Jurnal SimanteC
Vol. 14, No. 1 December 2025
P-ISSN : 2088-2130
E-ISSN : 2502-4884

Web-based employee reward determination system using Analytical Hierarchy Process (AHP)

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Abstract

This study develops a web-based employee performance evaluation system using the Analytical Hierarchy Process (AHP) method to overcome the problem of inaccuracy and unfairness in reward giving at PT Transcosmos Commerce. The system is designed using an Agile approach with the Django framework and SQLite database. The AHP method is applied to calculate the weight of the assessment criteria (discipline, responsibility, productivity, work quality, and cooperation) through pairwise comparisons, resulting in a consistency ratio (CR) value of 0.08 less than 0.1, which indicates acceptable consistency. The results of the AHP calculation show that the highest criterion weight is Productivity (0.32), followed by Work Quality (0.25), Responsibility (0.18), Cooperation (0.15), and Discipline (0.10). The final employee score is obtained by combining the criteria weight and alternative values, with the highest scores obtained by employees A1 (Dani) of 0.42, A2 (Farhan) of 0.35, and A3 (Freya) of 0.23. System testing has proven an increase in evaluation time efficiency of 60 percent compared to manual methods, as well as reducing the subjectivity of assessments. The system also provides visualization of results in the form of graphs and automatic reports, facilitating managerial decision-making.

Keywords: *AHP, criteria weighting, evaluation of performence, employee reward, Web Based System.*

1 INTRODUCTION

The advancement of information technology [1], [2] has driven many organizations to undergo digital transformation across various operational aspects, including decision-making through decision support systems. One of the main challenges in this area is the employee performance evaluation system, which is often still inefficient and unfair. Many companies continue to use manual methods for performance assessment, such as physical documents or spreadsheets. These methods not only complicate data collection and analysis but are also prone to assessment bias, inconsistency, and a lack of transparency in decision-making—especially when determining employee rewards.

PT. Transcosmos Commerce, one of Indonesia's leading e-commerce enabler companies, faces similar challenges. The Sales Team Division, which plays a strategic role in achieving sales targets, still conducts employee evaluations using conventional approaches. Although responsibilities and job complexity vary between employees depending on the type and scale of the brand they manage, the existing system fails to objectively account for these differences. Employees handling more complex or lesser-known brands risk receiving the same rewards as those managing well-established brands, since the evaluation is not based on structured and measurable indicators.

Digitalizing information systems has been proven to improve work efficiency and decision-making, as demonstrated in online learning systems by Erfisal & Fimawahib [3], and web-based performance evaluation applications by Wahyuni & Irawan [4], which showed improvements in operational efficiency, data accuracy, and the speed of employee evaluations.

The core issue addressed in this research is the absence of a structured, objective, and integrated performance evaluation system to support the employee reward process. Reliance on manual systems introduces risks such as input errors, difficulty in data aggregation, and inconsistency in assessments, all of which can lead to unfair reward distribution. This not only risks employee dissatisfaction and demotivation but may also affect overall organizational performance. The urgency of this research lies

in the need to digitalize the evaluation process to produce fairer, more transparent, and accountable results.

As a solution, this study aims to design and implement a web-based system integrated with the Analytical Hierarchy Process (AHP) method [5]. AHP is used to determine the weight of each evaluation criterion systematically and scientifically through pairwise comparisons. With this method, employee performance evaluations can be conducted in a more objective, measurable, and accountable manner. The system also enables real-time visualization of evaluation results and supports data-driven decision-making.

The novelty of this research lies in the direct application of the AHP method within a web-based performance evaluation system in the context of an e-commerce enabler company—an area that has not been extensively developed. The system is designed not only as a performance evaluation tool but also as a Decision Support System (DSS) for fair and proportional reward distribution.

The contribution of this research is to provide a relevant and practical information technology solution for the professional environment, particularly in the context of digital human resource management. By implementing this system, it is expected that companies can enhance evaluation efficiency, reduce subjectivity in assessments, and increase employee motivation and performance through transparent and structured reward mechanisms.

