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Decision Support System for Best Employee Evaluation Using the SMART Algorithm.

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Abstract
The integration of information technology in employee performance evaluation plays a crucial role in company management, as human resources are the primary assets determining success. This study applies the SMART Algorithm within a Decision Support System (DSS) to evaluate top employees at PT Raharja Jaya Mandiri Bekasi, aiming to enhance objectivity and data reliability through a digital system. Using the SMART Algorithm, employees are ranked based on specific criteria applied via the waterfall model. The results indicate that the SMART-based DSS improves accuracy and efficiency in employee evaluations, reduces bias through structured criteria, and accelerates decision-making. The system also strengthens data security and confidentiality through advanced access controls and encrypted storage. However, the DSS is not yet fully flexible and is not integrated with the existing attendance system, limiting efficiency and data access. Addressing these limitations would increase the system's adaptability, enabling it to evolve with company needs and changing evaluation standards. This study suggests that, with continuous improvement, the DSS can offer more optimal support for objective and efficient employee evaluations.

Keywords— Decision Support System, SMART Algorithm, Employee Performance Evaluation, Web-based System, Objective Assessment.

1 Introduction

The use of information technology has spread to all fields, especially because advanced automation makes work more practical. In the era of globalization, companies must compete fiercely, and their success heavily depends on talented individuals [1]. Human resources are considered valuable assets because the growth of a company is closely linked to employee performance [2]. Employee performance evaluation is a key aspect of optimal company management, driving motivation, productivity, and responsibility [3]. PT. Raharja Jaya Mandiri Bekasi, a manufacturing company, requires a system to select the best employees based on various factors such as discipline, teamwork, performance, skills, and achievements. Currently, evaluations are still conducted physically on paper, which can lead to subjectivity and errors. Therefore, a more objective and precise evaluation system is needed to ensure fair assessments and avoid the risk of data loss. A Decision Support System (DSS) can solve this problem by utilizing data and specific models to formulate decisions. There are various algorithms within DSS, such as Simple Additive Weighting (SAW), which has limitations in handling qualitative data and is sensitive to weights, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), which involves complex normalization processes and is weight-sensitive, and Analytic Hierarchy Process (AHP), which is time-consuming for many criteria and has high complexity. In this study, the SMART (Simple Multi-Attribute Rating Technique) method is relevant because it is easy to use, transparent, and provides a high level of understanding of the problem [4].

Research by Lailatul Munjiyah, Imam Himawan, and Rosdiana developed a system for selecting employee contract extensions using the SMART method. The result was that 61 out of 100 employees received contract extensions, demonstrating the system's effectiveness [5]. Research by Wa Ode Tantia, Poetri Lestari Lokapitasaria,

and Lilis Nur Hayatia showed that a system with the SMART algorithm successfully determined college study programs [6]. Furthermore, in research by Resanda Dianggara Widoproyo and Putri Aisyiyah Rakhma Devi, the AHP method was used to calculate the normalization of criteria, while the SMART method was used to calculate alternatives. The results of these two methods showed that the second alternative received the highest score, ranking first among twenty alternative data sets, with a final score of 61.784 [7].

2 Research methods

2.1 *Information System*

A system is a collection of components that form a unified whole. Information is an addition to knowledge that contributes to a general conceptual framework and known facts. Information relies on the context and general knowledge of the recipient for its use [8]. An information system is a combination of several components that work together to collect, process, store, and disseminate information to support decision-making and control within an organization or system. Information technology systems also provide the regular delivery of information. Information systems can also provide information that comes from various data sources available anywhere [9].

2.2 *Decision Support System*

A Decision Support System (DSS) is a system that can provide facilities for solving problems and the ability to communicate in addressing semi-structured or unstructured issues. A decision is a selection from several available options. This definition contains three main concepts: the selection is based on logic or reasoning, an individual must choose the best option from several available choices, and the individual must have a goal that they want to achieve through the decision made to approach that specific goal [10].

2.3 *Simple Multi-Attribute Rating Technique*

1. SMART (Simple Multi-Attribute Rating Technique) is a method designed by Edward in 1977 to support decision-making when faced with multiple choices. This method allows decision-makers to evaluate and select the best option based on a set of predefined goals. In this method, each option is assessed based on various attributes it possesses, with each attribute being assigned a specific value. These values are then calculated using a predetermined scale to assist in the selection process [11]. The stages of the SMART method [8], are as follows:
    1) Determine the number of criteria for the decision to be made.
    2) Determine the weight of the criteria and alternatives for each criterion using a scale of 0-100 based on priority importance.
    3) Calculate the normalization of the criterion weights by comparing the criterion weight values with the total criteria, using the following formula (1):
    $$\frac{W_j}{\sum W_j} \quad (1)$$
    Explanation:
    W_j= Criterion weight score.
    $\sum W_j$= Total criterion weight.
    4) Calculate the utility value for each criterion. For benefit criteria, the utility value is calculated using the following formula (2):
    $$u_i(a_i) = \frac{C_{outi} - C_{min}}{C_{max} - C_{min}} \quad (2)$$
    For cost criteria, it is calculated using the following formula (3):
    $$u_i(a_i) = \frac{C_{max} - C_{outi}}{C_{max} - C_{min}} \quad (3)$$
    Explanation:
    $u_i(a_i)$ = Utility value of criterion i for alternative i.
    C_{outi} = Value of criterion i.
    C_{max} = Maximum criterion value.
    C_{min} = Minimum criterion value.
    5) Calculate the final score by summing the total result of the multiplication between the normalized criterion weight and the utility score, as in the following formula (4):
    $$(a_i) = \sum w_{jnormal} * (a_i)\ m\ j \quad (4)$$

Explanation:

(a_i) = Final score of alternative i.

