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Decision Support System for Employee Performance Using AHP Method (Case Study: PT. Andhy Putra)

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ABSTRACT

The system supports the company's performance appraisal using the AHP (Case Study: PT. Andhy Putra) method, one of which is to find, select, assess and determine the best employees every year to match the abilities and assessment criteria applied so far. PT. Andhy Putra while assessing employee performance, especially in CME and OSP, still experiences shortcomings and weaknesses in determining qualified employees. This employee performance system has problems in assessing the performance appraisal data that is less accurate, which is carried out on a paper-based basis and requires less efficient time and large costs. For that, we need a decision support system in helping PT. Andhy Putra to conduct a performance appraisal every year. The method used in this employee assessment is AHP (Analytical Hierarchy Process), which is often also known as the weighting method. The process hierarchy analytical method is one of the methods used to find weight values based on existing criteria and helps facilitate the ranking of alternatives based on the distance between the positive ideal solution and the negative ideal solution. There are 5 (five) criteria as a tool to assess employee performance, namely commitment to the company, desire for achievement, cooperation, leadership and discipline accompanied by the results of the implementation of this process hierarchy method in the form of ranking the alternatives used. This decision support system is built using the PHP programming language and MySQL database.

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1. INTRODUCTION

The development of Information Technology (IT) to date has progressed very rapidly and has entered the Industrial Revolution 4.0 so that computer media is one that has an important role in data processing because it can produce accurate, precise and efficient information. Accurate means that the information produced is free from errors and can reflect the intent and purpose so that it can produce a computerized information system. Human Resources (HR) is one of the factors to

increase the productivity of the performance of an organization or agency. The development of information technology will have an impact in various fields, one of which is in improving the quality of employee performance based on the characteristics that underlie a person and relates to the effectiveness of individual performance at work. Therefore, it is necessary for Human Resources who have high competence to improve employee performance, especially at PT. Andy Putra.

PT. Andhy Putra during the evaluation of employee performance, especially in the CME and OSP fields, still experienced shortcomings and weaknesses in determining qualified employees. The employee performance appraisal system has experienced problems in processing employee performance appraisal data which is less accurate because it is still done on a paper-based basis and requires less efficient time and large costs. So that the employee performance assessment conducted by PT. Andhy Putra is considered less effective, accurate and efficient. For that, in helping the PT. Andhy Putra in assessing the best and quality employee performance requires a decision support system.

In the decision support system there are many algorithms used, one of which is the AHP method. The AHP method can help decision makers on the weighting of the established criteria. Each criterion and its weight will be hierarchically structured to perform calculations that can facilitate decision making based on the priorities set. AHP is a decision support model developed by Thomas L. Saaty, which describes complex multi-factor or multi-criteria problems into a hierarchy, meaning as a representation of a complex problem in a multi-level structure where the first level is the goal and is followed by factor level, criteria, sub-criteria and so on down to the last level of the alternative [1]. Employee performance appraisal is based on the characteristics that underlie a person and is related to the effectiveness of individual performance in work and can predict behavior and performance in a broad sense in all situations and jobs tasks [2].

This study aims to determine how to apply the AHP method in assessing employee performance based on the characteristics that underlie a person and relate to the effectiveness of individual performance in his work and how to design and build a decision support system for employee performance appraisal using the AHP method.

Literature review is a form of review or review of several previous research sources related to the title of the research being discussed, having similarities to the object or problem being studied, which will be used as a reference in research. The previous research journal used in this study was the Design of Employee Performance Assessment Based on Spencer's Competence with the Analytitcal Hierarchy Process Method (Case Study at the Irrigation Sub-Department, Public Works Service, Probolinggo City), this study focused on evaluating employee performance using the AHP method on Expert Choice 2000 application programming language. Assessment criteria include discipline, service, achievement, proactive, commitment to the organization, leadership, and cooperation [3]. Employee Performance Assessment Decision System Using Analytitcal Hierarchy Process Method. This study uses the criteria variables used include attitudes, attendance, skills, and discipline. The test results of the system that was built stated that the AHP method was very feasible to be applied to employee performance appraisal [4]. Employee Performance Assessment Decision Support System Using the AHP Method, this study focuses on evaluating employee performance by having three assessment criteria, namely work productivity, work attitude and managerial [5]. Decision Support System for Employee Performance Assessment Using the AHP Method. This study uses 6 criteria that will be tested with a limited number of employees who will be assessed for their work performance to only 5 employees. The AHP method is feasible to be applied to employee performance appraisal[6]. Decision Support System for Employee Performance Assessment Using the Analytic Hierarchy Process (AHP) method, in this study the criteria used in evaluating employee performance in this study are quality, quantity, task execution, responsibility, and ability criteria. The AHP method is feasible to be applied for employee performance appraisal [7]. Design and Build a Decision Support System for Employee Performance Assessment Using Desktop-Based AHP Method at PDAM Madiun Regency. This research focuses on evaluating employee performance with a system development model in the form of a waterfall model. The system built is very suitable for use in

