Journal of Information Technology and Cyber Security 3(2) July 2025: 84-94 EISSN 2987-386X | PISSN 2987-3878
DOI: 10.30996/jitcs.12523

Payroll Decision Support System for Production Employees Based on Key Performance Indicators Using the Simple Additive Weighting Method

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Received: 01 January 2025
Accepted: 01 March 2025
Revised: 21 February 2025
Available online: 14 September 2025

To cite this article: Suganda, T. B., & Dzikria, I. (2025). Payroll Decision Support System for Production Employees Based on Key Performance Indicators Using the Simple Additive Weighting Method. *Journal of Information Technology and Cyber Security, 3*(2), 84-94. https://doi.org/10.30996/jitcs.12523

Abstract
CV. XYZ is a Micro, Small, and Medium Enterprise (MSME) engaged in plastic sack sewing services and implements a piece rate pay system. The company faces obstacles in managing performance-based payroll, which impacts operational efficiency and payment accuracy. This study aims to develop a Payroll Decision Support System (DSS) to record and evaluate the work results of production employees using Key Performance Indicators (KPIs). KPI evaluation is applied as the main criteria in weighting using the Simple Additive Weighting (SAW) method, to produce optimal performance scores. The implementation of KPI-based incentives is expected to improve employee performance while encouraging a productive and transparent work culture. Blackbox testing shows that 97% of the test data meets user requirements, indicating that the system can run according to specifications. The results of this study contribute to the integration of KPIs and SAW in assessing production employee performance for fair and effective payroll decision-making, as well as helping companies implement efficient management practices.
Keywords: decision support system, key performance indicators, payroll, performance-based incentive, performance evaluation, simple additive weighting.

1. Introduction
The piece-rate pay system is an incentive-based individual payment method for each product that is completed (Dickinson & Gillette, 1994). This system is widely implemented by Micro, Small, and Medium Enterprises (MSMEs) in Indonesia, where employees receive payment according to the number of goods produced and the achievement of company targets. One of the companies implementing this system is CV. XYZ, which produces plastic sacks. The company faced challenges with its manual payroll system, which used paper sheets. This increased the risk of production data errors and lost work records, making employee performance evaluations less accurate and efficient.

Human resource management plays an important role in determining productivity and achieving company targets (Noval, Handrianto, & Supendar, 2020; Ratnasari & Mahmud, 2020). Objective employee performance evaluation can be conducted using Key Performance Indicators (KPIs). KPIs provide information on job objectives, achievements, how to achieve them, measures of success, and the achievement period (Dipura & Soediantono, 2022). To process KPIs into performance evaluation scores, the Simple Additive Weighting (SAW) method can be used, because this method gives weight to each KPI criterion so that the assessment becomes more objective (Rosyani, Normalisa, & Priambodo, 2019).

Several previous studies have developed SAW-based Decision Support Systems (DSS) for various purposes. For instance, Rosyani, Normalisa, & Priambodo (2019) assessed the performance of high-performing employees, Toresa, Zamsuri, Yunefri, & Sari (2022) selected high-performing employees, dan Fransiska, Fernando, & Pibriana (2020) used this method to determine salary increases based on criteria such as marital status, education, length of service, and attendance. However, research that specifically

assesses production employees with KPI and SAW for providing incentives is still limited.

This study aims to record production results, calculate payroll, and evaluate the performance of production employees using KPIs and the SAW method. This integration is expected to provide more objective performance assessments and fair and effective production payments. Furthermore, this study is expected to assist companies in decision-making to improve productivity, efficiency, and more transparent employee management.

2. Literature Review

2.1. Piece-Rate Pay System Based Payroll Information System

A piece-rate pay system is a wage or compensation system based on the number of units of product produced or work completed. Generally, wages are anything workers receive in return for their contributions to the company (Mukti & Asmaroni, 2020). By providing appropriate wages, employees tend to be motivated, which in turn has a positive impact on the continuity of the company's operations.