$w_{jnormal}$ = Normalized criterion weight.

(a_i) = Utility value of criterion i for alternative i.

6) Ranking is done by ordering the final values from the highest to the lowest. The best alternative is the one with the highest final score.

2. SMART algorithm calculations

1) Determine the number of criteria for the decision to be made.

Table 1. Weighting Reference

Weight	Discipline	Teamwork	Performance	Skills	Achievement
1	0	Poor	Poor	Poor	0
2	1 to 3	Fiar	Fair	Fair	1
3	4 to 6	Good	Good	Good	2 to 3
4	7 to 10	Very Good	Very Good	Very Good	4 to 5
5	> 10	Excellent	Excellent	Excellent	> 6

PT Raharja Jaya Mandiri Bekasi plans to conduct performance evaluations to identify the best employees based on the highest evaluation scores. There are five criteria that will serve as the foundation for the decision-making process, while five employees will be evaluated as alternative options.

2) Determine the weight of the criteria and alternatives for each criterion using a scale of 0-100 based on priority importance.

Table 2. Criteria

Code	Name	Category	The weight of criteria
C1	Discipline	Cost	30
C2	Performance	Benefit	20
C3	Teamwork	Benefit	10
C4	Skills	Benefit	20
C5	Achievements	Benefit	20
Total			100

The Attribute Category is divided into two: cost, where a smaller value is better, and benefit, where a larger value is better.

Table 3. Alternative

Code	Name	C1	C2	C3	C4	C5
A1	Aan Firmansyah	1	3	4	2	3
A2	Fauzan Wijanarko	2	3	1	3	3
A3	Rizki Adi Wibowo	2	2	2	3	4
A4	Anton Rusdiyanto	4	4	3	4	2
A5	Muhamad Haerul Rizal	3	3	4	4	4
Max		4	4	4	4	4
Min		1	2	1	2	2

3) Calculate the normalization of the criterion weights by comparing the criterion weight values with the total criteria.

Table 4. Criteria Normalization

Code	Name	Weight
C1	Discipline	0.3
C2	Performance	0.2
C3	Teamwork	0.1
C4	Skills	0.2
C5	Achievements	0.2

Formula Explanation:

$a_1 = \frac{30}{100} = 0.3$

$a_2 = \frac{20}{100} = 0.2$
$a_3 = \frac{10}{100} = 0.1$
$a_4 = \frac{20}{100} = 0.2$
$a_5 = \frac{20}{100} = 0.2$

4) Calculate the utility value for each criterion.

Table 5. Utility Value

Code	C1	C2	C3	C4	C5
A1	1	0,5	1	0	0,5
A2	0,666666667	0,5	0	0,5	0,5
A3	0,666666667	0	0,333333333	0,5	1
A4	0	1	0,666666667	1	0
A5	0,333333333	0,5	1	1	1

Formula Explanation:

$u_1(a_1) = \frac{4-1}{4-1} = 1$
$u_2(a_1) = \frac{4-2}{4-1} = 0{,}666666667$
$u_3(a_1) = \frac{4-2}{4-1} = 0{,}666666667$
$u_4(a_1) = \frac{4-1}{4-1} = 0$
$u_5(a_1) = \frac{4-3}{4-1} = 0{,}333333333$

$u_1(a_2) = \frac{3-2}{4-2} = 0{,}5$
$u_2(a_2) = \frac{3-2}{4-2} = 0{,}5$
$u_3(a_2) = \frac{2-2}{4-2} = 0$
$u_4(a_2) = \frac{4-2}{4-2} = 1$
$u_5(a_2) = \frac{3-2}{4-2} = 0{,}5$

$u_1(a_3) = \frac{4-1}{4-1} = 1$
$u_2(a_3) = \frac{1-1}{4-1} = 0$
$u_3(a_3) = \frac{2-1}{4-1} = 0{,}333333333$
$u_4(a_3) = \frac{3-1}{4-1} = 0{,}666666667$
$u_5(a_3) = \frac{4-1}{4-1} = 1$

$u_1(a_4) = \frac{2-2}{4-2} = 0$
$u_2(a_4) = \frac{3-2}{4-2} = 0{,}5$
$u_3(a_4) = \frac{3-2}{4-2} = 0{,}5$
$u_4(a_4) = \frac{4-2}{4-2} = 1$
$u_5(a_4) = \frac{4-2}{4-2} = 1$

$u_1(a_5) = \frac{3-2}{4-2} = 0{,}5$
$u_2(a_5) = \frac{3-2}{4-2} = 0{,}5$
$u_3(a_5) = \frac{4-2}{4-2} = 1$
$u_4(a_5) = \frac{2-2}{4-2} = 0$

$$u_5(a_5) = \frac{4-2}{4-2} = 1$$

5) Calculate the final score by summing the total result of the multiplication between the normalized criterion weight and the utility score.

