Decision Support System For Employee Performance Assessment To Determine The Status Of Reward Level Operator And Foreman Using Adaptive Neuro Fuzzy Inference System (Anfis)

Sandy Irawan [1], Judi Prajetno Sugiono [2]

[1][2] Information Technology Master Program
Institut Sains Dan Teknologi Terpadu – iSTTS, Surabaya, Indonesia
E-mail : [1] shan_classic@yahoo.com
E-mail : [2] jpsugiono@stts.edu

***Abstract*— Employees are required to have a good work ethic in order to advance their company. This causes many companies to motivate their employees in various ways. The general goal is for better and more stable employee performance so that it benefits the company. Rewards are given to employees who excel and are able to achieve certain targets, this is more effective in motivating employees than punishment so that it can be a source of motivation for employees to work optimally. In giving rewards, sometimes employees do not match the results of their performance and without applying good calculations. For that we need a recommendation system to support employee performance appraisal to get rewards. One of the methods used is the Adaptive Neuro Fuzzy Inference System (ANFIS) method. This method was chosen because it is able to complete employee performance appraisals based on predetermined criteria and is used as a reference in giving rewards. The amount of data obtained and will be used is a number of 537 employee data which will be divided into two data, namely training data which functions as a model of 524 data and test data which functions to test the system of 13 data. The training set uses a regression algorithm to form an employee performance appraisal model. This model is a representation of knowledge that will be used to predict the reward status of operator and foreman level employees.**

Keywords—employment; candidates; ANFIS; fuzzy

I. INTRODUCTION

In the world of work there is intense competition, employees are also required to have a good work ethic. This causes many companies to motivate their employees in various ways. The general goal is to make employee performance better and more stable so that it benefits the company. Reward and punishment are things used by HRD in moving employees to work together in the office. This system has long been known in the world of work.

Rewards are given to employees who excel and are able to achieve certain targets, while punishment is given to employees who make mistakes. Rewards or gifts are usually in the form of money, but there are also those who provide rewards in the form of awards, promotions and even holidays. And usually this reward is more effective to motivate employees compared to the threat of punishment or punishment. Many companies offer big rewards for their employees after they achieve certain achievements that even exceed their monthly salary. So it is not wrong for the company or HRD team to use reward and punishment, making it a source of motivation for employees to work optimally.

The same applies to PT. AAA, which is the largest integrated flour milling company in one location. In one effort to improve the performance of its employees, PT. AAA gives rewards to employees who have good performance. In giving rewards employees sometimes do not match the results of their performance. Employee rewards are often beaten flat, or sometimes the rewards are only given to them, without applying strong calculations. For this reason, it is necessary to have a recommendation system for supporting employee performance appraisal for reward. One method used is to use the Adaptive Neuro Fuzzy Inference System (ANFIS) method. This method was chosen because it is capable of completing employee performance appraisals based on predetermined criteria, which will later be used as a reference in rewarding itself. The results of the employee performance appraisal decision support system for rewarding also determine what percentage of rewards are given to each employee, so that in this study it will be proven that the ANFIS Method will have higher accuracy compared to other methods that will be applied to the decision support system employee performance appraisal recommendations to determine the status of awarding operator and foreman levels at PT. AAA.

Some research related to giving rewards to employees, among others, research conducted by Papageorgiou, et al. (2018) in his research, the fuzzy inference system (FIS) and the adaptive neuro-fuzzy inference system (ANFIS) were developed to classify the total quality of apples based on several fruit qualities, namely fruit mass, meat firmness, dissolved solid content and skin color. The FIS model was evaluated in the same farm for sequential three-year data (2005, 2006 and 2007) and showed 83.54%, 92.73% and 96.36% of the average

agreement respectively with results from human experts, whereas ANFIS provides lower prediction accuracy. The evaluation shows the advantages of the expert-based approach proposed using fuzzy sets and fuzzy logic.