A payroll information system plays a crucial role in HR welfare management. It enables companies to manage payroll in a structured, efficient, and accurate manner, ensuring that employee rights are met appropriately (Kaengke, 2021). Especially for small and medium scale companies (Gunasekaran, Forker, & Kobu, 2000), Information systems contribute to increased productivity and operational effectiveness (Azizah, Yuliana, & Juliana, 2017).

2.2. Employee Performance Evaluation Based on Key Performance Indicators

Performance evaluation is a systematic process used to assess employee performance with the goal of providing relevant feedback and ensuring accountability for assigned responsibilities. Through this process, organizations can identify their strengths and weaknesses (Widyaningrum, 2020). So that performance evaluation functions not only as a control tool, but also as a basis for strategic decision making to improve performance in the future (Aini, 2019).

In practice, employee performance evaluation encompasses various aspects, such as productivity level, quality of work results, interpersonal skills, target achievement, and other factors deemed relevant by the organization. The assessment process can be conducted using either a quantitative or qualitative approach, depending on the established indicators and expected standards (Aini, 2019). A comprehensive evaluation allows companies to obtain a more objective picture of an individual's contribution to achieving organizational goals.

Key Performance Indicators (KPIs) are parameters designed to measure the extent to which an organization, team, or individual has achieved its stated goals. As key indicators, KPIs not only help organizations assess success but also identify areas for improvement (Setyodewi, Widiarti, & Fathoni, 2023). Selecting the right KPIs is crucial because they must be aligned with the organization's operational context and expected performance targets. In the context of decision support systems, KPIs serve as measurable variables that can be integrated with multi-criteria evaluation methods, thus supporting more objective, transparent, and accountable assessments.

2.3. Simple Additive Weighting

Kiswanto, Susanto, & Wakhidah cited by Rosyani, Normalisa, & Priambodo (2019) stated that Simple Additive Weighting (SAW) is a method widely used to solve Multi-Attribute Decision-Making (MADM) problems. This method calculates the total weighting of each alternative against all relevant criteria (Irawan, 2020), then determine the best alternative based on the total score (Witasari & Jumaryadi, 2020). The SAW concept assumes that each criterion has a different level of importance. Each criterion is weighted according to its importance, then the value of each criterion is multiplied by that weight, and all the results are added together to produce a total score for each alternative.

SAW requires normalization of the decision matrix (x) so that all alternative ratings can be compared equally, both for benefit and cost attributes (Mahendra & Nugraha, 2020). Eq. (1) used to normalize the value of each attribute, where x_{ij} is the original value of alternative i on criterion j.

If the criterion is a benefit attribute, the normalized value r_{ij} is obtained by dividing x_{ij} by the maximum value of the criterion. Conversely, if the criterion is a cost attribute, the normalized value is obtained by divi-

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max x_{ij}} & If\ j\ is\ a\ benefit\ attribute \\ \frac{\min x_{ij}}{x_{ij}} & If\ j\ is\ a\ cost\ attribute \end{cases} \quad (1)$$

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (2)$$

Table 1
Key performance indicators (KPIs) and weights.

Criterion	KPI Name	Weight	Attribute
C1	Production Quantity	0.25	Benefit
C2	Production Quality	0.20	Benefit
C3	Additional Production (Over Target)	0.15	Benefit
C4	Production Time Efficiency	0.15	Benefit
C5	Production Errors	0.25	Cost

ding the minimum value of the criterion by x_{ij}. In this way, all attributes are on a uniform scale and can be directly compared. Once the normalized ratings are obtained, the preference value of each alternative V_i is calculated using Eq. (2), by multiplying each normalized rating value r_{ij} by the criterion weight w_j, then summing the results for all criteria. The value of V_i indicates the final ranking of each alternative, where a larger value indicates that alternative A_i is preferred (Nurdin in Nofriansyah, 2014).

