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Decision Support System for Determining Employee Bonuses using Analytical Hierarchy Process (AHP)

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ABSTRACT

Determining employee bonus salaries is one of the problems faced by every company, especially PT. Pyridam Farma, where the company finds it difficult to determine employees who are eligible to receive bonus salaries. There are many factors that cause this, including the fact that it takes quite a long time and the possibility of data being lost because it is still in hard copy form. This research uses the Analytical Hierarchy Process (AHP) as a weighting method for the basic criteria in determining employees who deserve a bonus salary, including length of service, absenteeism (attendance rate) and employee performance. The decision support system application determines employees who are eligible to receive this bonus salary on a web basis. The system that is built can determine which employees will receive bonus salaries based on predetermined weights and is able to determine what percentage of bonus salary employees will receive based on the assessments that have been carried out. This system can provide a solution for PT. Pyridam Farma to determine which employees will receive bonus salaries.

1. INTRODUCTION

This research began with identifying problems at PT. Pyridam Farma, especially in the Quality Assurance section, the process of determining bonuses is still carried out manually, where the criteria for determining bonus salaries have not been determined so that the company has difficulty in determining employees who will get bonus salaries, giving bonuses is only based on the assessment of the Management and does not look at other aspects and income percentages. The bonus salary is inaccurate because the calculations used are still manual.

The current method of giving bonuses to employees is less than optimal, this is based on the lack of employee satisfaction with receiving bonuses provided by the company. The assessment of bonus receipts currently is based only on the assessment of the work unit without considering other aspects. In every company, agency, organization, or business entity there will be providing a salary as compensation for an employee's work, apart from providing a basic salary to its employees, each agency often provides bonus salaries to stimulate the work performance and productivity of its employees. Employees are the most important part of the company, where the success of a company does not depend on the performance of each employee, so that they are always enthusiastic and motivated.

Bonus salary is an additional payment outside the wage or salary aimed at encouraging (providing incentives) so more responsibly, with the hope of higher profits. However, there is a problem in determining the correct order of priority in employee bonus salaries because employees have different performances.

In this research, to find the priority order for employee bonus salaries, criteria and alternative criteria will be used. Analytic Hierarchy Process is defined as modeling which is a solution to complex and irregular problems in data in a sequential manner followed by assessing each component at its level by giving subjective qualitative weights. So that it can represent various solutions for each resolved problem, for example this research was implemented in finding or determining the best employees selected

according to their level to receive bonuses based on several criteria determined by the company. To overcome this problem, a decision support system for determining employee bonus salaries was created using the AHP (Analytical Hierarchy Process) method as a recommendation for employees in giving bonuses based on the criteria of work results, attendance, and length of service.

2. RELATED WORK

The AHP (Analytic Hierarchy Process) method has many advantages in explaining the decision-making process using certain criteria so that the assessment will be more accurate [1]. The basic principle of AHP consists of first creating a hierarchy of problems to be solved, breaking them down into their elements, namely criteria and alternatives, then arranging them into a hierarchical structure and secondly evaluating the criteria and alternatives [2]. The basic concept of the AHP algorithm is in the process of forming a numerical and structured score in ordering each decision alternative based on how the alternative must pair optimally with the decision maker's criteria. There are four axioms in the AHP concept including:

1. The first axiom is Reciprocal Comparison which can be defined as a decision maker who makes comparisons and adjusts them according to his preferences. For example, preferences must be included in a group that has reciprocal conditions, namely if X is preferred to Y on the n scale, then Y is preferred to X on the 1/n scale.
2. Homogeneity shows that a person's preferences must be able to be represented on a limited scale or by using elements that can be compared with others. If this axiom is not fulfilled, then the elements being compared are not homogeneous and a new cluster (group of elements) must be formed.
3. Independence is a preference that represents the assumption that the criteria are independent of existing alternatives except for the overall goal. This shows that the pattern of dependence on AHP is unidirectional, meaning that the comparison between the 12 elements at one level is influenced or depends on the elements at the level above it.
4. Expectations can be interpreted as the goals of decision making with a hierarchy that is assumed by all. If the assumptions are not met, then the decision making does not use all available or necessary criteria or objectives so that the decision taken is considered incomplete and optimal. This decision support system research has 4 (four) criteria and these 4 criteria are honesty, work results, discipline and responsibility with the implementation of the AHP method and can help the personnel department in recapping it [3].