Another researcher, Mandal (2018) proposes ANFIS to detect and classify images of basmadi rice grains, the results of which ANFIS has a more promising accuracy in evaluating rice quality, with a classification accuracy> 98.5% for broken and whole rice seeds, compared with standard machine learning techniques namely, supporting vector machines (SVM) and K's closest neighbors (KNN). Milling efficiency was also assessed using a ratio between head rice and percentage of broken rice and 77.27% for the test sample. Research by Cakit, et al. (2020) by applying Structural Equation Modeling (SEM) and the Adaptive Neuro-Fuzzy Inference System (ANFIS) for Safety Culture Assessment: Integrated Modeling Approach, namely to model the safety culture of the Japanese petrochemical industry. The result is SEM shows that employee attitudes toward safety, support of co-workers, work pressure, and factory safety management systems are significant factors that influence violation behavior, motivation for personnel safety, and personnel error behavior. In addition, the application of the ANFIS modeling approach shows that employee attitudes are the most critical predictors of misconduct behavior and personnel misconduct behavior, while colleague support is the most critical predictor in modeling personnel safety motivation.

From some of the studies above the use of the ANFIS method is widely used for classification and approaches. However, this research was conducted to determine the status of employees who will be given rewards based on several criteria, including input specifications including: Position, Attendance, Disciplinary, Working Period, Work Results and Creativity. Output specifications, namely, determining who has the right to receive rewards, by looking at the results of each employee's assessment weight and what percentage of each employee's salary increases, as well as the ANFIS structure used consists of at least three hidden layers along with an input layer and output layer. The training process is carried out in feedforward without backpropagation because it is indeed on ANFIS's own calculations that are one-way. Weight arises from calculations that exist in each layer is not initialized randomly at the beginning.

II. METHOD

A. System Design Analysis

This research begins with the problems that exist in the company at PT. AAA, in order to be able to solve the problem while answering the existing problems, then analyzed the existing approach using the ANFIS method as a decision support system. Following the ANFIS system design concepts that will be described as Figure 1.

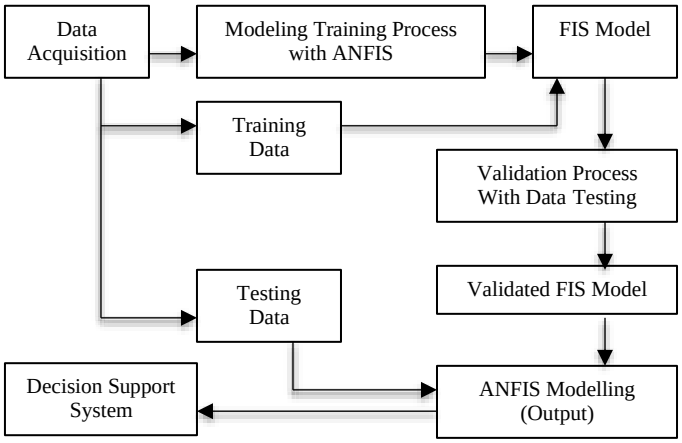

Figure 1. ANFIS System design

B. Data Acquisition

1) Sample Selection Method

The sample selection process is done by direct observation. The sample selection is based on 2019 employee data. The sample in this study is that some of the employees working at PT. AAA, so that the data collected 537 data. The following are the variables used in this study based on guidelines for determining 2019 model employees issued by the Human Resource Dept.

2) Method of collecting data

The data collection method is carried out directly by using:

- *Primary Data Primary data is a source of research data obtained directly from the original source. Primary research data obtained by observation, interviews and questionnaires. Data is recorded and collected for later data preparation.*
- *Secondary data is a source of research data obtained indirectly through intermediary media. Data obtained indirectly, for example from literature, documentation, books, journals and other information relating to achievement teachers and ANFIS.*

C. Adaptive Neuro Fuzzy Inference System

ANFIS (Adaptive Neuro Fuzzy Inference Systems) is one of the systems in the neuro fuzzy group, which is a hybrid system in soft computing. Hybrid system is the equivalent or combination of at least two soft computing methods with the aim of obtaining a more perfect algorithm.