The SAW method has proven effective for evaluating employee performance, particularly in determining individuals who are entitled to receive incentives or remuneration (Rosyani, Normalisa, & Priambodo, 2019; Dzikria, Ardan, & Ripando, 2023). Previous studies have shown that SAW can improve the objectivity, efficiency, and speed of performance evaluation (Dzikria, Ardan, & Ripando, 2023). For instance, Febryantahanuji and Lestari (2021) implemented SAW using criteria of attendance, lateness, number of reports, deposit recapitulation, printing errors, and stocktaking, with the result that the system speeds up evaluation and reduces errors.

Compared to other methods where Yuliyanti & Sartika (2023) utilized Analytical Hierarchy Process (AHP) dan Bahrudin (2022) used Weighted Product (WP), SAW was chosen because it is linear, in accordance with the KPI scale. AHP uses comparisons and WP is suitable for non-linear scales, while SAW facilitates decisions based on the sum of weights (Dzikria, Ardan, & Ripando, 2023). The stages of implementing SAW in the payroll information system can be summarized as follows:

1) Determine the attribute type for each criterion: benefit or cost.
2) Normalize attribute values according to their type.
3) Generate normalized ratings r_{ij} in Eq. (1).
4) Multiply the normalized ratings r_{ij} by the criterion weight w_j to calculate the preference value V_i in Eq. (2).
5) Rank alternatives based on V_i to obtain a comprehensive employee performance evaluation.

With SAW, each alternative is evaluated fairly and uniformly across all criteria, resulting in an objective employee performance ranking that can be used as a basis for decision-making in HR management.

3. Methodology

3.1. Data Collection

This study employed an observational method to directly study the work environment of CV. XYZ. Observations were conducted through observing the manual payroll process and employee performance evaluations, as well as through discussions regarding the company's procedures. The results of these observations were used to identify the functional and non-functional requirements of the payroll information system to be developed.

In addition to observations, data was collected through semi-structured interviews with several respondents representing the entire employee population and decision-makers at the company, including directors, managers, quality control, and production staff. The data collected included weekly payroll, daily employee work production data, and employee assessment criteria related to Key Performance Indicators (KPIs).

The KPI weighting process was conducted through intensive discussions with company stakeholders to ensure a thorough understanding of the performance evaluation process and the influence of each criterion on payroll decisions. Based on these interviews and discussions, the study derived several KPIs and their weightings, which served as the basis for the analysis, as shown in Table 1.

3.2. Implementation of Key Performance Indicators and Simple Additive Weighting

The payroll information system developed in this study was designed to address the limitations of manual systems that are prone to recording and calculation errors. Being web-based, this system simplifies the entire payroll process, from recording employee performance data to calculating incentives and penalties. The implementation of this new system is expected to improve operational efficiency, data trans-

Table 2
Criterion scoring for each alternative.

Alternative	C1	C2	C3	C4	C5
A1	5	6	2	4	6
A2	4	6	2	4	6
A3	5	5	2	5	4
A4	4	6	1	4	6
A5	4	4	3	5	6
A6	3	6	2	4	6
A7	4	5	2	5	3
A8	4	6	2	5	6

Table 3
Normalized decision matrix.

Alternative	C1	C2	C3	C4	C5
A1	1.00	1.00	0.67	0.80	0.50
A2	0.80	1.00	0.67	0.80	0.50
A3	1.00	0.83	0.67	1.00	0.75
A4	0.80	1.00	0.33	0.80	0.50
A5	0.80	0.67	1.00	1.00	0.50
A6	0.60	1.00	0.67	0.80	0.50
A7	0.80	0.83	0.67	1.00	1.00
A8	0.80	1.00	0.67	1.00	0.50

Table 4
Weighted values (initial).