Table 6. Final Score

Code	C1	C2	C3	C4	C5	Final Score
A1	0,3	0,1	0,1	0	0,1	0,6
A2	0,2	0,1	0	0,1	0,1	0,5
A3	0,2	0	0,033333333	0,1	0,2	0,5333333
A4	0	0,2	0,066666667	0,2	0	0,4666667
A5	0,1	0,1	0,1	0,2	0,2	0,7

Formula Explanation:

$$a_1 = (1 * 0.3) + (0{,}5 * 0.2) + (1 * 0.1) + (0 * 0.2) + (0{,}5 * 0.2) = 0{,}3 + 0.1 + 0{,}1 + 0 + 0.1$$

$$= 0.6$$

$$a_2 = (0{,}666666667 * 0.3) + (0{,}5 * 0.2) + (0 * 0.1) + (0{,}5 * 0.2) + (0{,}5 * 0.2)$$

$$= 0{,}2 + 0.1 + 0 + 0.1 + 0.1 = 0.5$$

$$a_3 = (0{,}666666667 * 0.3) + (0 * 0.2) + (0{,}333333333 * 0.1) + (0.5 * 0.2) + (1 * 0.2) = 0.2 +$$

$$0 + 0.33333333 + 0.1 + 0.2 = 0.5333333$$

$$a_4 = (0 * 0.3) + (1 * 0.2) + (0.666667 * 0.1) + (1 * 0.2) + (0 * 0.2)$$

$$= 0 + 0.2 + 0.066666667 + 0.2 + 0 = 0{,}4666667$$

$$a_5 = (0.333333333 * 0.3) + (0.5 * 0.2) + (1 * 0.1) + (1 * 0.2) + (1 * 0.2)$$

$$= 0.1 + 0.1 + 0.1 + 0.2 + 0.2 = 0.7$$

6) Ranking

Table 7. Ranking

Code	Final Score	Ranking
A1	0,6	**2**
A2	0,5	**4**
A3	0,5333333	**3**
A4	0,4666667	**5**
A5	0,7	**1**

According to the ranking results, Muhamad Haerul Rizal, identified by code A5, obtained a final score of 0.7, earning him the title of best employee at PT Raharja Jaya Mandiri Bekasi.

2.4 *PHP*

PHP, which stands for Hypertext Preprocessor, is a server-side programming language specifically designed for web creation and development. This programming language focuses on the ability to develop dynamic web pages and is primarily used by web developers [12].

2.5 *MySQL*

MySQL is software that falls under the category of RDBMS (Relational Database Management System). Its function is as a database management application, known for its speed in sending and receiving data. MySQL also supports multi-user usage through basic SQL commands [13].

2.6 *Website*

As software, a website plays a role in displaying documents on the internet, allowing users to connect to the internet through a computer [14]. A website is an online medium with a specific web address and contains various types of content, including text, images, videos, audio, and interactive forms. Its purposes vary, including information, communication, e-commerce, entertainment, and other needs.

2.7 *Black-Box Testing*

Black Box testing is a method that focuses on the functional specifications of software, where testers define a set of input conditions and test the functional specifications of the program[15]. This method emphasizes the functionality of the system. Black Box testing has both advantages and disadvantages. One advantage is its ability to identify aspects that do not meet the requirements specified during the software development process. However, a limitation of Black Box testing is the restricted scope of testing, as testers may not have in-depth knowledge of the internal structure of the software being tested.

3 Results and Discussion

1. Use case Diagram

Use Case Diagram for a Decision Support System for selecting the best employees using the SMART algorithm at PT Raharja Jaya Mandiri Bekasi. It involves three main actors: Manager, Supervisor (SPV), and HRD (Human Resources Department). Each actor interacts with different system functionalities.