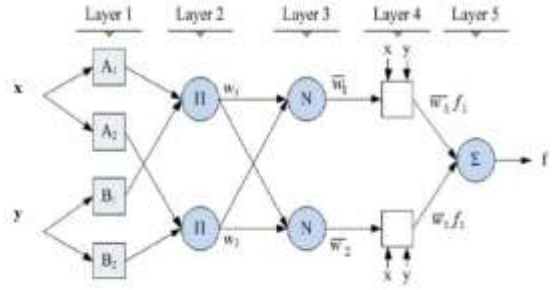

Figure 2. ANFIS Structure

The function of each layer can be explained as follows:

- *Layer one, all nodes in this layer are adaptive nodes (parameters can change) with node functions, as in the formula 1.*

$$f(x,a,b,c) = \frac{1}{1+\frac{x-c^{2b}}{a}} \quad (1)$$

with parameter b usually positive. Parameter c is located in the middle of the curve. The Gaussian membership function is stated by formula 2.

$$A(x) = e^{\frac{(x-c)^2}{2a^2}} \quad (2)$$

- *Layer two. All nodes in this layer are non-adaptive (fixed parameters). The function of this node is to multiply every incoming input signal. Node function, as in the formula 3.*

$$O_{2,1} = mA_i(x).mB_i(x) = W_i \quad (3)$$

- *Layer three, Each node in this layer is a non-adaptive node that displays the normalized firing strength function, which is the ratio of the output of the i node in the previous layer to all outputs of the previous layer, with the form of the node function as in the formula 4.*

$$O_{3,i} = \frac{W_i}{w_1 + w_2} \quad (4)$$

- *Layer four, Each node in this layer is an adaptive node with a node function, as in the formula 5.*

$$O_{4,i} = O_{3,i}(a_{4,i} = O_{3,i}(a_i x) + b_i y + g_i \quad (5)$$

- *Layer five. In this layer there is only one fixed node whose function is to add all entries. Node function, as in the formula 6.*

$$O_{5,i} = \frac{\mathrm{S} w_i y_i}{\mathrm{S}} \quad (6)$$

D. Decision Support System

Decision Support System is a system that functions to transform data and information into alternative decisions and priorities. Decision Component :

- *Alternative Decisions*
- *Decision Criteria*
- *Criteria Weight*
- *Assessment Model*
- *Decision Structure*

III. RESULT AND DISCUSSION

A. Data Collection

After the employee data collection process is carried out at PT. AAA obtained the total number of foreman and operator level employee data totaling 537 employee data. The collection process also found several attributes such as identification number, name, section, competency, discipline, date of entry, position level and department. And from the employee data collection process at PT. AAA will take most of the data or 524 employee data which will be used as training data or data modeling with the ANFIS algorithm and a small portion of data or more precisely 13 employee data that will be used as test data to test the system created.

B. System Design and Illustration

1) System Design

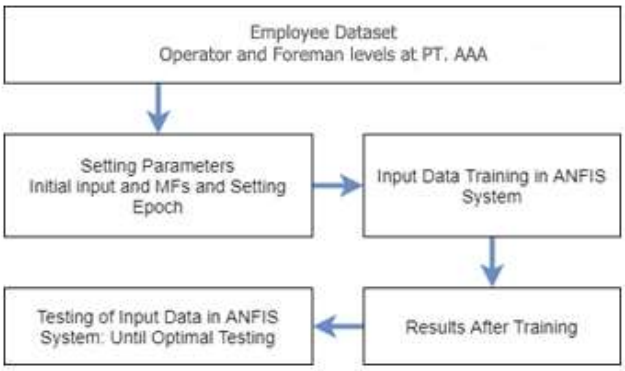

Figure 1 ANFIS system block diagram.