Alternative	C1	C2	C3	C4	C5
A1	0.25	0.20	0.10	0.12	0.125
A2	0.20	0.20	0.10	0.12	0.125
A3	0.25	0.17	0.10	0.15	0.1875
A4	0.20	0.20	0.05	0.12	0.125
A5	0.20	0.13	0.15	0.15	0.125
A6	0.15	0.20	0.10	0.12	0.125
A7	0.20	0.17	0.10	0.15	0.250
A8	0.20	0.20	0.10	0.15	0.125

Table 5
Re-normalization of criterion C5 (production errors).

Alternative	C5
A1	1.00
A2	1.00
A3	0.67
A4	1.00
A5	1.00
A6	1.00
A7	0.50
A8	1.00

parency, and accuracy in employee payroll management in the production division.

Employee performance evaluation within the system is conducted using Key Performance Indicators (KPIs) as the measurement basis. The KPIs used (Table 1) are selected based on their relevance to company productivity. Each criterion is assigned a weighting that represents its level of importance, so that more critical indicators contribute more to the final assessment.

To integrate KPIs into the decision-making system, this study uses the SAW (Scale-Based Analysis). The SAW calculation process begins by assigning weights to each KPI criterion (Table 2) based on employee production data over a one-month period. Next, the decision matrix is normalized to ensure equal scale comparisons between attributes (Table 3). The normalized result is multiplied by the criterion weights to obtain a weighted score (Table 4).

Because one of the criteria, C5 (Production Error), is a cost attribute, renormalization was performed to ensure the interpretation of its values was consistent with the evaluation logic (Table 5). The results were

Table 6
Final weighted values.

Alternative	C1	C2	C3	C4	C5
A1	0.25	0.20	0.10	0.12	0.25
A2	0.20	0.20	0.10	0.12	0.25
A3	0.25	0.17	0.10	0.15	0.17
A4	0.20	0.20	0.05	0.12	0.25
A5	0.20	0.13	0.15	0.15	0.25
A6	0.15	0.20	0.10	0.12	0.25
A7	0.20	0.17	0.10	0.15	0.13
A8	0.20	0.20	0.10	0.15	0.25

Table 7
Alternative ranking based on SAW scores.

Alternative	C1	C2	C3	C4	C5	Score	Rank
A1	0.25	0.20	0.10	0.12	0.25	0.92	1
A2	0.25	0.20	0.10	0.12	0.25	0.87	4
A3	0.25	0.17	0.10	0.15	0.17	0.83	5
A4	0.25	0.20	0.05	0.12	0.25	0.82	6
A5	0.25	0.20	0.15	0.15	0.25	0.88	3
A6	0.25	0.20	0.10	0.12	0.25	0.82	7
A7	0.25	0.17	0.10	0.15	0.13	0.74	8
A8	0.25	0.20	0.10	0.15	0.25	0.90	2

Table 8
Alternative ranking under changes in criteria weights.

Alternative	C1	C2	C3	C4	C5	Score	Rank
A1	0.20	0.20	0.10	0.16	0.25	0.91	1
A2	0.16	0.20	0.10	0.16	0.25	0.87	4
A3	0.20	0.17	0.10	0.20	0.17	0.83	5
A4	0.16	0.20	0.05	0.16	0.25	0.82	7
A5	0.16	0.13	0.15	0.20	0.25	0.89	3
A6	0.12	0.20	0.10	0.16	0.25	0.83	6
A7	0.16	0.17	0.10	0.20	0.13	0.75	8
A8	0.16	0.20	0.10	0.20	0.25	0.91	2

then used to recalculate the weighted scores (Table 6). The final SAW score was obtained by summing all weighted scores, followed by a ranking of the alternatives (Table 7).

In addition to the main calculations, this study conducted sensitivity simulations to analyze the impact of small changes in KPI weights on the final scores and employee rankings. For example, when the weight of C1 was decreased from 0.25 to 0.20 and the weight of C4 was increased from 0.15 to 0.20, there was a significant change in the positions of alternatives A4, A5, and A7 (Table 8). These results indicate that criterion weights have a crucial influence on evaluation outcomes.