The main objective of this research is to build a web-based employee performance evaluation system that applies the Analytical Hierarchy Process (AHP) to calculate evaluation weights. The study is expected to benefit both companies—through more effective decision-making—and employees—through a fairer and more motivating reward system.

2 LITERATURE REVIEW

Various studies have been conducted in efforts to develop objective and efficient employee performance evaluation systems by utilizing information technology and multi-criteria decision-making methods. One commonly used approach is the Analytical Hierarchy Process (AHP), which can establish priorities based on pairwise comparisons between criteria. In a study conducted by Prawira and Amin [6], AHP was implemented to determine the best employee at PT. Citra Prima Batara, taking into account aspects such as honesty, responsibility, and work discipline. The results showed that AHP was capable of producing objective recommendations; however, the system lacked direct web integration to facilitate real-time and continuous data management.

Another study by Sumardiono [7] at Universitas XYZ also applied AHP to evaluate administrative staff performance. The developed E-Result system used the waterfall approach to build a web-based application. While it succeeded in improving evaluation efficiency and objectivity, the system remained generic and did not specifically address the dynamics of performance evaluation in the e-commerce sector, which typically involves more dynamic, varied, and target-based work. Additionally, the criterion weights were determined internally without considering the varying difficulty levels of the brands or projects managed by each employee.

Meanwhile, Halawa [8] developed a performance evaluation system using the Graphic Rating Scale method at PT. Tri Karya Cemerlang. Although this approach is simpler and easier to use, it tends to be less flexible in handling complex, hierarchical multi-criteria evaluations. Moreover, the method did not include a consistency validation mechanism between criteria, as AHP does. The evaluation approach also lacked a mathematically traceable and accountable weighting process for decision-making.

Wibisono et al, [9] developed a decision support system based on AHP for evaluating employee performance and determining bonuses fairly. The system was designed with a comprehensive hierarchical structure and pairwise comparison consistency validation, which proved to enhance objectivity and transparency in performance evaluations.

Rikky and Septanto [10] applied the Profile Matching method at PT. ABC to assess exemplary employees. The application allowed for a more structured evaluation process and produced automatic rankings. However, this study did not address transparency and fairness in assessment based on workload differences among the projects handled by employees—an important consideration in an e-commerce context like PT. Transcosmos Commerce, where job challenges can vary significantly between brands.

Additionally, Gunawan [11] implemented the Weighted Product method in employee evaluation, but this method does not provide a consistency validation mechanism like AHP. Ramli et al. also demonstrated the effectiveness of AHP in multi-criteria decision-making for product selection in the e-commerce sector, but their focus was limited to physical products rather than human resources.

In contrast to previous approaches, this study focuses on developing a web-based employee performance evaluation system with integrated AHP, used to objectively calculate evaluation criterion weights. The system is specifically tailored to the context of an e-commerce enabler company, which has unique needs in evaluating sales teams managing brands with varying levels of complexity. Moreover, the system considers the unique characteristics of work based on the scale of each brand—an aspect not thoroughly addressed in previous studies.

The main shortcoming of previous research lies in the lack of a system that combines the flexibility of web-based technology, a structured multi-criteria calculation method, and a focus on brand-based task complexity into one integrated solution. Therefore, this study fills that gap by building a decision support system that not only calculates evaluation scores objectively using AHP but also incorporates fairness based on the actual work context. This approach is expected to contribute to fairer and more accountable performance management practices in digital, target-oriented companies such as PT. Transcosmos Commerce.

3 RESEARCH METHODOLOGY

This study adopts a software engineering approach using the Agile system development method. Agile is well-suited for dynamic information system projects, as demonstrated by Dwivedi et al [12], who outlined the evolving trends in artificial intelligence and adaptive system development approaches. This approach was chosen for its iterative and flexible nature, enabling continuous system adjustments based on user needs. The system development process consists of six stages Requirements, Design, Development, Testing, Deployment, and Review.