In the first stage is data preparation, where at this stage data collection is carried out from the staffing of the personnel obtained from PT. AAA. Then in the second stage the training stage is carried out, this stage will produce attributes which will then become input in the decision-making system stage. After conducting the data training stage in the second stage, a dataset

will be obtained which will be used as input at the modeling stage using the ANFIS algorithm. ANFIS modeling steps are as follows:

a. Provide input and output data pairs for training.
b. ANFIS trains FIS by initializing FIS, namely setting initial prices for the parameters of the membership function in the FIS. FIS initialization includes: selecting the number of membership functions (membership function), selecting the type of membership function (triangle or gaussian), selecting the number of training iterations (epoch).
c. ANFIS trains FIS by modifying the parameters of the membership function until a minimum error is obtained between the FIS output and the output training data.
d. Model validation is the FIS testing process that has been trained by ANFIS, but uses input / output data that has not been trained in FIS.

The next stage is conducting data training and then it will continue with the decision making process. In ANFIS it begins by setting initial parameters such as the number of membership functions, error goals, and epoch. Then the training and testing process is carried out until the best data model is found which will then be made a reference in the prediction process.

2) System Illustration

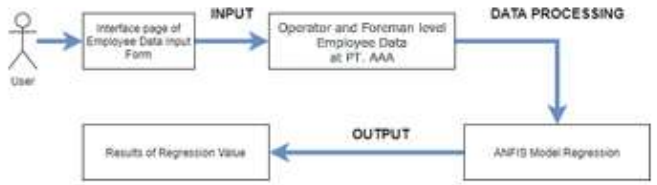

Figure 2 Illustration of performance appraisal system for employees of PT. AAA with ANFIS algorithm.

From Figure 2 it can be explained as the flow of the assessment system starting with the user inputting employee data through the program interface to be made, then the data will be processed with regression based on ANFIS modeling and the output that will be generated is an assessment based on ANFIS modeling in the form of alerts or notifications that contain the calculated value on the same page.

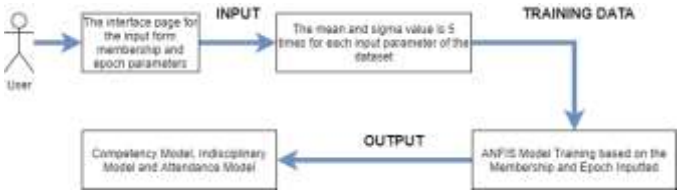

Figure 3 Illustration of modeling system with ANFIS algorithm.

From Figure 3 it can be explained as a training or modeling system flow starting with the user inputting the mean and sigma values 5 times for each input parameter, then the data will be processed with training based on ANFIS modeling and the output that will be produced is a model for assessing employee data based on competence , discipline and attendance.

Figure 4 Illustration of employee data deletion system.

From Figure 4, it can be explained as a total data deletion system flow that has been input on the assessment interface page. This aims to clean all data if there are errors in the parameters that determine employee performance assessments such as competency targets, current competencies, percentage of competencies, disciplinary targets, disciplinary, current disciplinary, disciplinary percentage, target attendance, current attendance and percentage attendance.

Figure 5 Illustration of system for determining employees who are eligible for rewards.

From Figure 5, it can be explained as a system for determining employees who deserve a reward. This is done by searching for the user to input the minimum value of performance to find employee data that has a value more than the minimum value that has been entered. After obtaining a number of employee data, it will be searched based on the highest performance value, if the highest score is more than one employee name, the employee data with the highest performance value will be searched based on the employee's longest tenure with PT. AAA. If there is more than one employee name, the employee's data with the longest tenure will be searched based on the employee's position where the foreman position is prioritized. If there is more than one employee name, the data for employees who have foreman positions will be searched based on the employee's department which is prioritized by the production department.

C. Model interpretation

1) Learning process model (Training)

In the training process or training data modeling for employee performance appraisal of PT. AAA using the ANFIS algorithm will use 524 employee data, which will create three training data models. The three training data models have different functions to assess employee performance. The three models include a competency model in which the target competency attributes and current competencies act as input data in modeling using the ANFIS algorithm, while the competency weight attribute acts as target data in modeling using the ANFIS algorithm. Furthermore, the disciplinary model in which the disciplinary, disciplinary and current disciplinary target attributes act as input data in modeling using the ANFIS algorithm, while the disciplinary weight attribute acts as target data in modeling using the ANFIS algorithm. And lastly, the presence model in which the target attendance, presence and current presence attributes act as input data in modeling using the ANFIS algorithm, while the attendance weight attribute acts as target data in modeling using the ANFIS algorithm.