The distribution of employees' final scores is visualized in Fig. 1, which intuitively shows the distribution of alternative preferences and provides a clear picture of the relative contribution of each criterion to performance evaluation. Thus, the integration of KPIs and SAW in the payroll system not only supports an objective calculation process but also provides a transparent and measurable basis for managerial decision-making regarding employee performance.

3.3. Waterfall Model

This research applies the Waterfall Model as a framework for the software development process because of its linear and sequential nature, where each phase must be fully completed before proceeding to the next phase, without any overlap between stages (Sommerville, 2016). The selection of this model was based on the conditions of CV. XYZ, which required clarity of system requirements from the start of development. An Agile-based approach was deemed less appropriate because the company did not deal with the dynamics of frequently changing requirements or short system release periods.

The first stage is requirements analysis and definition. In this stage, system requirements were gathered through direct observation and interviews with various stakeholders at CV. XYZ, including managers, quality control, and super admins. This data collection resulted in the identification of 19 functional requirements and 11 non-functional requirements. Functional requirements encompass data ma-

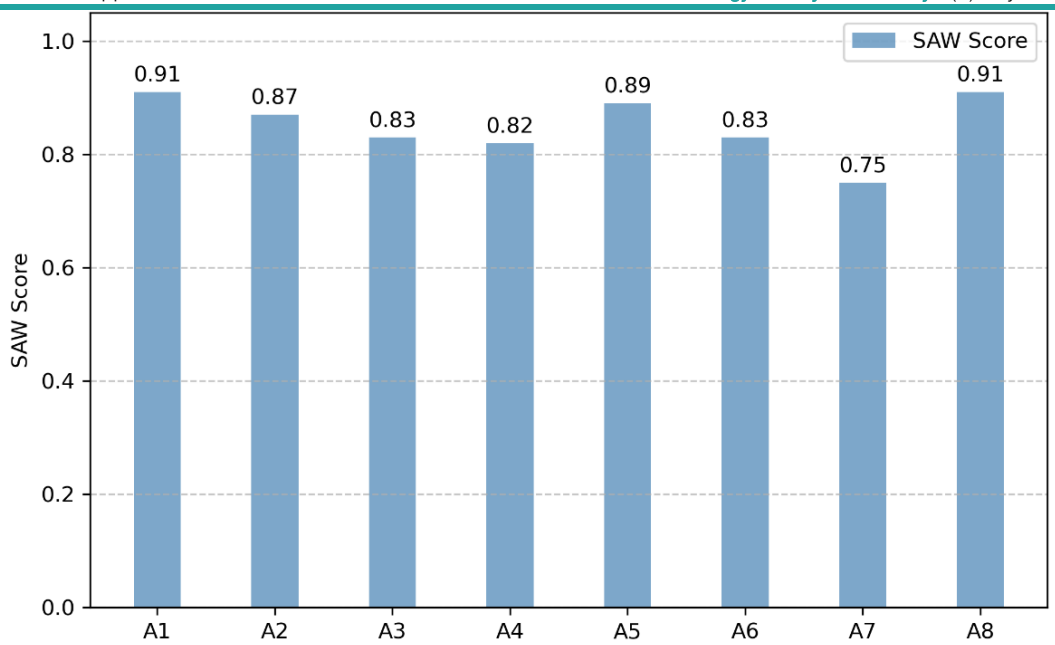

Fig. 1. Employees' SAW scores.

nagement for goods, employees, orders, production, quality control, payroll, KPIs, performance evaluation, and calculations using the SAW method. Non-functional requirements encompass reliability, usability, maintainability, performance, scalability, and quality.

The second stage is software design. The identified requirements are used as the basis for designing a payroll system based on KPIs and the SAW method. The design is realized in the form of user flows, use case diagrams, activity diagrams, and sequence diagrams using Figma and Draw.io. These diagrams illustrate the interactions between actors and the system, the process flow, and the logic of employee performance evaluation. The main actors in the system are managers, quality control, and super admins.