PDAM Madiun district [8]. Analysis and Design of Decision Support Systems for Employee Performance Assessment with the Analytical Hierarchy Process (AHP) Method. This study uses assessment criteria in the form of work results, work mastery, work attitudes, discipline and supporting criteria [9]. Design of Decision Support System for Employee Performance Assessment at LPK Alfabank Semarang Using the Analytical Hierarchy Process (AHP) method. This study uses a system development method in the form of System Development Lyfe Cycle (SDLC) with the criteria used are expertise, work performance, discipline, personality and managerial skills [10]. Employee Performance Analysis and Assessment at Mining Company Dump Truck Operators Using AHP Method and Rating Scale (Case study: PT. Pama Indo Mining), the criteria used are ability and knowledge, safety, productivity, and attitude [11]. As for the last research entitled Decision Support Analysis of Job Performance Assessment Based on Work Targets and Work Behavior of Education Personnel, the assessment criteria used are quantity, quality, time and cost [12].

2. RESEARCH METHOD

2.1 Research Framework

This research method consists of a research framework, which is a description of how it works and the steps for conducting research, while the framework of this research includes:

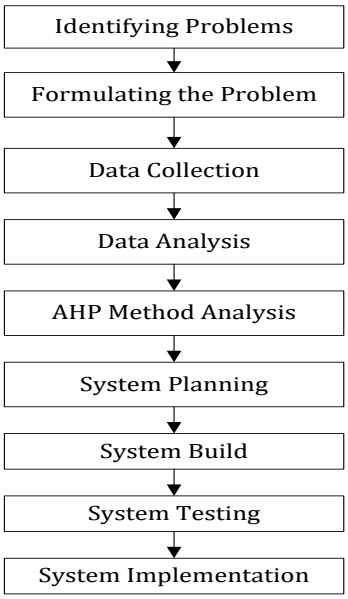

Figure 1. Research Framework

2.2 Description of the Framework

The description of the framework is a further explanation regarding the description of the process of the research framework carried out, along with the explanation:

a. Identifying Problems
   The main problem faced is the lack of motivation of employees in improving their performance and the inaccurate results of employee performance appraisals so far conducted by PT. Andy Putra
b. Formulating the Problem
   Formulate the problem of asking several things related to employee performance appraisal.
c. Data Collection
   Methods of data collection is done by observation or direct observation to PT. Andy Putra. In addition to direct observation, interviews were also conducted with parties related to this

research. The speakers at the time of this interview were Mr. Surya Dharma Tanjung, S. Psi as HRD Manager at PT. Andy Putra.

d. Data Analysis
After obtaining data regarding employee performance appraisals, then data analysis is carried out so that the data can be easily utilized.

e. AHP Method Analysis
The analysis stage of the AHP method is the stage for processing data using the analytical hierarchy process method. At this stage solving an uncomplicated and unstructured situation into several components in a hierarchical arrangement, by giving subjective values about the relative importance of each variable, and determining which variable has the highest priority in order to obtain the results of employee performance appraisals at PT. Andy Putra.

f. System Planning
The proposed system design uses UML (Unified Modeling Language), interface design, input design and output design.

g. System Build
The program used to create the system is using the PHP programming language and MySQL database

h. System Testing
System testing is carried out to assess whether the system that has been made is in accordance with what is expected, is an activity to evaluate the advantages and disadvantages of the system

i. System Implementation
System implementation is the procedure carried out to complete the design that is in the document, namely the approved system design and test, install, start, and use the new system or the repaired system.