2) Model validation process (Testing)

In the process of testing the test data on the training data model for the performance appraisal of employees of PT. AAA will use 13 employee data at the company. The testing process itself is carried out by inputting the performance value of each of these employees, so for example an employee named Bambang Setiawan needs to input the target competency value, current competency, disciplinary target, disciplinary, current disciplinary, target attendance, attendance and current attendance. From inputting the performance values, three weight values will be obtained, namely competency weight, disciplinary weight and attendance weight based on prediction calculations using the employee performance appraisal model of PT. AAA that has been created.

D. ANFIS System Testing Results

1) Testing Results and Data Modeling

In this employee data modeling uses 524 employee data from the total data, namely 537 employee data. The use of 524 employee data is used as training data or a basis for making ANFIS modeling for employee performance appraisals based on competency, discipline and attendance categories. In ANFIS modeling for employee performance appraisal based on competency categories, 2 columns are used as input data, namely the competency target column and current competency, and 1 column as the target data, namely the competency weight column. Since making ANFIS modeling requires a membership, membership in ANFIS modeling for performance appraisal based on competency categories can be seen in Table 1.

Table 1 ANFIS modeling membership table for employee performance appraisal based on competency attributes.

	Membership									
	M 1	S 1	M 2	S 2	M 3	S 3	M 4	S 4	M 5	S 5
Target Competency	0	1	-1	2	-4	10	-7	7	5	1
Current Competency	1	2	2	3	-2	10	-10.5	5	4	3

In ANFIS modeling for employee performance appraisal based on the disciplinary category, 3 columns will be used as input data, namely the disciplinary, indisciplinary and current indisciplinary target column, and 1 column as the target data, namely the disciplinary weight column. For making membership in ANFIS modeling for performance appraisal based on disciplinary categories can be seen in Table 2.

Table 2 ANFIS modeling membership table for employee performance appraisal based on disciplinary attributes.

	Membership									
	M 1	S 1	M 2	S 2	M 3	S 3	M 4	S 4	M 5	S 5
Target Indisipliner	0	1	-1	2	-4	10	-7	7	5	1
Indisipliner	1	2	2	3	-2	10	-10.5	5	4	3
Current Indisipliner	2	3	-1	1	4	2	-5	5	-7	7

ANFIS modeling for employee performance appraisal based on attendance category will use 3 columns as input data, namely the target attendance column, attendance and current attendance, and 1 column as the target data, namely the attendance weight column. For making membership in ANFIS modeling for performance assessment based on attendance category, it can be seen in Table 3.

Table 3 ANFIS modeling membership table for employee performance appraisal based on attendance attributes.

	Membership									
	M 1	S 1	M 2	S 2	M 3	S 3	M 4	S 4	M 5	S 5
Target Indisipliner	0	1	-1	2	-4	10	-7	7	5	1
Indisipliner	1	2	2	3	-2	10	-10.5	5	4	3
Current Indisipliner	2	3	-1	1	4	2	-5	5	-7	7

2) Employee Assessment Testing

In testing the employee performance appraisal on the system that has been created, it will use a total of 13 employee data from all employee data, namely 537 employees. To test these 13 employee data, the inputted data includes competency targets, current competencies, disciplinary targets, disciplines, current disciplines, target attendance, attendance, current attendance, joining dates, position level and workplace departments. From all employee data that is inputted, the system in the application will predict the competency weight value, the disciplinary weight value and the attendance weight value using the ANFIS modeling that has been made. After that the three weight values are added together so that the overall performance value of the employee will be obtained. To find out employee input data based on competency attributes from 13 employee data can be seen in Table 4.

Table 4 Employee input data table based on competency attributes.