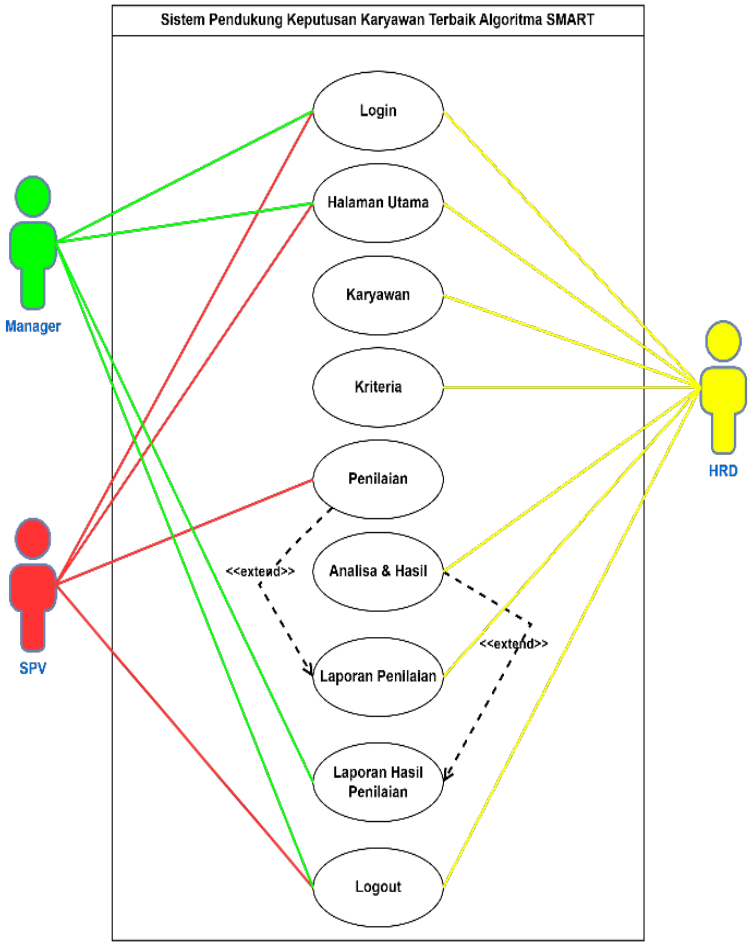

Figure 1. Use Case Diagram

2. Entity Relationship Diagram (ERD)

Figure 2 represents an Entity Relationship Diagram (ERD) for a decision support system that evaluates employees using the SMART (Simple Multi Attribute Rating Technique) algorithm. This ERD illustrates a decision-making system that tracks employee performance based on various criteria and subcriteria, with scores assigned to each attribute. The ERD also includes the system's users and reports generated from employee evaluations.

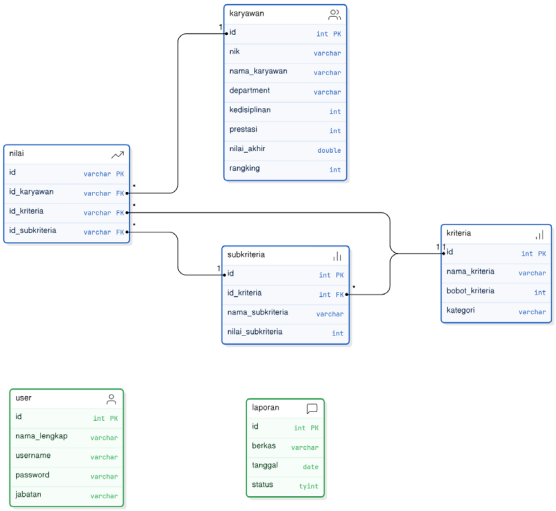

Figure 2. Entity Relationship Diagram

3. Implementation Sistem

At this stage of system implementation, the main focus is to integrate the previously designed blueprint into a functional application that can be used by the relevant parties. This system implementation refers to the use of Use Case and Entity Relationship Diagram (ERD) as the foundation in the development of the system, which is built to support the process of selecting the best employees at PT Raharja Jaya Mandiri Bekasi. Additionally, the SMART (Simple Multi-Attribute Rating Technique) algorithm is also implemented in the system to assist in the employee evaluation and assessment process in an objective and structured manner.

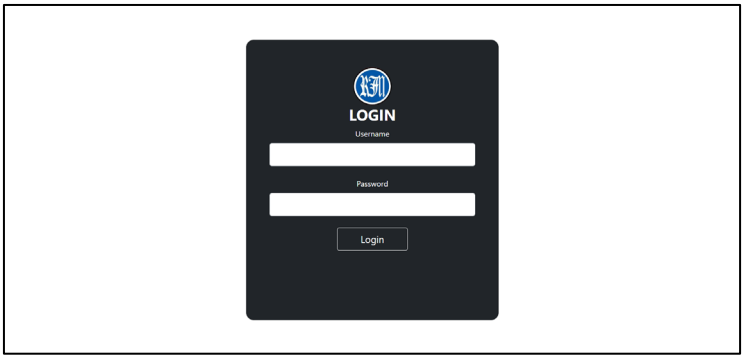

Figure 3. Login Interface

HRD, Supervisors, and Managers are required to log in before proceeding with any further activities or tasks within the system.