3. RESULT AND DISCUSSION

In designing a decision support system for evaluating employee performance at PT. Andhy Putra is done by applying the AHP method.

3.1 AHP Method Calculation

a. Determining Alternative Variables

Table 1.
Alternative

Code	Alternative
A1	Ir. Maralus Silitonga
A2	Apri Lesamana Bukit, SH
A3	Lamhot Silalahi, S.T
A4	Parlin Sitorus, S.SP
A5	Faduhusi Gulo, SH

b. Define Criteria

Table 2.
Criteria

Code	Criteria
C1	Komitmen Pada Perusahaan
C2	Keinginan Berprestasi
C3	Kerja Sama
C4	Memimpin
C5	Disiplin

c. Define the Hierarchy

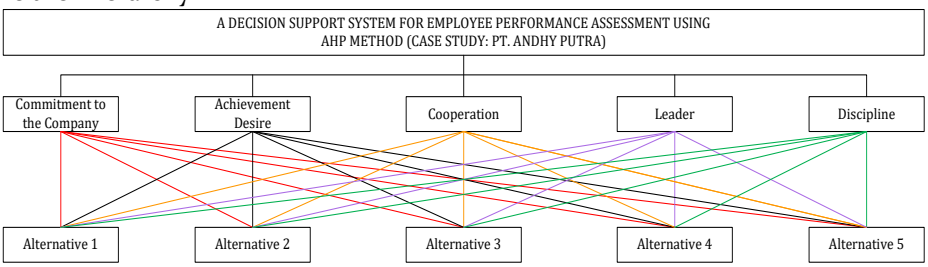

Figure 2. Define the Hierarchy

d. Criteria Paired Comparison Matrix

Table 3
Criteria paired comparison matrix

Criteria	C1	C2	C3	C4	C5
C1	1	3.0000	2.0000	3.0000	2.0000
C2	0.3333	1	2.0000	2.0000	2.0000
C3	0.5000	0.5000	1	2.0000	2.0000
C4	0.3333	0.5000	0.5000	1	2.0000
C5	0.5000	0.5000	0.5000	0.5000	1
Amount	**2.6667**	**5.5000**	**6.0000**	**8.5000**	**9.0000**

e. Normalization and Prioritization of Criteria

Table 4.
Normalization and prioritization of criteria

Comparison	C1	C2	C3	C4	C5	Amount	Priority
C1	0.3750	0.5455	0.3333	0.3529	0.2222	**1.8290**	**0.3658**
C2	0.1250	0.1818	0.3333	0.2353	0.2222	**1.0977**	**0.2195**
C3	0.1875	0.0909	0.1667	0.2353	0.2222	**0.9026**	**0.1805**
C4	0.1250	0.0909	0.0833	0.1176	0.2222	**0.6391**	**0.1278**
C5	0.1875	0.0909	0.0833	0.0588	0.1111	**0.5317**	**0.1063**