Target Kompetensi	Current Kompetensi
43	29
43	29
43	20
43	22
43	23
43	23
43	27
41	31
41	31
41	18
41	18
41	18
41	18

To find out the employee input data for performance appraisal based on the disciplinary attributes of the 13 employee data, it can be seen in Table 5 where the table contains three columns or three data, namely the target column for disciplinary, disciplinary and current disciplinary.

Table 5 Employee input data table based on disciplinary attributes.

Target Indisipliner	Indisipliner	Current Indisipliner
8	0.5	7.5
8	0	8
8	3.5	4.5
8	1	7
8	0	8
8	3.5	4.5
8	1.5	6.5
8	0	8
8	1	7
8	1.5	6.5
8	0	8
8	0	8
8	0	8

To find out employee input data for performance appraisal based on attendance attributes from 13 employee data, it can be seen in Table 6, which in the table contains three columns or three inputted data, namely the target column for attendance, attendance and current attendance.

Table 6 Employee input data table based on attendance attributes.

Target Kehadiran	Kehadiran	Current Kehadiran
8	0.999495968	7.995967742
8	1	8
8	0.937247984	7.497983871
8	0.951108871	7.608870968
8	0.97328629	7.786290323
8	0.992691532	7.941532258
8	0.962701613	7.701612903
8	0.998739919	7.989919355
8	0.999495968	7.995967742
8	0.999243952	7.993951613
8	0.993447581	7.947580645
8	1	8
8	0.962701613	7.701612903

To find out the employee input data which is used as an option in the process of determining the reward of all employee data, the 13 employee data entered will also input the employee's date of joining, the position level and the employee's department category can be seen in Table 7 which in the table contains three columns or three data are inputted, namely the joining date column, position level and department category.

Table 7 The input data table for the completeness of employee data.

Tanggal Bergabung	Level Posisi	Kategori Departemen
7/1/1998	Foreman	Non Produksi
7/1/1998	Foreman	Non Produksi
9/1/1994	Operator	Non Produksi

3/1/2002	Operator	Non Produksi
6/1/2002	Operator	Non Produksi
7/1/2002	Operator	Non Produksi
7/1/2002	Operator	Non Produksi
4/1/1992	Foreman	Non Produksi
7/1/1998	Foreman	Non Produksi
7/1/1998	Operator	Non Produksi
7/1/1998	Operator	Non Produksi
12/1/2000	Operator	Non Produksi
8/1/2002	Operator	Non Produksi

The 13 employee data above will be entered one by one to test the results of employee performance calculations from the 524 employee data modeling to predict the total employee performance value which includes competency, discipline and attendance categories using the application system that has been made. Whereas for an example of the testing process of the application system on employee performance appraisal can be seen in Figure 6 as the process of inputting individual data and employee performance and Figure 7 as the result of the application system calculation process on the overall value of employee performance.

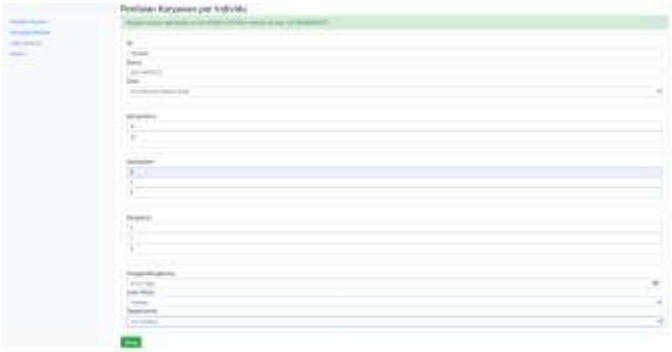

Figure 6 An example of an individual data input process

and employee performance.

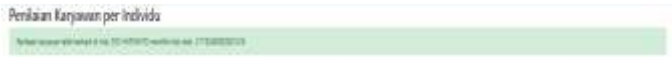

Figure 7 The results of the employee performance appraisal process.