This research produced 12 activity diagrams, showing the activities of each use case for various actors, and 12 sequence diagrams, providing a technical overview of the process flow from the actor to the system interface, controller, and database. The use case diagram for manager performance evaluation illustrates how managers can manage data on goods, employees, KPIs, orders, daily production, payroll, performance evaluations, and generate payroll and employee performance evaluation reports for a specific period.

Fig. 2 shows the manager's process for conducting employee performance evaluations. To create a performance evaluation, managers first define KPIs, weight each criterion, and assign a rating for each criterion. Managers then enter the performance evaluation code and the production date range. The system calculates a SAW score based on the predetermined criteria and displays a list of employees ranked from highest to lowest. Managers can then generate a performance evaluation report based on the selected date.

The third stage is implementation and unit testing. The design was implemented using the PHP programming language with the Laravel framework and the Model-View-Controller (MVC) architecture. Unit testing was conducted in parallel throughout development to ensure each module functioned as intended.

The fourth stage is integration and system testing. The system was tested as a whole using black-box testing methods to assess the alignment between defined requirements and implementation results. This research developed 13 test cases and sub-cases to thoroughly test the system's functionality.

The final stage is operation and maintenance. The developed system was implemented in the CV. XYZ work environment, specifically to support payroll operations and performance evaluation in the plastic sack production division. Regular maintenance was performed to ensure the system remained adaptive to the company's evolving needs.

With this approach, each development stage could be systematically controlled, the risk of errors was minimized, and the resulting payroll system was able to provide objective, efficient, and user-friendly decision support for all company stakeholders. The resulting diagram and visualization (Fig. 2) help understand the performance evaluation flow and the role of each actor in the system, so that the implementation of KPIs and SAW can be carried out in a transparent and measurable manner.