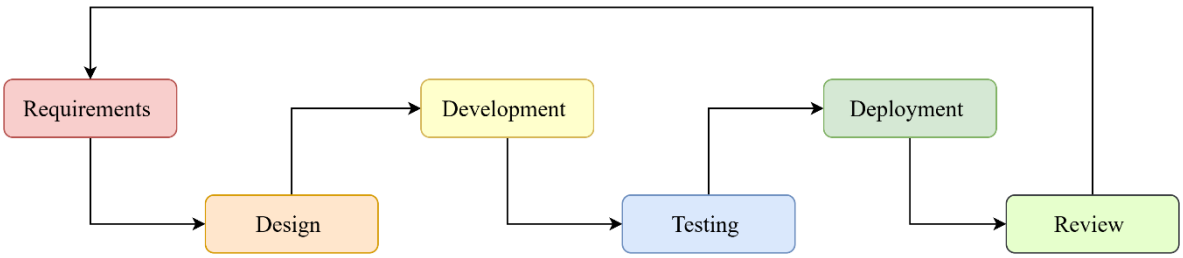

Figure 1. System Development Stages Using the Agile Method

In the development of this system, the Agile method was used due to its iterative and flexible nature, allowing quick adjustments to user needs. Figure 1 illustrates the system development stages based on the Agile method applied in this study. The Agile development phases are described as follows:

1. Requirements: Involves identifying system requirements based on observations, interviews, and literature review. Evaluation criteria are determined using the AHP method.
2. Design: Initial design of the web-based system, including database structure and user interface layout.
3. Development: The system is developed in stages, covering performance recording and AHP weight calculations.
4. Testing: Functional testing is carried out to evaluate system performance.
5. Deployment: The system is implemented on a small scale in the work environment.
6. Review: Evaluation is conducted based on user feedback and improvements are made iteratively.

This research was conducted in the work environment of PT. Transcosmos Commerce, Jakarta. The focus of the study is on the Team Sales Division, which has target-oriented job characteristics and varying challenges depending on the brand being handled. This became a key consideration in developing an evaluation system that takes into account the actual work context of each employee.

Data were collected through observation of the company's existing manual performance evaluation process, interviews with HR and Project Managers regarding evaluation indicators and reward-related issues, as well as a literature review to strengthen the methodological and technical foundation. The main materials included data on performance evaluation indicators and information on the organizational structure of the relevant division. The tools used included a development computer, the Django framework (Python-based), and SQLite for the local database. SQLite offers a lightweight, file-based architecture capable of efficiently handling both OLTP and OLAP loads, making it a suitable choice for small to medium-scale information system applications [13]. Django was chosen due to its advantages in productivity, security, and modularity, supported by its Model-Template-View (MTV) architecture, Object Relational Mapper (ORM), and a broad community and library ecosystem that accelerates web application development [14]. Meanwhile, the AHP method was used to determine the weight of each criterion, verify consistency through the Consistency Ratio, and select the best alternative [15].

The main method applied in this employee reward evaluation system is the Analytical Hierarchy Process (AHP), introduced by Thomas L. Saaty. AHP is a quantitative approach for multi-criteria decision-making, which is well-suited for employee evaluation based on specific performance indicators. In the developed system, AHP is not only used as an analytical method but is also directly integrated into the web-based system workflow as the core of the decision-making process.

The system guides users through a series of steps, from pairwise comparisons to the final ranking results, automatically based on AHP formulas, as follows:

1. Constructing the Pairwise Comparison Matrix

Users compare criteria (or alternatives against each criterion) using a 1–9 scale. The results form a comparison matrix such as:

$$A = \begin{bmatrix} 1 & a_{12} & a_{13} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & a_{23} & \cdots & a_{2n} \\ \vdots & \ddots & \ddots & \vdots & \vdots \\ \frac{1}{a_{12}} & \frac{1}{a_{12}} & \cdots & 1 & \vdots \end{bmatrix} \quad (1)$$

In equation (1), the general form of the pairwise comparison matrix is shown, where each element represents the relative importance between two criteria based on a scale from 1 to 9 provided by the user. The values of a_{ij} are obtained from user input on the system interface.