In Table 8 and Table 9 below are the overall performance prediction calculations for the 13 employees. Predictions of employee performance appraisals based on competency categories will produce competency weight values and competency percentages which are written in decimal format instead of percent, this competency percentage value is obtained by calculating the competency weight value multiplied by the value of 40% or 0.4. For the prediction of employee performance appraisal based on the disciplinary category, it will also produce disciplinary weight values and the percentage of disciplines written in decimal format instead of percent, this disciplinary percentage value is obtained by calculating the value of disciplinary weight multiplied by a value of 20% or 0.2. As well as the prediction of employee performance appraisal based on attendance category will also produce attendance weight value and attendance percentage which in that column is written in decimal format instead of percent, this attendance percentage value is obtained by calculating the attendance weight value multiplied by the value 20% or 0.2. Meanwhile, to calculate the overall employee performance value or total weight, the process of calculating the total competency weight value, the disciplinary weight value and the attendance weight value is the sum of the competency percentage, disciplinary percentage and attendance percentage.

Table 8 Table of prediction results of employee performance based on competency and disciplinary attributes.

Bobot Kompetensi	Prosentase Kompetensi	Bobot Indisipliner	Prosentase Indisipliner
0.714482	0.285793	0.957853	0.191571
0.714482	0.285793	1.001099	0.20022
0.530884	0.212354	0.753255	0.150651
0.571982	0.228793	0.919192	0.183838
0.592349	0.23694	1.001099	0.20022
0.592349	0.23694	0.753255	0.150651
0.673772	0.269509	0.883709	0.176742
0.792407	0.316963	1.001099	0.20022
0.792407	0.316963	0.919192	0.183838
0.52062	0.208248	0.883709	0.176742
0.52062	0.208248	1.001099	0.20022
0.52062	0.208248	1.001099	0.20022
0.52062	0.208248	1.001099	0.20022

Table 9 Table of prediction results of employee performance based on the attributes of attendance and overall employee performance scores.

Bobot Kehadiran	Prosentase Kehadiran	Bobot Total	Prosentase Total
0.999658	0.199932	2.671993	0.677295
0.999665	0.199933	2.715245	0.685945
0.998814	0.199763	2.282953	0.562767
0.999007	0.199801	2.490181	0.612433
0.99931	0.199862	2.592758	0.637021
0.999569	0.199914	2.345173	0.587504
0.999166	0.199833	2.556648	0.646084
0.999648	0.19993	2.793153	0.717112
0.999658	0.199932	2.711256	0.700733
0.999655	0.199931	2.403984	0.584921
0.999579	0.199916	2.521297	0.608383

0.999665	0.199933	2.521383	0.608401
0.999166	0.199833	2.520885	0.608301

3) Testing of Reward Determination for Employees

The process of determining rewards for employees of PT. This AAA has several conditions, the conditions are as follows.

a. Determined based on the overall performance value of each employee, so that the highest overall performance value of the employee will be taken and if the highest score is more than one employee, it will follow provision number 2.
b. It is determined based on the length of service, so that the highest employee tenure will be taken and if the highest score is more than one employee, it will follow provision number 3.
c. It is determined based on the level of the employee's position, so that it will be prioritized from the foreman position and if the foreman position is more than one employee then it will follow provision number 4.
d. Determined based on the place of the employee department, so it will be prioritized from the production department.

Based on the provisions above, an example of the process of determining rewards for employees of PT. This AAA will later bring out the names of employees from all PT AAA data.

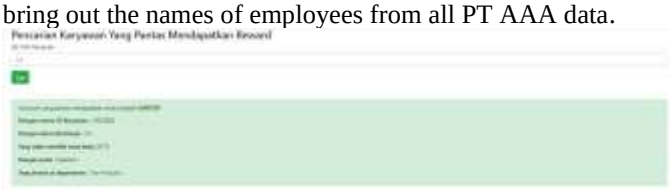

Figure 8 Example of the process of determining employee rewards.