The decision support system with weighting of each criterion for receiving employee bonuses becomes a reference for other companies in facing similar challenges related to financial transparency and better decision making [4],[5]. The AHP method has been widely used by previous researchers, for example the decision support system for scholarship winners with a probability or probability level of 90% [6]. Apart from that, AHP also provides an accuracy rate of 95.44% in the decision support system for receiving decent housing assistance [7] [8]. Meanwhile, this method can provide decisions for employee recruitment (accuracy rate 82.5%) and determine annual bonuses for school employees [9], [10]. In the AHP method there are two criteria, namely profit criteria and cost criteria. This research uses 5 criteria, namely attendance, discipline, training, length of service and work achievements to determine giving bonuses to employees [11].

3. METHODOLOGY

This research consists of several stages, including collecting criteria data from personnel, filtering employee data, analysis, and application design, then implementing the AHP method and ending with application testing to ensure procedural functions.

3.1 Analytic Hierarchy Process

AHP is a decision support algorithm developed by Thomas L. Saaty, the problem solving process is carried out using many complex criteria which are later arranged to produce a hierarchy [12]. Where the stages consist of problem decomposition, criteria weighting, then matrix preparation and consistency testing, followed by setting priorities in each hierarchy, then synthesis of priorities and finally decision making or determination.

Analytical Hierarchy Process is an algorithm that improves the development of priorities from various options using various criteria. The basic concept of AHP is in the process of forming a numerical score to rank each decision alternative according to how well the alternative matches the decision maker's criteria in a problem that occurs. The AHP method procedure is as follows [13]:

1. First define the criteria.
2. Then declare the criteria values using pairwise comparisons with a comparison scale of 1-9 which is then converted into a matrix.
3. Next, add up the values for each column of the matrix created previously.
4. Stage 4, divide each value from the column by the total of the column concerned to obtain a normalization matrix, so that at this stage the data has been normalized.
5. Finally add up the values for each row and divide based on the number of elements to produce an average. So the result data shows priority data per criteria.

The calculation of the criteria is complete, if. When deciding, it is important to know how good the consistency is, because we don't want decisions to be based on considerations that have low consistency. Therefore, continue by calculating consistency. And this priority data is also used as a criterion value.

1. First, each value in the 1st column is multiplied by the relative priority value of the 1st element, then the value of the 2nd column by the relative priority of the 2nd element, until all elements
2. Each row is added together.
3. The three results in the second point are divided into relative priority elements.
4. Then add up the results at point 3 with all the elements, the result is called λ max. Calculate the Consistency Index (CI) with the formula: $CI = (\lambda \text{ max} - n) / n$, where n is the number of elements.

5. Next, calculate the Consistency Ratio (CR) with the formula: CR=CI/IR, where IR = Random Consistency Index.
6. Then check the hierarchy consistency. If the value is > 10%, then the assessment is corrected but if the consistency ratio (CI/IR < 0.1 then the results are said to be correct.)

3.2 Analysis and Design

Based on the results of the analysis, several deficiencies in the current system can be seen, namely:

1. Management of employee data, attendance data, work output and length of service is still done manually, this results in reporting of employees who will receive bonus salaries to be long and inaccurate.
2. Leaders have difficulty viewing employee salary bonus reports, because employee salary bonus reports are still manually input.

The objectives of the bonus program provided by the company are as follows: For companies, the aim of giving bonuses is to increase production by encouraging employees to work disciplined and have higher enthusiasm. It is hoped that this bonus can achieve the goals of producing better production quality, increasing effectiveness and efficiency in the use of production factors, and preventing high employee turnover. For Employees By providing bonuses from the company, it is hoped that employees will gain many benefits. Benefits which are non-wage components include, for example, getting a bigger salary at the end of the year, getting encouragement to develop oneself, trying to work as well as possible, and loyalty to the company.