2. Matrix Normalization and Eigenvector Calculation

$$EV_i = \frac{\sum_{j=1}^{n} \left(\frac{a_{iJ}}{\sum_{k=1}^{n} a_{kj}} \right)}{n} \quad (2)$$

As shown in equation (2), each element in the matrix is normalized by dividing each value in a column by the total of that column. Then, the average value of each row is calculated as the eigenvector value, which represents the priority weight of each criterion. The EV_i value represents the priority weight of a criterion or alternative, and is automatically calculated by the system once the matrix input is completed.

3. Consistency Calculation (λmaks, CI, CR).

To ensure that the pairwise comparisons have been conducted logically and are acceptable, consistency testing is performed using three main calculation steps: the computation of λmax (maximum lambda), the Consistency Index (CI), and the Consistency Ratio (CR).

$$\lambda_{\text{maks}} = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{AW_i}{EV_i} \right) \quad (3)$$

Equation (3) is used to calculate the value of λmax, which serves as an initial consistency indicator for the comparison of criteria. This value is obtained from the multiplication of the initial matrix and the eigenvector.

1. AW_i is the result of multiplying the i-th row of the matrix by the weight vector.
2. EV_i is the weight of the i-th criterion
3. n is the number of criteria used in the evaluation.

Next, equation (4) is used to calculate the Consistency Index (CI), which indicates the level of inconsistency in the weighting process. The smaller the CI value, the better the consistency.

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4)$$

To determine whether the CI value is within an acceptable range, the Consistency Ratio (CR) is used. CR is the ratio between the CI and the Random Index (RI), which is an index empirically determined by Saaty based on the number of criteria. The Consistency Ratio (CR) is then calculated to assess the consistency of the data:

$$CR = \frac{CI}{RI} \quad (5)$$

The RI (Random Index) value depends on the number of criteria (n), for example:

Table 1. RI (Random Index) Values

n	RI
3	0.58
4	0.90
5	1.12
6	1.24

Equation (5) presents the calculation of the Consistency Ratio (CR), which is the ratio between the Consistency Index (CI) and the Random Index (RI), as shown in table 1. If the CR value is below 0.1, the matrix is considered consistent and can be used in subsequent calculations.

