, modeling, and problem solving*," [1] DSS methods, such as Fuzzy Logic, Neural Network, Machine Learning, Deep Learning, SAW, AHP, TOPSIS, and DEA, continue to evolve with new technologies.

One of the most popular techniques for multicriteria decision making is the Analytical Hierarchy Process. AHP helps decision makers sort decision alternatives byconsidering various relevant criteria or objectives. This method facilitates decision making by simplifying complex problems into more organized parts in a hierarchy. Analytical Hierarchy Process (AHP) allows to give relative weight to each criterion through pairwise comparisons that are carried out measurably but subjectively. This makes decisions made more efficient and effective. "*AHP provides the possibility for users to give relative weight values of a multiple criteria intuitively, namely by making pairwise*

comparisons"[2]

The AHP process is very important to be implemented in the Population and Civil Registration Officeof South Tangerang City because it can overcome the problem of subjectivity in determining the best employees, which is often influenced by the personal assessment of the Head of the Office. By systematically compiling assessment criteria and considering each factor through pairwise comparisons, the Analytical Hierarchy Process (AHP) allows for more objective decision making. This ensures that decisions made are clearer, fairer, and based on relevant data and criteria, thereby reducing bias and increasing accuracy when selecting the best employees.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

An approach to decision-making called the Analytical Hierarchy Procedure (AHP) integrates several interconnected criteria. By allocating numerical weights to each component according to its degree of significance, AHP can be used to arrange complicated issues in a hierarchical manner. "*AHP allows for a more objective and structured evaluation in the context of decision making involving various alternatives, which can result in more appropriate decisions."* [2] In the context of this research, AHP can be used to determine priorities and select the best alternative in situations involving multiple criteria, such as assessing organizational performance or selecting a business strategy, by measuring the value and importance of each.

Haudi (2021) asserts that the Analytical Hierarchy Process (AHP) is a technique for making efficient decisions that streamlines and expedites the process. *"AHP does this by breaking down the problem into its parts, arranging these parts or variables in a hierarchical order, assigning numerical values to subjective judgments about the importance of each variable, and synthesizing all of these judgments to determine a particular variable."* [3]

METHODS

This study uses quantitative descriptive and evaluation methodology. Three main sources, namely the Head of the Dukcapil Office of South Tangerang City Drs. H. Dedi Budiawan, MM; Secretary of the Office Hj. Dwi Suryani, M.Si; and Head of General and Personnel Affairs Zeki Yamani, were extensively interviewed. This interview's objectives were to establish criteria, prioritize tasks, and use the Analytic Hierarchy Process to guarantee the validity of the analysis results. This research is applied since its goal is to solve actual issues in the workplace.

"The goal of applied research is to solve real-world issues in the field, and the findings can be used immediately." [4] To get the best employee assessment objectively, the analysis process includes interviews to identify criteria, weighting using the Analytical Hierarchy Process (AHP), calculating consistency ratios, and ranking.

RESULT AND DISCUSSION

When applying the Analytic Hierarchy Process (AHP), the hierarchical structure is crucial for mapping and examining the several criteria that serve as the foundation for decision-making. The hierarchical structure, with priority levels divided according to pertinent criteria and sub-criteria, is depicted in **Figure 1.** The study's conclusions and analysis in this section cover the hierarchical framework that is employed to rank the best solution in order of importance. The study also discusses the validity of the data collected from interviews with key informants. The outcomes of the Analytical Hierarchy Process analysis aid in the development of suitable solutions for professional issues and offer a deeper comprehension of the elements that affect decision-making.

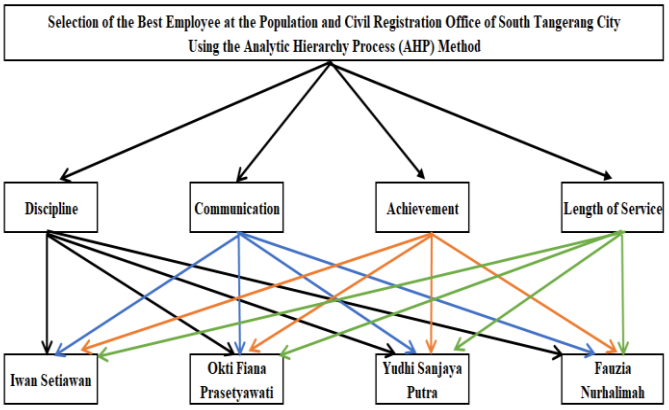

Figure 1. The AHP Method's Hierarchical Structure

Using a simple scale of paired comparisons, the Analytical Hierarchy Process method evaluates and contrasts elements in a hierarchical structure according to their relative value. **Table 1** shows a paired comparison scale used to determine the level of significance of a particular element. This scale is an extremely useful tool for figuring out which criterion and sub-criteria should be given priority during the decision-making process, based on the study's findings and discussion. By using this scale, researchers can make recommendations that are more accurate and in line with the needs of the organization.