$$C1.1=\frac{C1.1}{Ttl.column1}=\frac{1}{2.6667}=0.3750$$

$$C1.2=\frac{C1.2}{Ttl.column1}=\frac{0.3333}{2.6667}=0.1250$$

$$C1.3=\frac{C1.3}{Ttl.column1}=\frac{0.5000}{2.6667}=0.1875$$

$$C1.4=\frac{C1.4}{Ttl.column1}=\frac{0.5000}{2.6667}=0.1250$$

$$C1.5=\frac{C1.5}{Ttl.column1}=\frac{0.5000}{2.6667}=0.1875$$

$$C2.1=\frac{C2.1}{Ttl.column1}=\frac{0.3000}{5.5000}=0.5455$$

$$C2.2=\frac{C2.2}{Ttl.column1}=\frac{1}{5.5000}=0.1818$$

$$C3.4=\frac{C3.4}{Ttl.column1}=\frac{0.5000}{6.0000}=0.0833$$

$$C3.5=\frac{C3.5}{Ttl.column1}=\frac{0.5000}{6.0000}=0.0833$$

$$C4.1=\frac{C4.1}{Ttl.column1}=\frac{3.0000}{8.5000}=0.3529$$

$$C4.2=\frac{C4.2}{Ttl.column1}=\frac{2.0000}{8.5000}=0.2353$$

$$C4.3=\frac{C4.3}{Ttl.column1}=\frac{2.0000}{8.5000}=0.2353$$

$$C4.4=\frac{C4.4}{Ttl.column1}=\frac{1}{8.5000}=0.1176$$

$$C4.5=\frac{C4.5}{Ttl.column1}=\frac{0.5000}{8.5000}=0.0588$$

$$C5.1=\frac{C5.1}{Ttl.column1}=\frac{2.0000}{9.0000}=0.2222$$

$$C2.3=\frac{C2.3}{Ttl.column1}=\frac{0.5000}{5.5000}=0.0909 \qquad C5.2=\frac{C5.2}{Ttl.column1}=\frac{2.0000}{9.0000}=0.2222$$
$$C2.4=\frac{C2.4}{Ttl.column1}=\frac{0.5000}{5.5000}=0.0909 \qquad C5.3=\frac{C5.3}{Ttl.column1}=\frac{2.0000}{9.0000}=0.2222$$
$$C2.5=\frac{C2.5}{Ttl.column1}=\frac{0.5000}{5.5000}=0.0909 \qquad C5.4=\frac{C5.4}{Ttl.column1}=\frac{2.0000}{9.0000}=0.2222$$
$$C3.1=\frac{C3.1}{Ttl.column1}=\frac{2.0000}{6.0000}=0.0333 \qquad C5.5=\frac{C5.5}{Ttl.column1}=\frac{1}{9.0000}=0.1111$$
$$C3.2=\frac{C3.2}{Ttl.column1}=\frac{2.0000}{6.0000}=0.0333$$
$$C3.3=\frac{C3.3}{Ttl.column1}=\frac{1}{6.0000}=0.1667$$

To determine the priority of the criteria, the number of rows in each column in the criteria is summed first, namely:

1) TotalC1 = C1.1+C1.2+C1.3+C1.4+C1.5= 0.3750+0.5455+0.3333+0.3529+0.2222= **1.8290**
2) TotalC2 = C2.1+C2.2+C2.3+C2.4+C2.5= 0.1250+0.1818+0.3333+0.2353+0.22222 = **1.0977**
3) TotalC3 = C3.1+C3.2+C3.3+C3.4+C3.5= 0.1875+0.0909+0.1667+0.2353+0.2222 = **0.9026**
4) TotalC4 = C1.4+C4.2+C4.3+C4.4+C4.5= 0.1250+0.0909+0.0833+0.1176+0.2222 = **0.6391**
5) TotalC5 = C5.1+C5.2+C5.3+C5.4+C5.5= 0.1875+0.0909+0.0833+0.0588+0.1111 = **0.5317**

From the calculation result above, it can be obtained the priority value of the criteria (eigen value), where n (number of criteria) = 5, namely:

1) *Eigen Value* C1 = $\frac{TotalC1}{n} = \frac{1.8290}{5} = 0.3658$
2) *Eigen Value* C2 = $\frac{TotalC2}{n} = \frac{1.0977}{5} = 0.2195$
3) *Eigen Value* C3 = $\frac{TotalC3}{n} = \frac{0.9026}{5} = 0.1805$
4) *Eigen Value* C4 = $\frac{TotalC4}{n} = \frac{0.6391}{5} = 0.1278$
5) *Eigen Value* C5 = $\frac{TotalC5}{n} = \frac{0.5317}{5} = 0.1063$

f. Create the Addition Matrix of Each Row

Table 5.
The addition matrix of each row

SUM	C1	C2	C3	C4	C5	Amount
C1	0.3658	0.6586	0.3610	0.3835	0.2127	1.9816
C2	0.1219	0.2195	0.3610	0.2556	0.2127	1.1708
C3	0.1829	0.1098	0.1805	0.2556	0.2127	0.9415
C4	0.1219	0.1098	0.0903	0.1278	0.2127	0.6624
C5	0.1829	0.1098	0.0903	0.0639	0.1063	0.5532