1) HRD interface

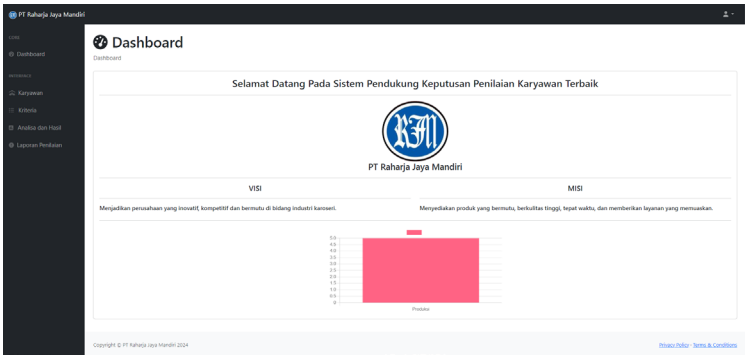

Figure 4. HRD Dashboard Interface

Figure 4 shows the main screen displayed after the HRD has logged in, where various menus are available for HRD access Figure 4 displays the main interface after HRD has logged in, showing accessible menus such as Employee, Criteria, Evaluation Report, Analysis and Results.

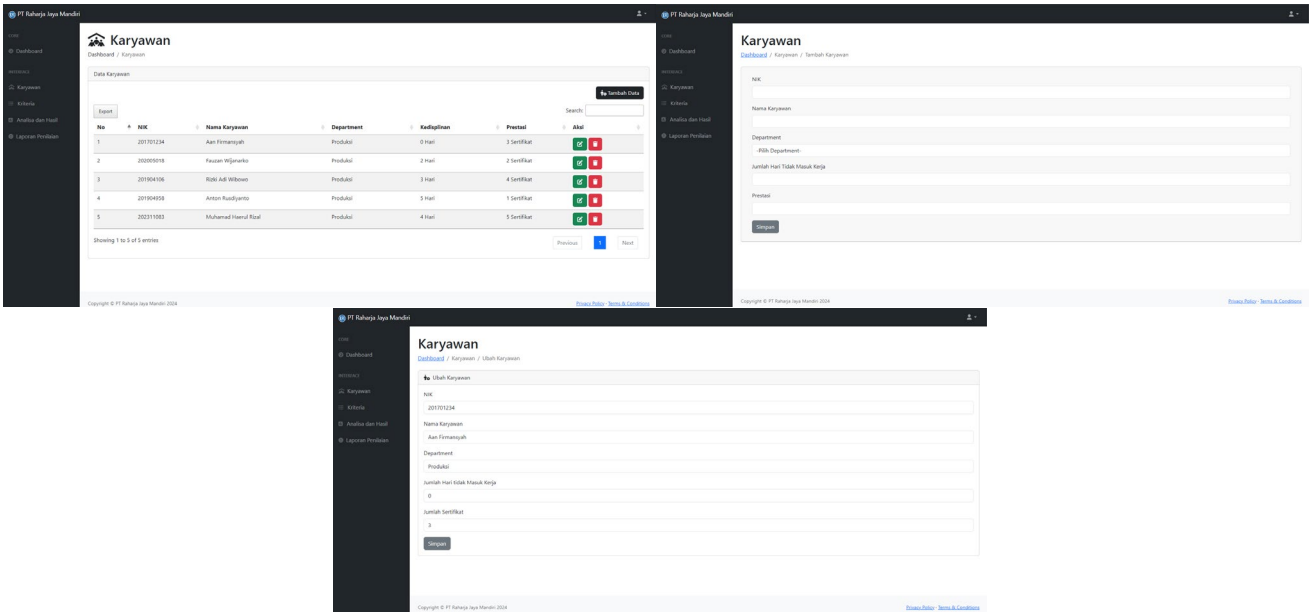

Figure 5. Employee Interface

Figure 5 presents the Employee menu interface, offering HRD a comprehensive and user-friendly platform to manage employee data. Here, HRD can effortlessly view, add, edit, and delete employee information, streamlining the process of maintaining accurate and up-to-date records.

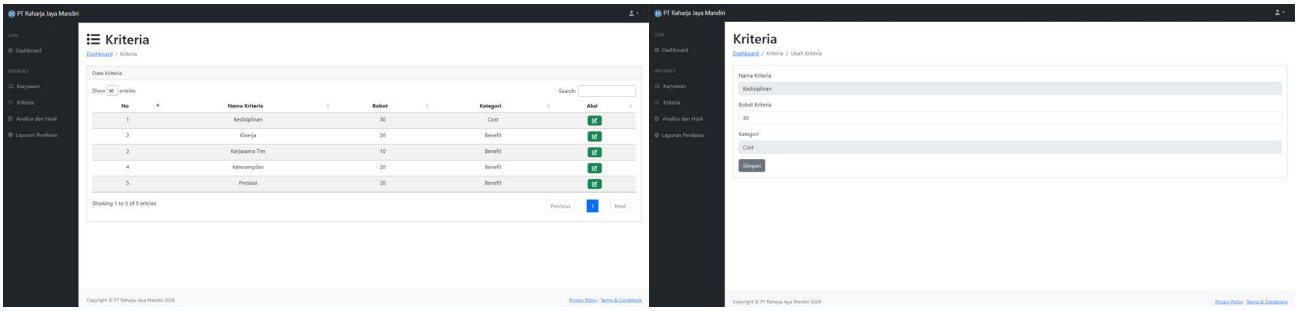

Figure 6. Criteria Interface

Figure 6 displays the Criteria menu interface, where HRD cannot add or delete criteria data but can view and adjust the weights of the criteria.