Tabel 1. Basic Scale of Paired Comparison

Level of Interest	Meaning	An explanation
One (1)	Both aspects are equally significant.	Possess the same worth.
Three (3)	One factor is marginally more significant than the other.	One value is marginally more than the other.
Five (5)	One component is more significant than the others.	One element's value is crucial in relation to other elements.
Seven (7)	Clearly, one component is more significant than the others.	One component is significantly more significant than the other.
Nine (9)	One component is far more significant than the others.	One component is more absolute than the other.
Two (2), Four (4), Six (6) and Eight (8)	Values from neighboring considerations	Negotiation or compromise is needed

Table 2. displays the matrix of comparisons between the four criteria employed in this study. In order to ascertain the relative weight of each criterion in the Analytical Hierarchy Process analysis, a paired evaluation process was conducted, which produced this matrix. In the results and discussions of the study, this matrix is very important to show how the relationship between criteria affects each other in the decision-making process. In the matrix, each value indicates the relative importance or priority of each criterion that has been analyzed. These values are used to calculate the priority weight of each criterion. Therefore, this comparison matrix is very important to gain a better understanding of the components that form the final decision of this study and to find the most appropriate solution to the problem at hand.

Tabel 2. Comparison Matrix of 4 Criteria

Criteria	Discipline	Communication	Achievement	engths of Service
Discipline	1	0,333	0,250	0,333
Communication	3	1	0,500	0,250
Achievement	4	2	1	0,500
Length of Service	3	4	2	1

Total	11	7,333	3,750	2,083

Tabel 3. Criteria Value Matrix

Criteria	Discipline	Communication	Achievement	Length of Service	Total	Priority	Eigen Value
Discipline	0,091	0,045	0,067	0,160	0,363	0,091	0,998
Communication	0,273	0,136	0,133	0,120	0,662	0,166	1,214
Achievement	0,364	0,273	0,267	0,240	1,143	0,286	1,072
Length of Service	0,273	0,545	0,533	0,480	1,832	0,458	0,954
Total	1	1	1	1	4	1	4,238

$$\mathbf{C\ I} = \frac{\lambda max\text{-}n}{n\text{-}1} \qquad (1)$$

Information :

C I : Index of Consistency
λmax : Eigenvalue maximum of the matrix of pairwise comparisons.
n : The number of elements or criteria in the matrix.

$$C\ I = \frac{4{,}238 - 4}{4 - 1} = \frac{0{,}238}{3} = \mathbf{0{,}079}$$

Particularly in the AHP method, **Table 4.** displays the Random Index (RI) value that is utilized to gauge consistency in the pairwise comparison procedure. This RI is calculated based on the number of criteria involved in the comparison matrix, and the more criteria used, the greater the RI required to maintain consistency. In this study, the RI value used to measure consistency in pairs in the matrix is four (4).

To ensure that the comparisons made in the Analytical Hierarchy Process (AHP) analysis remain valid and reliable and to provide a solid basis for decision making, the RI value is essential.

Tabel 4. Index of randomness

The number of elements or criteria in the matrix (n)	Index of randomness (R I)
One (1)	Zero point zero zero (0.00)
Two (2)	Zero point zero zero (0.00)
Three (3)	Zero point five eight (0.58)
Four (4)	Zero point nine zero (0.90)
Five (5)	One point one two (1.12)
Six (6)	One point two four (1.24)
Seven (7)	One point three two (1.32)
Eight (8)	One point four one (1.41)
Nine (9)	One point four five (1.45)
Ten (10)	One point four nine (1.49)
Eleven (11)	One point five one (1.51)
Twelve (12)	One point four eight (1.48)
Thirteen (13)	One point five six (1.56)
Fourteen (14)	One point five seven (1.57)
Fifteen (15)	One point five nine (1.59)

With four criteria, the Random Index (RI) is equal to 0.90.

$$\mathbf{C\ R} = \frac{\mathbf{C\ I}}{\mathbf{R\ I}} \qquad (2)$$

Information :