$C_{1.1} = C_{1.1} * TotalRowC_1 = 1 * 0.3658 = 0.3658$
$C_{2.1} = C_{1.2} * TotalRowC_1 = 0.3333 * 0.3658 = 0.1219$
$C_{3.1} = C_{1.3} * TotalRowC_1 = 0.5000 * 0.3658 = 0.1829$
$C_{4.1} = C_{1.4} * TotalRowC_1 = 0.3333 * 0.3658 = 0.1219$
$C_{5.1} = C_{1.5} * TotalRowC_1 = 0.5000 * 0.3658 = 0.1829$
$C_{2.1} = C_{2.1} * TotalRowC_1 = 3.0000 * 0.2195 = 0.6586$
$C_{2.2} = C_{2.2} * TotalRowC_2 = 1 * 0.2195 = 0.2195$
$C_{3.2} = C_{2.3} * TotalRowC_2 = 0.5000 * 0.2195 = 0.1098$
$C_{4.2} = C_{2.4} * TotalRowC_2 = 0.5000* 0.2195 = 0.1098$
$C_{5.2} = C_{2.5} * TotalRowC_2 = 0.5000 * 0.2195 = 0.1098$
$C_{1.3} = C_{3.1} * TotalRowC_3 = 2.0000 * 0.1805 = 0.3610$
$C_{2.3} = C_{3.2} * TotalRowC_3 = 2.0000 * 0.1805 = 0.3610$

$C_{3.3} = C_{3.3} * TotalRowC_3 = 1 * 0.1805 = 0.1805$
$C_{4.3} = C_{3.4} * TotalRowC_3 = 0.5000* 0.1805 = 0.0903$
$C_{5.3} = C_{3.5} * TotalRowC_3 = 0.5000 * 0.1805 = 0.0903$
$C_{1.4} = C_{4.1} * TotalRowC_4 = 3.0000 * 0.1278 = 0.3835$
$C_{2.4} = C_{4.2} * TotalRowC_4 = 2.0000 * 0.1278 = 0.2556$
$C_{3.4} = C_{4.3} * TotalRowC_4 = 2.0000 * 0.1278 = 0.2556$
$C_{4.4} = C_{4.4} * TotalRowC_4 = 1* 0.1278 = 0.1278$
$C_{5.4} = C_{4.5} * TotalRowC_4 = 0.5000 * 0.1278 = 0.0639$
$C_{1.5} = C_{5.1} * TotalRowC_5 = 2.0000 * 0.1063 = 0.2127$
$C_{2.5} = C_{5.2} * TotalRowC_5 = 2.0000 * 0.1063 = 0.2127$
$C_{3.5} = C_{5.3} * TotalRowC_5 = 2.0000 * 0.1063 = 0.2127$
$C_{4.5} = C_{5.4} * TotalRowC_5 = 2.0000* 0.1063 = 0.2127$
$C_{5.5} = C_{5.5} * TotalRowC_5 = 1 * 0.1063 = 0.1063$

After knowing the number of pairwise comparison matrices for each row, each row is added up on the criteria, including the following:

$TotalRowC_1 = C_{1.1} + C_{2.1} + C_{3.1} + C_{4.1} + C_{5.1} = 0.3658 + 0.6586 + 0.3610 + 0.3835 + 0.2127 =$ **1.9816**
$TotalRowC_2 = C_{1.2} + C_{2.2} + C_{3.2} + C_{4.2} + C_{5.2} = 0.1219 + 0.2195 + 0.3610 + 0.2556 + 0.2127 =$ **1.1708**
$TotalRowC_3 = C_{1.3} + C_{2.3} + C_{3.3} + C_{4.3} + C_{5.3} = 0.1829 + 0.1098 + 0.1805 + 0.2556 + 0.2127 =$ **0.9415**
$TotalRowC_4 = C_{1.4} + C_{2.4} + C_{3.4} + C_{4.4} + C_{5.4} = 0.1219 + 0.1098 + 0.0903 + 0.1278 + 0.2127 =$ **0.6624**
$TotalRowC_5 = C_{1.5} + C_{2.5} + C_{3.5} + C_{4.5} + C_{5.5} = 0.1829 + 0.1098 + 0.0903 + 0.0639 + 0.1063 =$ **0.5532**

g. Consistency Ratio Calculation
This calculation is used to ensure that the value of the consistency ratio (CR) 0.1. If it turns out that the value of CR 0.1 then the pairwise comparison matrix must be improved.