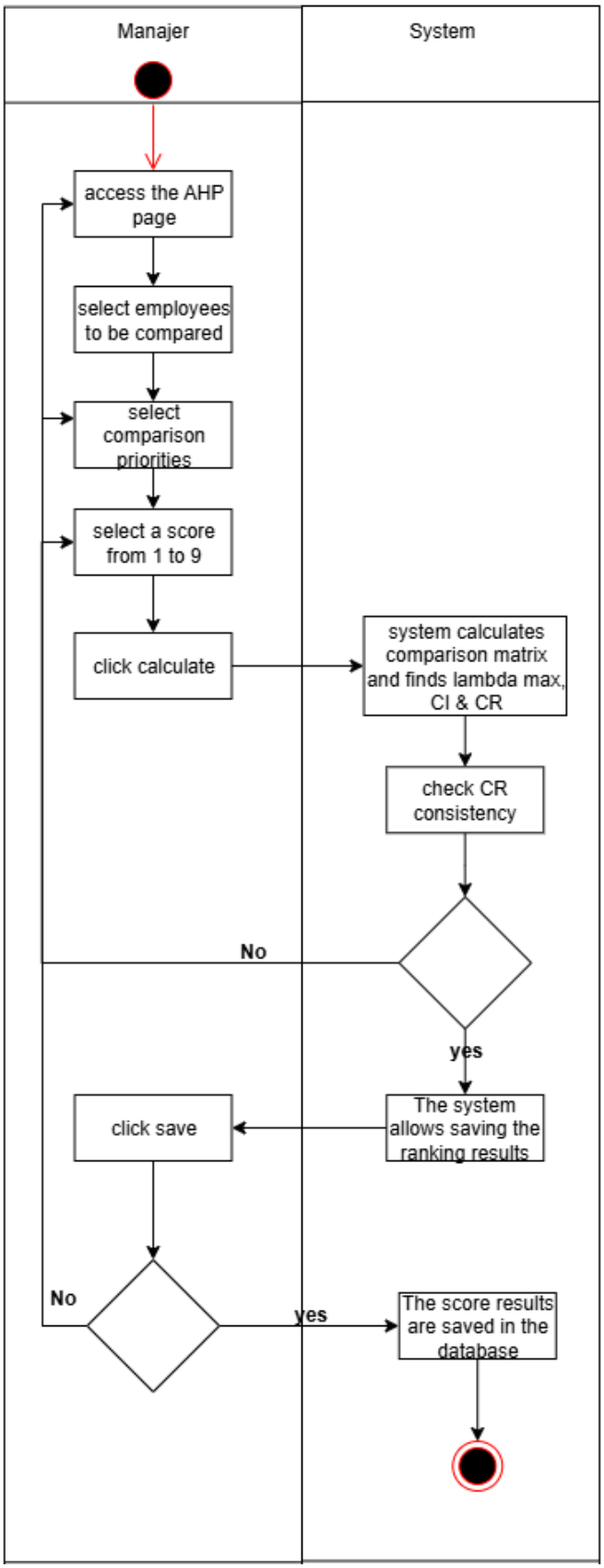

Figure 2. AHP System Flowchart

Based on figure 2, the manager begins the evaluation process by accessing the AHP page, selecting the employees to be compared, and assigning comparison scores based on priority. The system then

calculates the comparison matrix and tests its consistency using the values of λmax, CI, and CR. If the CR value is less than 0.1, the system allows the ranking results to be saved to the database.

4 RESULTS AND DISCUSSION

This study developed a web-based employee reward evaluation system using the Analytical Hierarchy Process (AHP) method, integrated into an automated calculation process. The implementation results were analyzed based on the methodological stages previously described, starting from hierarchy construction, pairwise comparison input, weight calculation, to the generation of alternative rankings. The results are presented through calculation tables, evaluation charts, and system interface screenshots to strengthen the evidence of implementation.

1. Hierarchy Structure and User Input

Users begin the evaluation process by constructing a hierarchical structure, where the main objective is to determine which employee deserves the reward based on five predetermined criteria: Discipline, Responsibility, Productivity, Work Quality, and Teamwork. The alternatives evaluated in this study are three employees A1 (Dani), A2 (Farhan), and A3 (Freya). The pairwise comparison input interface for the alternatives is presented in figure 3.

2. Evaluation of Alternatives Against Criteria

Each employee is compared against each criterion. The following table presents the evaluation results for each criterion:

Figure 3. Evaluation of Alternatives Against Criteria

Figure 4. Alternative Weights for Each Criterion

Figure 4 presents the results of the AHP calculation used to evaluate the performance of three employees (Dani, Farhan, and Freya) based on two criteria: productivity and effectiveness. For the

productivity criterion, Farhan has the highest score (0.5396), indicating he excels the most in this aspect. Meanwhile, for the effectiveness criterion, Freya scores the highest (0.6813), demonstrating the best performance in terms of effectiveness. Both tables show a Consistency Ratio (CR) value of 0.0079, which indicates that the evaluation is consistent.

3. This process is carried out for all criteria. All alternative weights are then combined using the criterion weights to generate the final scores, as shown in figure 5.

Figure 5. Final Scores and Alternative Rankings

The final results are visualized in the system as a bar chart, as shown in figure 6.