C R : Consistencratio of consistency
C I : Index of Consistency
R I : Index of randomness

$$\mathbf{C\ R} = \frac{0{,}079}{0{,}90} = \mathbf{0{,}09\ (Consistent)}$$

Provision :

- The equality of the weight values assigned to the various criteria is known as consistency.
- The consistency of the hierarchy is acceptable if the C I / C R score is less than 10%.
- The data judgment assessment needs to be improved if the C I / C R value is more than 10%.
- A consistent matrix is one where the C R value is less than or equal to 0.1.
- The matrix is deemed inconsistent if the C R value is more than 0.1.

The evaluation of discipline sub-criteria in the organization is thoroughly examined in **Tables 5** and **6**, which employ comparison and value matrices to show the degree of discipline in many areas. **Table 5** compares several sub-criteria, namely "less discipline", "discipline", "very discipline", and "too discipline", which are calculated based on the relative relationship between the categories. The results of the comparison matrix

Tabel 5. Comparison Matrix on Discipline Sub Criteria

Sub Criteria	LessDiscipline	Discipline	Very Discipline	Too Discipline
Less Discipline	1	0,500	0,333	0,500
Discipline	2	1	0,333	0,333
Very Discipline	3	3	1	0,500
Too Discipline	2	3	2	1
Total	8	7,500	3,667	2,333

In addition, **Table 6.** produces these findings by calculating the priority value and eigenvalue of each discipline subcriteria. This provides a better understanding of how important each category is in determining the overall level of discipline. The results of this analysis will be used to determine which parts need to be improved to improve discipline in an effort to increase productivity and work effectiveness in the company.

Tabel 6. Discipline Sub-Criteria Value Matrix

Sub Criteria	Less Discipline	Discipline	Very Discipline	Too Discipline	Total	Priority	Eigen Value
Less Discipline	0,125	0,067	0,091	0,214	0,497	0,124	0,994
Discipline	0,250	0,133	0,091	0,143	0,617	0,154	1,157
Very Discipline	0,375	0,400	0,273	0,214	1,262	0,316	1,157
Too Discipline	0,250	0,400	0,545	0,429	1,624	0,406	0,947
Total	1	1	1	1	4	1	4,255

$$C\ I = \frac{4,255 - 4}{4 - 1} = \frac{0,255}{3} = 0,085$$

$$R\ I = 0,90$$

$$C\ R = \frac{0,085}{0,90} = \mathbf{0,09\ (Consistent)}$$

It is very important to assess the level of effectiveness of communication in the organization, the analysis of communication sub- criteria is presented in **Table 7.** and **Table 8.**, and **Table 7**. displays a comparison matrix between several communication categories, namely "Less Communicative", "Communicative", "Very Communicative", and "Too Communicative." The results of this matrix show a qualitative assessment of each sub-criteria in terms of communication quality.

Tabel 7. Comparison Matrix of Communication Sub-Criteria

Sub Criteria	Less Communicative	Communicative	Very Communicative	Too Communicative
Less Communicative	1	0,333	0,250	0,333
Communicative	3	1	0,500	0,250

Very Communicative	4	2	1	0,500
Too Communicative	3	4	2	1
Total	11	7,333	3,750	2,083

Table 8 expands this matrix by calculating the eigenvalues and priority values for each category. This shows how much influence each subcategory has on overall communication. The results of this analysis indicate that we now have a better understanding of how each element of communication contributes to the overall quality of organizational communication. This understanding will be used to find which areas need to be improved to enhance the quality of interactions between members of the organization.

Tabel 8. Communication Sub-Criteria Value Matrix

Sub Criteria	Less Communicative	Communicative	Very Communicative	Too Communicative	Total	Priority	Eigen Value
Less Communicative	0,091	0,045	0,067	0,160	0,363	0,091	0,998
Communicative	0,273	0,136	0,133	0,120	0,662	0,166	1,214
Very Communicative	0,364	0,273	0,267	0,240	1,143	0,286	1,072
Too Communicative	0,273	0,545	0,533	0,480	1,832	0,458	0,954
Total	1	1	1	1	4	1	4,238

$C\ I = \frac{4,238 - 4}{4\ -1} = \frac{0,238}{3} = 0,079$

$R\ I = 0,90$

$C\ R = \frac{0,079}{0,90} =$ **0,09 (Consistent)**

An important factor in assessing the quality and contribution of individual performance in the organization is the performance sub-criteria, which are thoroughly analyzed in **Tables 9** and **10**. **Table 9**. shows a comparison matrix between four performance categories, namely "Bad", "Good", "Very Good", and "Too Good", which shows the relative relationship between the sub-criteria based on the expected level of performance. This matrix shows how one performance category correlates with the other categories and shows how much performance improvement is seen in the overall context.