Table 6.
Consistency ratio calculation

Consistency Ratio	Amount	Priority	Results
C1	1.9816	0.3658	2.3474
C2	1.1708	0.2195	1.3903
C3	0.9415	0.1805	1.1220
C4	0.6624	0.1278	0.7903
C5	0.5532	0.1063	0.6595
	Total		**6.3095**
	Average		**1.2619**

h. Calculating Lambda Max (λmax)
To calculate the Lambda Max is to use the following equation:

Lambda *Max* = 2.3474 + 1.3903 + 1.1220 + 0.7903 + 0.6595 / 5 = **1.2169**

i. Calculating the Value of CI (Consistency Index)
To calculate the value of CI (Consistency Inde) use the following equation formula:

$$CI = \frac{(\lambda Max\text{-}n)}{(n\text{-}1)} = \frac{(1.2619\text{-}5)}{(5\text{-}1)} = \frac{-3.7381}{4} = \mathbf{-0.9345}$$

j. Calculating CR Value (Consistency Ratio)
The value of CR (Consistency Ratio) criteria by using the following formula:

$$CR = \frac{CI}{IR} = \frac{-0.9345}{1.12} = \mathbf{-0.8344}$$

So, this calculation is consistent because the value of CR ≤ 0.1

k. Alternative Pairwise Comparison Matrix
Then the next step is to calculate the weighting or analysis of the criteria for the alternative values. After calculating the criteria analysis of the alternatives, the results of the analysis of priority criteria and alternative priorities can be obtained.

Table 7.
Results of analysis of priority criteria and alternative priority values

Alternative	Criteria of Priority					The Final Results
	0.3658	0.2195	0.1805	0.1278	0.1063	
	Alternative of Priority					
	C1	C2	C3	C4	C5	
A1	0.5267	0.4635	0.4487	0.4488	0.4486	**0.4805**
A2	0.2107	0.2374	0.2547	0.2520	0.2473	**0.2337**
A3	0.1525	0.1726	0.1613	0.1602	0.1618	**0.1605**
A4	0.0690	0.0820	0.0915	0.0938	0.0933	**0.0817**
A5	0.0411	0.0446	0.0437	0.0451	0.0491	**0.0437**

Information:
Final Result Value = Priority of Each Alternative * Priority Criteria

a. The Final Result A1 =
(0.5267*0.3658)+(0.4635*0.2195)+(0.4487*0.1805)+0.4488*0.1278)+
(0.4486*0.1063) = **0.4805**

b. The Final Result A2 =
(0.2107*0.3658)+(0.2374*0.2195)+(0.2547*0.1805)+0.2520*0.1278)+
(0.2473*0.1063) = **0.2337**

c. The Final Result A3 =
(0.1525*0.3658)+(0.1726*0.2195)+(0.1613*0.1805)+0.1602*0.1278)+
(0.1618*0.1063) = **0.1605**

d. The Final Result A4 =
(0.0690*0.3658)+(0.0820*0.2195)+(0.0915*0.1805)+0.0938*0.1278)+
(0.0933*0.1063) = **0.0817**

e. The Final Result A5 =
(0.0411*0.3658)+(0.0446*0.2195)+(0.0437*0.1805)+0.0451*0.1278)+
(0.0491*0.1063) = **0.0437**

l. Ranking Results and Recommendations for Best Employee Performance
The following are the results of ranking and recommendations for the best employee performance at PT. Andhy Putra uses the AHP (Analytical Hierarchy Process) method.