With a computerized system design, data security will be more guaranteed, and can improve the performance of the existing system. System analysis can be controlled as the decomposition of a complete information system into components to identify and evaluate problems so that improvements can be proposed. Before carrying out system design, an analysis of the system currently running in the organization is first carried out. To make things easier, this research analyzes documents, functionalities, and system users to minimize misperceptions during system development.

System functionality analysis of the application for determining employee bonus salaries is helps display employee data, employee attendance data, work output and work period. The second assist HRD in determining employees who will receive salary bonuses.

Analysis of the application user system for determining employee salary bonuses, namely:

1. HRD staff as employees and managers of computer input and output who have the task of determining employee bonus salaries.
2. Leaders are only given access to view reports in determining employee salary bonuses.

System design is determining how to achieve the set targets and involves configuring the software and hardware components of the system so that after installation the system will meet the specifications made at the end of the system analysis phase. The discussion is intended to outline the needs in application development. The focus of application development lies in the interface by including the interaction needs of employee classification using a decision support system. The next system development process is to design the system using a structured approach. The tools used are data flow diagrams and entity relationship diagrams.

3.3 Software testing

Software testing is a verification and evaluation stage that the software that has been built carries out each of its functions well so that it can avoid bugs, minimize development costs, and ensure optimal performance when the application is used. Interface implementation will be carried out on the server that has been provided by adapting to the display that has been determined by the system, so that the implementation process will use the tools that have been provided so that not many additions are needed.

TABLE 1. CASES AND TEST RESULT TESTING

No	Form / Module Tested	Function	Result
1	Login	That users have security in using the application as expected	Valid
2	Fill in username and password correctly then click the login button	To open the application	Valid
3	Fill in Employee	To view, add and update employe	Valid
4	Fill in Criteria data	To determine the assessment criteria that will be used	Valid
5	Enter the weight between the criteria	To process whether the employee is eligible to get a bonus based on the assessment for each criterion	Valid
6	Check Selection Results	To ensure that data has been stored that has been processed according	Valid
7	Process Results	Report to be submitted to management	Valid

Testing uses test data to test all program elements (internal data, loops, logic, decisions, and paths). Test data is generated by knowing the internal structure (source code) of the software. Testing is carried out by executing test data and checking whether the software functions work well. Test data is generated from software specifications.

4. RESULT AND DISCUSSION

This research uses a web-based application for the interface from managing employee data to implementing the AHP method. Completion of the decision-making system using the AHP method is expected to provide transparency in the assessment of employee bonuses based on attendance criteria, work results and length of service. As shown in figure 1. regarding employee data, after the admin has successfully logged in, there are several menus starting with the Employee Data menu where in this menu, the admin can view, add, or update employee data.

This interface, meticulously designed and executed, serves as the cornerstone for the subsequent implementation of the AHP method, forming a cohesive bridge between the intricate layers of employee data management and the nuanced processes underpinning decision-making related to bonuses. The capacity to augment or modify employee data ensures that the system remains dynamic and adaptable to the evolving nature of personnel information.

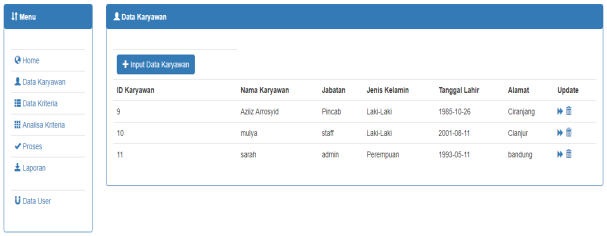

FIGURE 1. EMPLOYEE DATA MANAGEMENT

The Criteria Data Input menu interface aims to view, add, or replace the criteria that will be used in determining employee bonuses, shown in Figure 2.