Tabel 9. Comparison Matrix of Achievement Sub-Criteria

Sub Kriteria	Bad	Good	Very Good	Too Good
Bad	1	0,333	0,250	0,250
Good	3	1	0,500	0,333
Very Good	4	2	1	0,500
Too Good	4	3	2	1
Total	12	6,333	3,750	2,083

The priority value and eigenvalue of each sub-criteria are then determined in **Table 10**, which

furthers the study. This displays each category's relative weight in the overall performance evaluation. The results show that we have a better understanding of the components that most influence performance achievement and which parts may need more attention to improve organizational performance more efficiently.

Tabel 10. Matrix of Sub-Criteria Achievement Values

Sub Criteria	Bad	Good	Very Good	Too Good	Total	Priority	Eigen Value
Bad	0,083	0,053	0,067	0,120	0,323	0,081	0,968
Good	0,250	0,158	0,133	0,160	0,701	0,175	1,110
Very Good	0,333	0,316	0,267	0,240	1,156	0,289	1,084
Too Good	0,333	0,474	0,533	0,480	1,820	0,455	0,948
Total	1	1	1	1	4	1	4,110

$$C\ I = \frac{4,110 - 4}{4 - 1} = \frac{0,110}{3} = 0,037$$

$$R\ I = 0,90$$

$$C\ R = \frac{CI}{RI} = \frac{0,037}{0,90} = \mathbf{0,04\ (Consistent)}$$

Tables 11 and **12** provide a comprehensive analysis of the sub-criteria of length of service, which is an important component in assessing the experience and contribution of the workforce in a company. **Table 11**. displays a comparison matrix between the categories "New", "Old", "Very Old", and "Too Long", which shows the relationship between these categories based on the length of service related to work productivity and effectiveness.

Tabel 11. Comparison Matrix on Length of Service Sub-Criteria

Sub Criteria	New	Old	Very Old	Too Long
New	1	0,333	0,500	0,333
Old	3	1	0,500	0,333
Very Old	2	2	1	0,333
Too Long	3	3	3	1
Total	9	6,333	5,000	2,000

Table 12 illustrates the additional analysis conducted by calculating the priority values and eigenvalues of each sub- criteria. This provides a relative value for each category in assessing the effect of length of service on overall performance. The results give us a better understanding of how length of service affects an individual's performance and contribution. They also indicate areas where improvements can be made to enhance employee contribution to the organization through better work experience management.

Tabel 12. Matrix of Sub-Criteria Values for Length of Service

Sub Criteria	New	Old	Very Old	Too Long	Total	Priority	Eigen Value
New	0,111	0,053	0,100	0,167	0,430	0,108	0,968
Old	0,333	0,158	0,100	0,167	0,758	0,189	1,200
Very Old	0,222	0,316	0,200	0,167	0,905	0,226	1,131
Too Long	0,333	0,474	0,600	0,500	1,907	0,477	0,953
Total	1	1	1	1	4	1	4,252

CI $= \frac{4,252 - 4}{4 - 1} = \frac{0,252}{3} = 0,084$

RI $= 0,90$

CR $= \frac{CI}{RI} = \frac{0,084}{0,90} =$ **0,09 (Consistent)**

The priority value matrix summarizing the evaluation results for the four main criteria and sixteen sub-criteria analyzed previously is presented in **Table 13.** For each criterion Discipline, Communication, Achievement, and Length of Service, a certain priority level is assigned. This priority level indicates how much influence each has on the overall assessment. In this table, a lower priority value indicates that the criterion or sub-criterion has a smaller impact on the performance evaluation. Conversely, a higher priority value indicates that the criterion or sub-criterion has a greater impact. Specifically, the criteria “Too Long”, “Too Communicative”, “Too Good”, and “Too Disciplined” were given higher priority values, indicating that higher quality in these elements tends to have a greater impact on one’s performance assessment. These results provide important insights into the most influential components in managing

Tabel 13. Four criteria and sixteen sub-criteria make up the priority value matrix.