Table 8.
Best employee performance rankings and recommendations

Rank	Code	Employee Name	The Final Result
1	A1	Ir. Maralus Silitonga	0.4805
2	A2	Apri Lesmana Bukit, S.H	0.2337
3	A3	Lamhot Silalahi, S.T	0.1605
4	A4	Parlin Sitorus, S.SP	0.0817
5	A5	Faduhusi Gulo, S.H	0.0437

3.2 System Design and Implementation

a. Use Case Diagram
The use case diagram on the decision support system for evaluating employee performance uses the analytical hierarchy process method at PT. Andhy Putra are as follows:

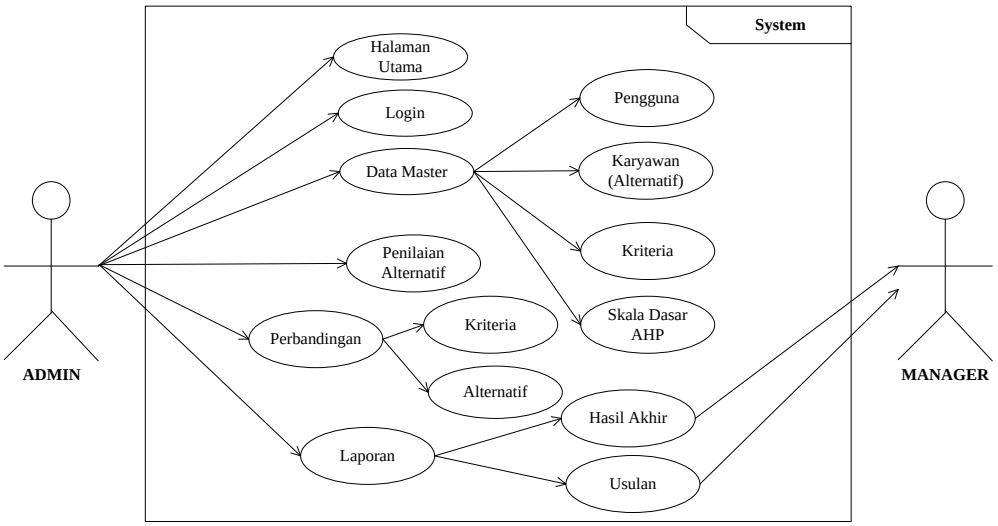

Figure 3. uses case diagram

b. Output Result

After designing the system, the system can be implemented from the results of ranking the best employee performance as shown in the following figure:

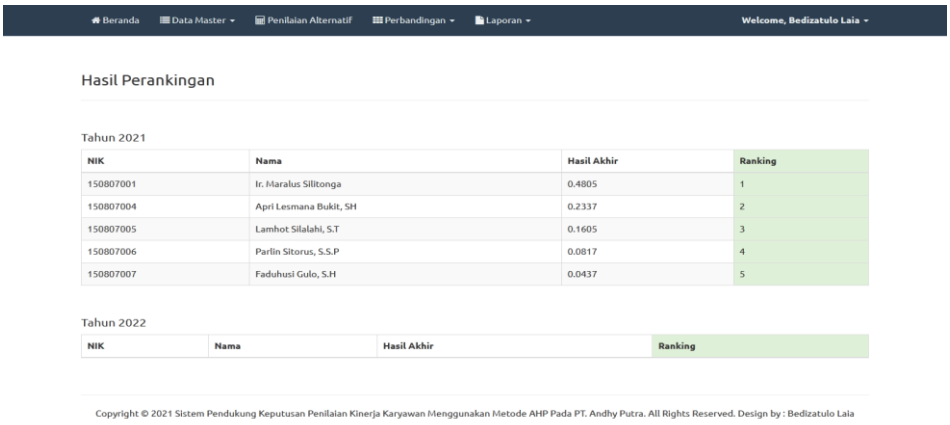

Figure 4. Output Result

4. CONCLUSION

Recruitment decision support system at PT. Andhy Putra was designed with UML (Use Case Diagram, Activity Diagram and Class Diagram) modeling, using the PHP programming language and MySQL database. By applying the AHP (Analytical Hierarchy Process) method, it can be used to build a decision support system for evaluating employee performance using the AHP method at PT. Andhy is based on the criteria for evaluating employee performance that have been determined by the company, namely commitment to the company, desire for achievement, cooperation, leadership, and discipline. From the results of system testing, it is shown that the alternative A001 on behalf of Ir. Maralus Silitonga as the first rank with a total result of 0.4805 and followed by the second rank with the alternative code A002 on behalf of Apri Lesmana Bukit, S.H with a total score of 0.2337, so that the best employee is the alternative A001 on behalf of Ir. Maralus Silitonga at PT. Andhy Putra for the period of 2021.

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