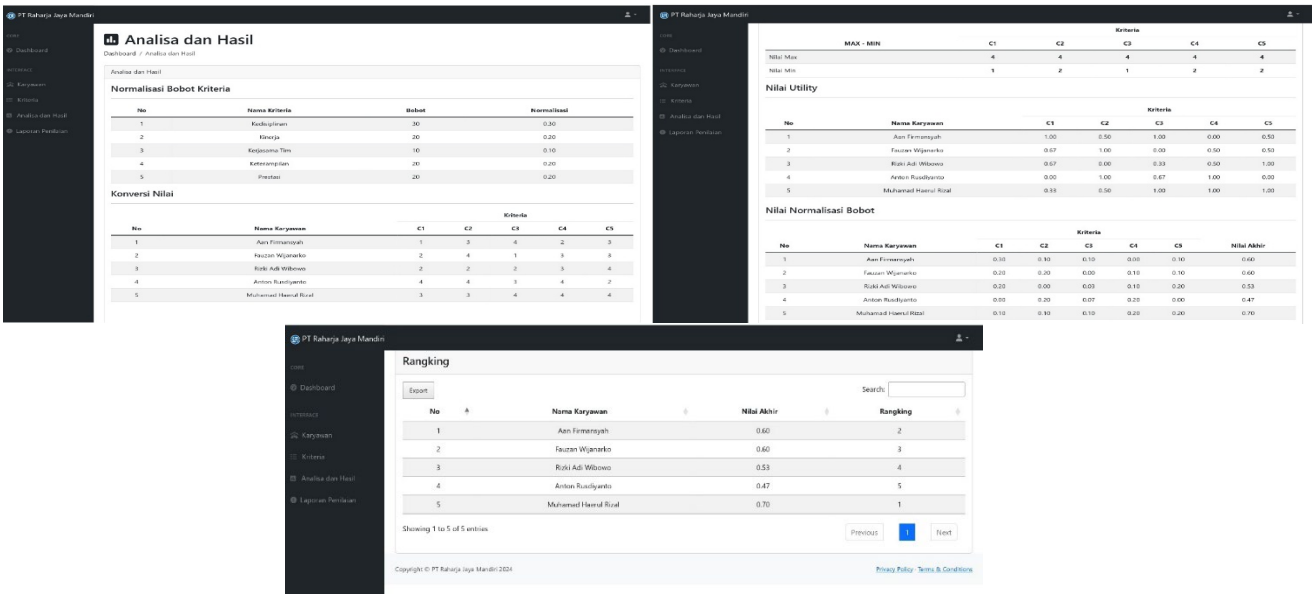

Figure 7. Analysis and Results Interface

Figure 7 shows the Analysis and Results menu, providing a detailed summary of the assessment analysis conducted by the supervisor. In this menu, HRD can easily review and understand the evaluation results. Additionally, HRD has the option to download the analysis results.

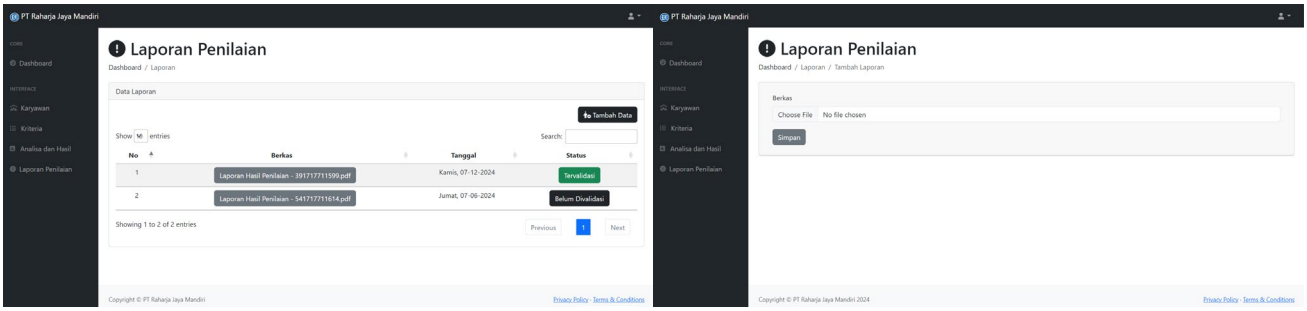

Figure 8. Evaluation Report Interface

Figure 8 displays the Evaluation Report menu, where HRD can upload the assessment document previously downloaded from the Analysis and Results menu. Once the document is submitted, HRD only needs to wait for approval from the manager before officially announcing the evaluation results. This menu streamlines the communication and verification process between HRD and the manager, ensuring that every step has been reviewed before the final results are announced.