IV. CONCLUSION

Predictions of employee performance appraisals based on competency categories will produce competency weight values and competency percentages written in decimal format instead of percent, this competency percentage value is obtained by calculating the competency weight value multiplied by a value of 40% or 0.4. For the prediction of employee performance appraisal based on the disciplinary category it is obtained by calculating the weight value of the disciplinary multiplied by a value of 20% or 0.2. As well as the prediction of employee performance appraisal based on the attendance category, the calculation of the value of attendance weight multiplied by the value of 20% or 0.2. Meanwhile, to calculate the overall employee performance value or total weight, the process of calculating the number of competency weight values, disciplinary weight values and attendance weight values is the sum of the competency percentage, disciplinary percentage and attendance percentage.

REFERENCES

[1] Amara, Karima, Arezki Fekik, D. Hocine, Mohamed Lamine Hamida, El-Bay Bourennane, Toufik Bakir, Ali Malek. "Improved Performance of a PV Solar Panel with Adaptive Neuro Fuzzy Inference System ANFIS based MPPT", 7th International Conference on Renewable Energy Research and Applicaton, Paris, France,Oct.14-17,2018

[2] Jian-Hua, Zhang, Li-Fang Kong, Zhang Tian, Wei Hao. "The Performance Parameter Fault Diagnosis for Automobile Engine Based on ANFIS", 2010 International Conference on Web Information Systems and Mining, 978-0-7695-4224-9/10 $26.00 © 2010 IEEE DOI 10.1109/WISM.2010.149

[3] Emir ZUNIC, Almir DJEDOVIC and Zikrija AVDAGIC. "Decission support system for candidates classification in the employment process based on ANFIS method", 2016 XI International Symposium on Telecommunications (BIHTEL) October 24-26, 2016, Sarajevo, Bosnia and Herzegovina

[4] Fatkhurrozi, Bagus, M. Aziz Muslim, dan Didik R. Santoso. 2012. "Penggunaan Artificial Neuro Fuzzy Inference Sistem (ANFIS) dalam Penentuan Status Aktivitas Gunung Merapi", Jurnal EECCIS Vol. 6, No. 2, Desember 2012

[5] Muhajirah, Aenul, Eka Safitri, Titin Mardiana, Hartina dan Andi Setiawan. 2019. "Analisis Tingkat Akurasi Metode Neuro Fuzzy dalam Prediksi Data IPM di NTB", JTAM, Vol. 3, No. 1, (hal. 58-64). p-ISSN 2597-7512, e-ISSN 2614-1175

[6] Suparmi, Vicy Septiawan. 2019. "REWARD DAN PUNISHMENT SEBAGAI PEMICU KINERJA KARYAWAN PADA PT. DUNIA SETIA SANDANG ASLI IV UNGARAN", Serat Acitya – Jurnal Ilmiah UNTAG Semarang, ISSN : 2302-2752, Vol. 8 No. 1, 2019

[7] Syafrizal, Melwin. 2010. "SISTEM PENDUKUNG KEPUTUSAN (DECISION SUPPORT SYSTEM)", JURNAL DASI Vol. 11 No. 3 September 2010, ISSN: 1411-3201

[8] Wardani, Akbar Rizky, Yuki Novia Nasution, Fidia Deny Tisna Amijaya. 2017. "APLIKASI LOGIKA FUZZY DALAM MENGOPTIMALKAN PRODUKSI MINYAK KELAPA SAWIT DI PT. WARU KALTIM PLANTATION MENGGUNAKAN METODE MAMDANI", Jurnal Informatika Mulawarman, Vol. 12, No. 2 September 2017, e-ISSN 2597-4963 dan p-ISSN 1858-4853

[9] Sitio, Sartika Lina Mulani. 2018. "PENERAPAN FUZZY INFERENCE SYSTEM SUGENO UNTUK MENENTUKAN JUMLAH PEMBELIAN OBAT (STUDI KASUS: GARUDA SENTRA MEDIKA)", JURNAL INFORMATIKA UNIVERSITAS PAMULANG, Vol. 3, No. 2, Juni 2018, ISSN 2541-1004