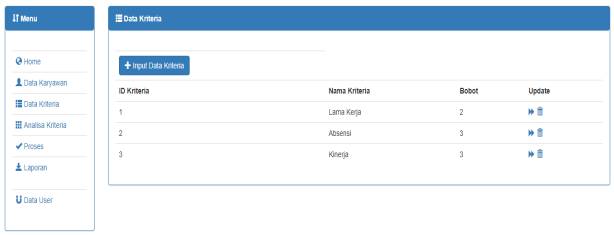

FIGURE 2. MANAGEMENT OF CRITERIA DATA

Figure 3 shows the criteria analysis menu determining the weight of the relationship between criteria, where the most important criterion has a high weight value compared to the other criteria. Meanwhile, the process of determining the criteria for determining employee bonuses is shown in Figure 4.

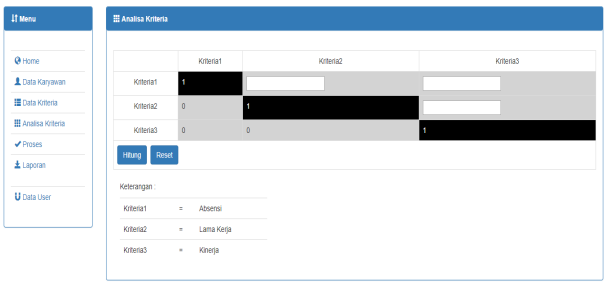

FIGURE 3. CRITERIA ANALYSIS MENU

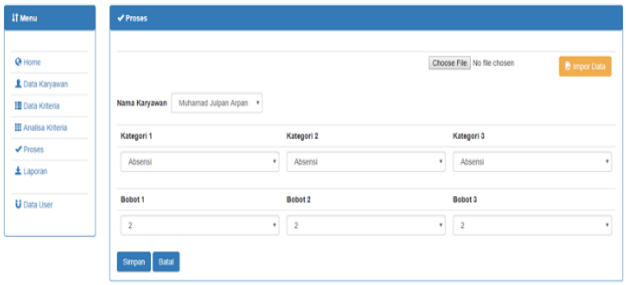

FIGURE 4. PROCESS CRITERIA ANALYSIS

This research uses matrix comparisons to simulate the relative contribution of elements for each criterion and then compares based on decisions by assessing the highest level of importance of an element with other elements in a criterion. The process of comparing pairs, starting from the highest hierarchy with the aim of selecting a criterion, for example K, then determines the elements to be compared, such as K1, K2, and K3, using a reference to the criteria used previously. The assessment of each criterion is carried out for expert decision making according to the problem area being faced and has dependence and importance on the criteria. For example, comparing an element in a criterion against itself produces a value of 1. But if we compare element i against element j with the aim of achieving a certain value, then we compare element j compared with element i so that we can see the assessment results in Table 2 , 3 , 4, 5 and 6. The results of this research are based on analysis which includes several factors.

4.1 First Stage

Criterion weight is the score given to each decision criterion, so that it can describe high or low importance. Determination of weights which aims to compare the elements contained in the decomposition process for each criterion has been completed so as to produce an optimal hierarchy. then the next stage is to carry out pairwise weight comparisons of the criteria in each hierarchy by making a reference based on their relative level of importance. Decomposition process has been completed and the hierarchy has been arranged properly. Next, a pairwise comparison assessment (weighting) is carried out in each hierarchy based on their relative level of importance.

The first stage of this research is determining the weight of each criterion.

a. Work output is 1.5 times more important than absenteeism.
b. Work output is 3 times more important than work experience.
c. Absenteeism is twice as important as work time.

TABLE 2. PAIR COMPARATION MATRIX

Criteria	Output Jobs	Absenteeism	Years of Service	Priority Vector
Output Jobs	1	1.5	3	0.50
Absenteeism	0,67	1	2	0.33
Years of Service	0.33	0.50	1	0.17
Total	**2.00**	**3.00**	**6.00**	**1.00**
		Principal Eigen Value (Imax)		***3.00***
			CI	***0.00***
			CR	***0%***

Table 2 shows the level of importance of each criterion, where the criterion with the highest eigenvalue and eigenvector has the first level of importance or priority, namely the work result of 0.50 in this research. Where the company prioritizes employee performance by looking at the results of the work, then the second is attendance where the presence of speech plays a role in being a supporter if an employee has good work results, namely for the attendance criteria with a priority vector value of 0.33. The third criterion is work period with a value of 0.17 priority where sometimes work time cannot measure good or even very professional performance for an employee.