2) Supervisor Interface

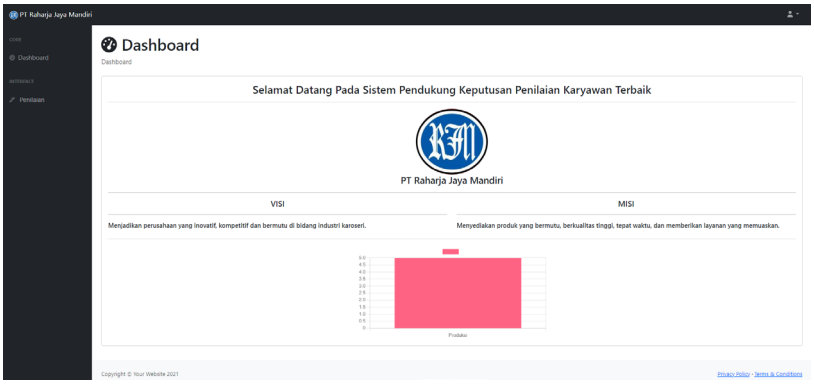

Figure 9. Supervisor Dashboard Interface

Figure 9 shows the main interface after the supervisor has logged in, where only the Evaluation menu is accessible.

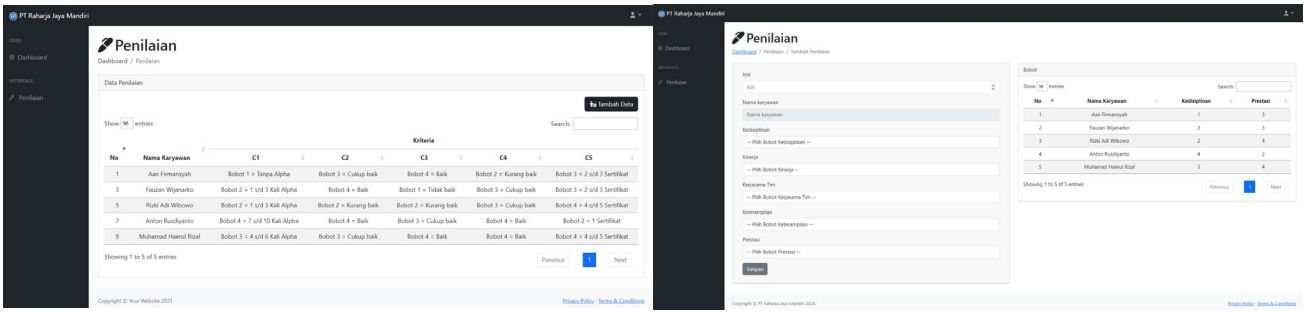

Figure 10. Evaluation Interface

Figure 10 displays the layout of the Evaluation menu, where the supervisor has limited access. In this interface, the supervisor can only view and add evaluation data but does not have permissions to modify or delete existing records, simplifying the evaluation process and enhancing data reliability.

3) Manager Interface

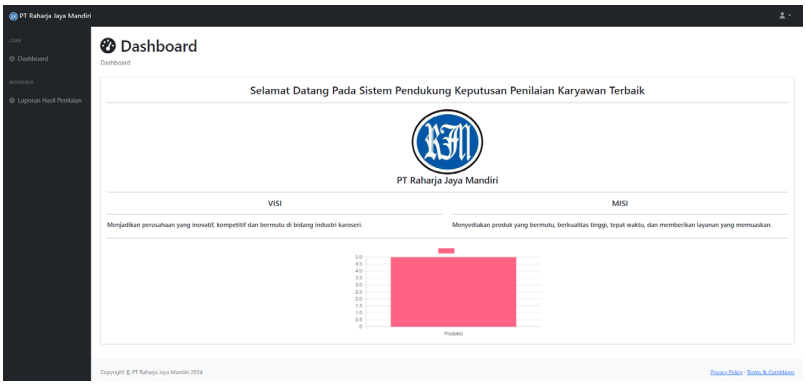

Figure 11. Manager Dashboard Interface

Figure 11 shows the interface after the manager has logged in, where only the Evaluation Result Report menu is available.

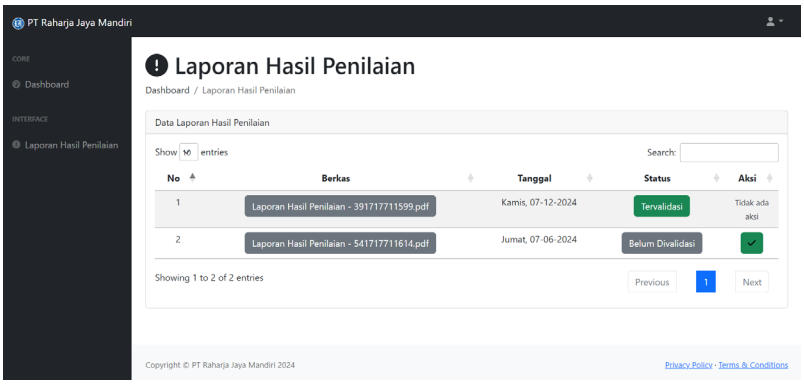

Figure 12. Evaluation Result Report

Figure 12 shows the Evaluation Report menu interface, where the manager can view the report results submitted by HRD. The manager also has the option to approve the evaluation report before it is officially announced.