No	Criteria/ Sub Criteria	Nilai Prioritas
1	Discipline	0,091
2	Less Discipline	0,124
3	Discipline	0,154
4	Very Discipline	0,316
5	Too Discipline	0,406
6	Communication	0,166
7	Less Communicative	0,091
8	Communicative	0,166
9	Very Communicative	0,286
10	Too Communicative	0,458
11	Achievement	0,286
12	Bad	0,081
13	Good	0,175
14	Very Good	0,286
15	Too Good	0,455
16	Length Of Service	0,458
17	New	0,108
18	Old	0,189
19	Very Old	0,226
20	Too Long	0,477

Tables 14 and **15** show the evaluation results of the four best employee candidates based on the criteria and sub-criteria of Discipline, Communication, Achievement, and Length of Service. This analysis shows the comparison of each candidate's performance, with Iwan Setiawan achieving the top position thanks to excellent assessments on the sub-criteria of Discipline and Length of Service, and Fauzia Nurhalimah taking second place, showing excellence on the sub-criteria of Discipline and Length of Service. **Table 15**. shows These results provide an in-depth overview of each candidate's strengths and weaknesses, which can help you choose the most suitable employee.

Tabel 14. Comparison Matrix of the Best Employee Choice Alternatives

Sub Criteria	Discipline	Communication	Achievement	Length of Service
Iwan Setiawan	Too Discipline	Very Communicative	Very Good	Too Long
Okti Fiana Prasetyawati	Very Discipline	Very Communicative	Good	New
Yudhi Sanjaya Putra	Discipline	Less Communicative	Good	New

Fauzia Nurhalimah	Very Discipline	Communicative	Very Good	Old

Tabel 15. Final Result Matrix of Best Employee Selection

Sub Kriteria	Discipline	Communication	Achievement	Length of Service	Total	Ranking
Iwan Setiawan	0,037	0,047	0,082	0,218	0,384	1
Okti Fiana Prasetyawati	0,029	0,047	0,050	0,049	0,176	3
Yudhi Sanjaya Putra	0,014	0,015	0,050	0,049	0,129	4
Fauzia Nurhalimah	0,029	0,027	0,082	0,087	0,224	2

The final results matrix of the best employee evaluation is created using four sub-criteria: discipline, communication, achievement, and length of service. These are based on the findings of the analysis conducted using the Analytic Hierarchy Process. The table displays the overall score for every sub-criteria.

Iwan Setiawan ranked first as the best employee with a total score of 0.384, placing him in first place. Fauzia Nurhalimah ranked second with a total score of 0.224, Okti Fiana Prasetyawati ranked third with a score of 0.176, and Yudhi Sanjaya Putra ranked fourth with a total score of 0.129.

The results show that Iwan Setiawan has a significant advantage, especially in the Length of Service sub- criteria, which contributes greatly to his total score. Meanwhile, each of the other employees also has advantages in certain sub-criteria, which are the evaluation material for further development.

CONCLUSIONS

A study on the use of Decision Support Systems based on the Analytical Hierarchy Process to identify the top workers at Tangerang City South's Population and Civil Registration Service has yielded a number of findings, including:

1. The subjectivity issue in employee evaluation, which is frequently impacted by personal opinions, has been successfully resolved using the Analytical Hierarchy Process method. AHP makes the process of choosing the top workers more methodical, unbiased, and data-driven.
2. This study produced a hierarchical structure that groups primary criteria such as discipline, communication, achievement, and length of service, as well as related criteria such as level of discipline and communication skills.
3. The Consistency Index (CI) and Consistency Ratio (CR) values in the test findings indicate that the Analytical Hierarchy Process (AHP) judgments are acceptable and consistent, with the CI value being 0.079 and the CR value being 0.09.
4. This study demonstrates how the Analytical Hierarchy Process (AHP) can be trusted to identify the most qualified staff members at the South Tangerang City Population and Civil Registration Service in order to make judgments that are more open, equitable, and grounded in objective factors. Also, this study demonstrates that AHP can lessen assessment bias resulting from subjective factors.
5. The researcher suggests that the Analytical Hierarchy Process (AHP) method continue to be applied and developed for employee assessment at the Population and Civil Registration Service of South Tangerang City. In addition, the findings of this study can be used as a reference for other institutions that want to implement an objective assessment system using AHP.

The Population and Civil Registration Service of South Tangerang City has successfully increased transparency and objectivity in the decision-making process by using DSS based on Analytical Hierarchy Process to choose the best staff.

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