The next process is synthesis, namely, to obtain overall priorities, the considerations regarding pairwise comparisons need to be synthesized. Steps taken is:

a. Add up the values from each column in the matrix.
b. Divide each value of a column by the total of that column concerned to obtain matrix normalization.
c. Add up the values from each row and divide them with the number of elements to get the average value.

4.2 Second Stage

Provide assessments to employees according to predetermined criteria. Based on work output:

1. Art is 1x better than Okta
2. Art 4 times better than Herni
3. Okta is 3 times better than Herni

TABLE 3. PAIR COMPARATION MATRIX BASED ON WORK OUTPUT

Output Jobs	Seni	Herni	Okta	Priority Vector
Seni	1	4	1	0.40
Herni	0.25	1	0.33	0.13
Okta	1.00	3.00	1	0.42
Total	**2.25**	**8.00**	**2.33**	**1.00**
	Principal Eigen Value (Imax)			***3.01***
			CI	***0.01***
			CR	***1%***

Based on Work Absence
1. Seni is 3 times more diligent than Okta
2. Art is twice as diligent as Herni
3. Herni is twice as diligent as Okta

TABLE 4. PAIR COMPARATION MATRIX BASED ON WORK ABSENCE

Absenteeism	Seni	Herni	Okta	Priority Vector
Seni	1	2	3	0.54
Herni	0.50	1	2	0.30
Okta	0.33	0.50	1	0.16
Total	**1.83**	**3.50**	**6.00**	**1.00**
	Principal Eigen Value (Imax)			***3.01***
			CI	***0.01***
			CR	***1%***

Based on Work Period
1. Art is 2 times longer than Okta
2. Seni is 5 times longer than Herni
3. Okta is 3 times longer than Herni

TABLE 5. PAIR COMPARATION MATRIX BASED ON WORK PERIOD

Years of Service	Seni	Herni	Okta	Priority Vector
Seni	1	5	2	0.58
Herni	0.20	1	0.33	0.11
Okta	0.50	3	1	0.31
Total	**1.70**	**9.00**	**3.33**	**1.00**
	Principal Eigen Value (Imax)			***3.00***
			CI	***0.00***
			CR	***0%***

4.3 Third Stage

Of all the calculations carried out on the 3 criteria, namely work period, work results, and attendance, next, the relationship is carried out with the priority alternatives and produces a table of relationship between criteria and alternatives.After getting the weights for each employee, the total scores for the three employees are as follows:

TABLE 6. PAIR COMPARATION MATRIX BASED ON WORK PERIOD

Overall	Weight	Seni	Herni	Okta
Output Jobs	0.5000	1.5	3	0.50
Absenteeism	0.3333	1	2	0.33
Years of Service	0.1667	0.50	1	0.17
Composite Weight		**1.69**	**6.17**	**4.81**

Table 6 shows the overall assessment for 3 samples of employees which shows a higher level of importance with the weight value. Based on Table 6, it can be concluded that the employee on behalf of Herni has the highest assessment weight so that the employee who gets the bonus is Herni.

5. CONCLUSIONS

Table 2 shows the level of importance of each criterion, where the criterion with the highest eigenvalue and eigenvector has the first level of importance or priority, namely the work result of 0.50 in this research. Based on the results of research and testing of the decision support system to determine which employees are eligible to receive bonuses that have been carried out by the authors, several conclusions can be drawn as follows. First, the decision support system for determining the number of bonuses received by employees has been successfully built based on what has been done and has become PT's solution. Pyridam Farma in providing bonus amounts. Second, the decision support system application that has been built is able to assist in providing reports regarding determining the number of bonuses that will be received by employees. Third, apart from being able to determine which employees will receive bonuses, this decision support system can display the percentage and amount of bonus salary income for each employee.

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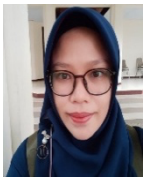

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