4. System Testing

After the system development phase is completed, the next step is to conduct system testing using the black box testing method to gather user feedback. This method is effective in evaluating the application's functionality based on user interactions with the system, without considering the system's internal structure.

Testing is carried out through pre-prepared test cases, as well as using testing tables to ensure that the system operates as expected. During the testing process, input data is entered into the system to verify whether the output results align with expectations. The goal of this testing is to ensure that each feature and function of the application operates correctly and meets the intended objectives, while also providing feedback for further system improvements.

Table 8. HRD Role Testing

No	Menu	Test Scenario	Expected Outcome	Bug/Issue	Status
1	Login	Enter a valid username and password	The system displays the main page if login is successfull	None	Success
2	Employee	Access the Employee menu	The system successfully displays the Employee page	None	Success
3	Add Employee	Select Add in the employee menu, fill in employee data, and save it	The system displays the add employee form, saves the employee data, and returns to the employee page	None	Success
4	Edit Employee	Select an employee to edit, make changes, and save them.	The system successfully the edit employee form, save the changes, and return to the employee page	None	Success

No	Menu	Test Scenario	Expected Outcome	Bug/Issue	Status
5	Delete Employee	Select an employee and delete their data	The system successfully deletes the selected employee's data and return to the employee page	None	Success
6	Export Employee	Click the Export button on the employee page	The system successfully downloads the employee data file	None	Success
7	Criteria	Access the criteria menu	The system successfully display the criteria page	None	Success
8	Edit Criteria	Select a criteria, change its weight, and save the change	The system displays the edit criteria form, saves the change, and returns to the criteria page	None	Success
9	Analysis and Results	Access the Analysis and Results menu	The system successfully displays the Analysis and Results page, along with the calculation results as expected	None	Success
10	Export Assessment Results	Click the Export button on the Analysis and Results page	The system successfully downloads the assessment results file	None	Success
11	Assessment Report	Access the Assessment Report menu	The system successfully displays the assessment report page	None	Success
12	View Document	Click a document in the report table to view its content	The system successfully displays the content of the selected document	None	Success
13	Add Assessment Report	Clik Add, Upload a report document, and save it	The system displays the upload document form, saves the report, and returns to the assessment report page	None	Success
14	Logout	Log Out of the system	The system logs out and displays the login page	None	Success

Table 9. Supervisor Role Testing

No	Menu	Test Scenario	Expected Outcome	Bug/Issue	Status
1	Login	Enter a valid username and password	The system displays the main page if login is successfull	None	Success
2	Evaluation	Access the Evaluation menu	The system successfully displays the Evaluation page	None	Success
3	Add Evaluation	Select Add menu on the Evaluation page, fill in evaluation data, and save it	The system displays the add form, saves data successfully, and returns to the evaluation page	None	Success
4	Logout	Log Out of the system	The system logs out and displays the login page	None	Success

Table 10. Manager Role Testing

No	Menu	Test Scenario	Expected Outcome	Bug/Issue	Status
1	Login	Enter a valid username and password	The system displays the main page if login is successfull	None	Success
2	Report Results Evaluation	Access the Report Results Evaluation menu	The system successfully displays the Report Results Evaluation page	None	Success
3	View Document	Click on a document in the table to view its contents	The system successfully displays the contents of the selected document	None	Success
4	Validation	Click the validation action on the select report	The system successfully validates the report and return to the report results evaluation page	None	Success
5	Logout	Log Out of the system	The system logs out and displays the login page	None	Success

Based on the system testing results and the feedback received from the roles of HRD, Supervisor, and Manager, all system functions are operating smoothly without any issues or bugs. All menus are easily accessible, processes

such as adding, editing, and deleting data are accurate, and data export is successful. The system is responsive and quick in responding to user input, with consistent performance. The user experience is positive, with intuitive and easy-to-understand navigation. Overall, the system has successfully met the expectations set during testing.

4 Conclusion

Based on the research and discussion regarding the decision support system for evaluating the best employees at PT Raharja Jaya Mandiri Bekasi, the following conclusions can be drawn:

1. The implementation of a web-based Decision Support System using the SMART Algorithm improves accuracy and efficiency in evaluating the best employees at PT Raharja Jaya Mandiri Bekasi.
2. This web-based system saves time and resources in employee evaluations and provides an easily accessible tool for Managers, HRD, and Supervisors.
3. The use of the SMART Algorithm in this system enhances transparency and objectivity in evaluations, reducing subjective bias, and ensuring that the best employees are selected based on measurable criteria.

5 Suggestion

Based on the research, the decision support system for evaluating the best employees requires some recommendations to further improve the system and serve as a basis for future studies. The following are suggestions for this research:

1. Integrating the decision support system for employee evaluation with the HRD system at PT Raharja Jaya Mandiri Bekasi will enhance data access and efficiency, thereby improving employee evaluation processes.
2. Collaborating the SMART Algorithm with other algorithms to enhance the employee selection process and achieve better results.

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