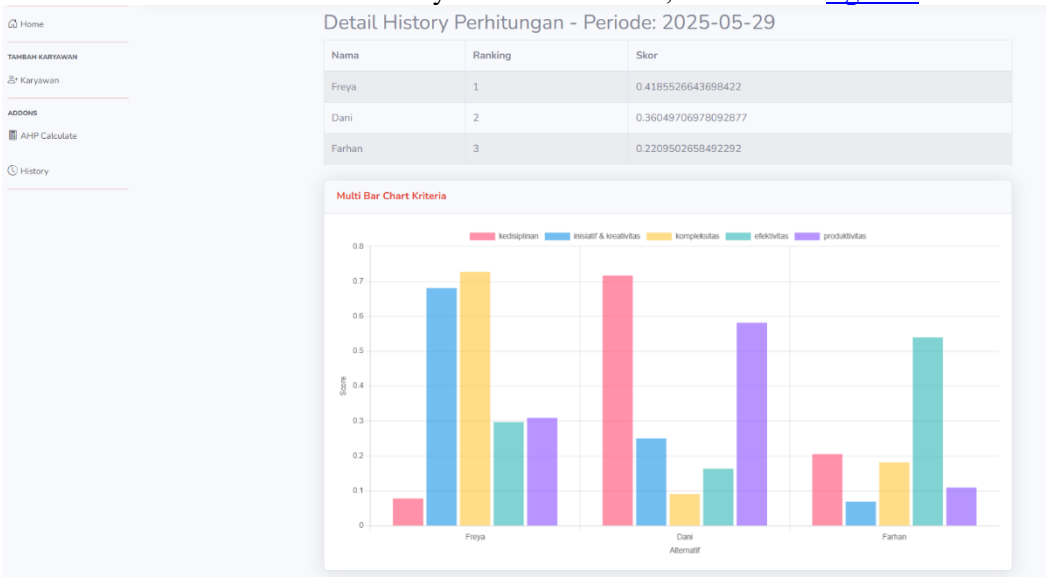

Figure 6. Employee Evaluation and Ranking Chart

This system applies a quantitative evaluation method based on the Analytical Hierarchy Process (AHP), which is analytical and structured. The AHP method is fully integrated and automated within the web-based platform, allowing for comprehensive implementation. The processes of calculating criterion weights, validating consistency (CR), and generating the final ranking are all carried out automatically and can be easily used by non-technical users such as HR personnel. Since AHP provides clear hierarchical weightings and consistency validation through the CR value, it demonstrates that the method enhances objectivity and efficiency in selecting educational personnel based on systematically calculated criterion weights.

5 CONCLUSION

This study successfully developed a web-based employee performance evaluation system integrating the Analytical Hierarchy Process (AHP) method to create objective and measurable assessments at PT Transcosmos Commerce. The analysis results show that the system is capable of generating clear criterion weightings, with Productivity as the most dominant factor (0.32), followed by Work Quality (0.25), Responsibility (0.18), Teamwork (0.15), and Discipline (0.10). The Consistency Ratio (CR) value of 0.08 indicates that the evaluations were conducted consistently and are accountable. Final employee scores, such as Dani (0.42), Farhan

(0.35), and Freya (0.23), clearly illustrate performance differences, enabling the company to distribute rewards more fairly and transparently.

In terms of impact, the system significantly improves fairness in reward distribution by eliminating the subjective biases that often occur in manual assessments. Employees handling more complex projects or brands now receive evaluations that are proportional to their efforts. Furthermore, the system offers tangible operational benefits, such as a 60% reduction in evaluation time and increased transparency through data visualizations that are easy for all parties to understand. These features not only accelerate decision-making processes but also build employee trust in the evaluation system.

The development of an AI-based predictive module can also be considered to provide long-term performance projections. In addition, large-scale trials across various divisions are necessary to assess the system's scalability and evaluate its effectiveness in broader contexts. The findings of this study are not only relevant to PT Transcosmos Commerce but can also be adapted by other companies facing similar human resource management challenges.

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