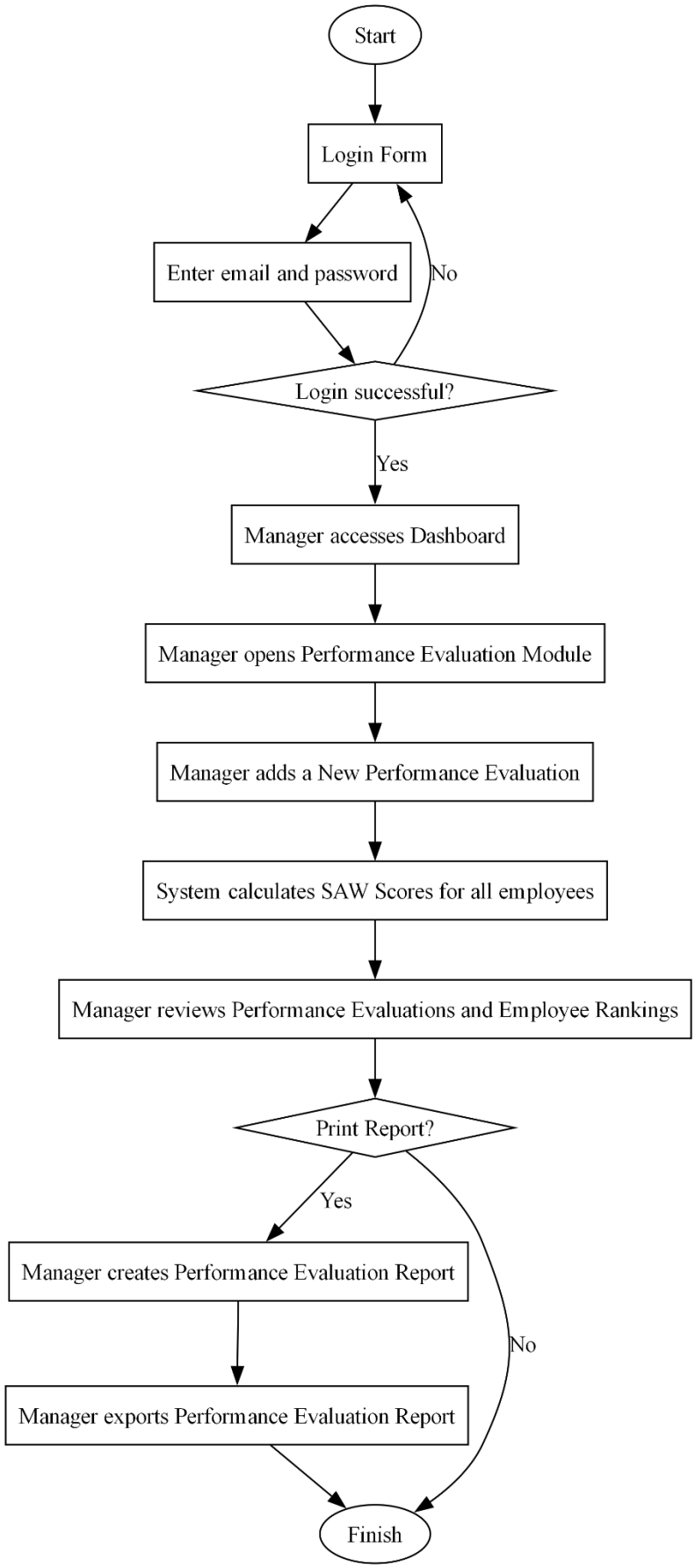

Fig. 2. Employee performance evaluation workflow.

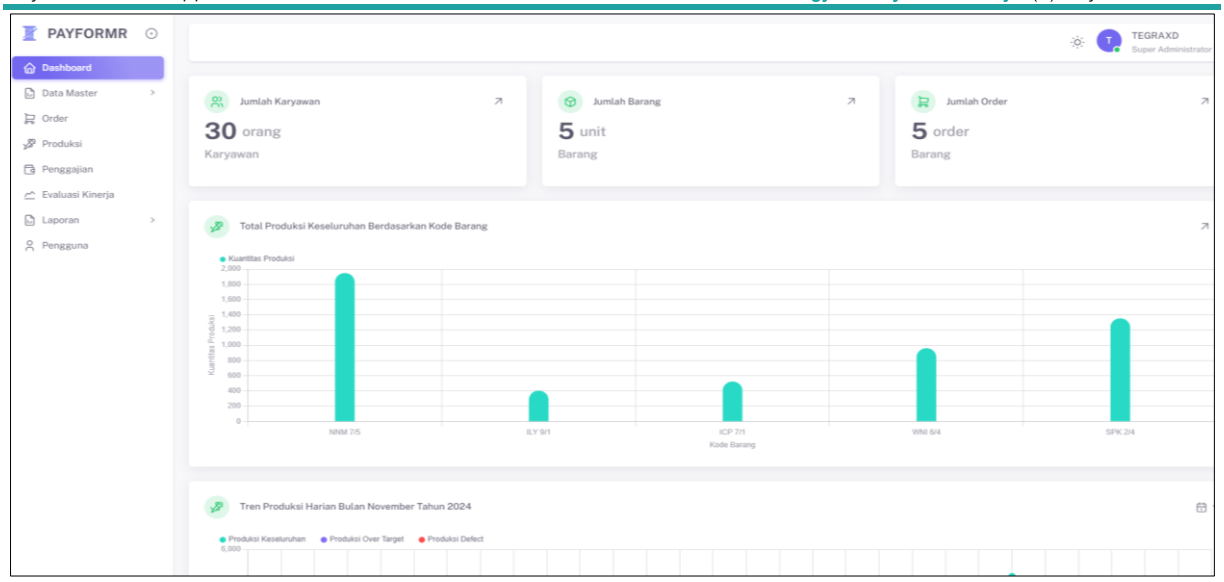

Fig. 3. User dashboard interface (manager).

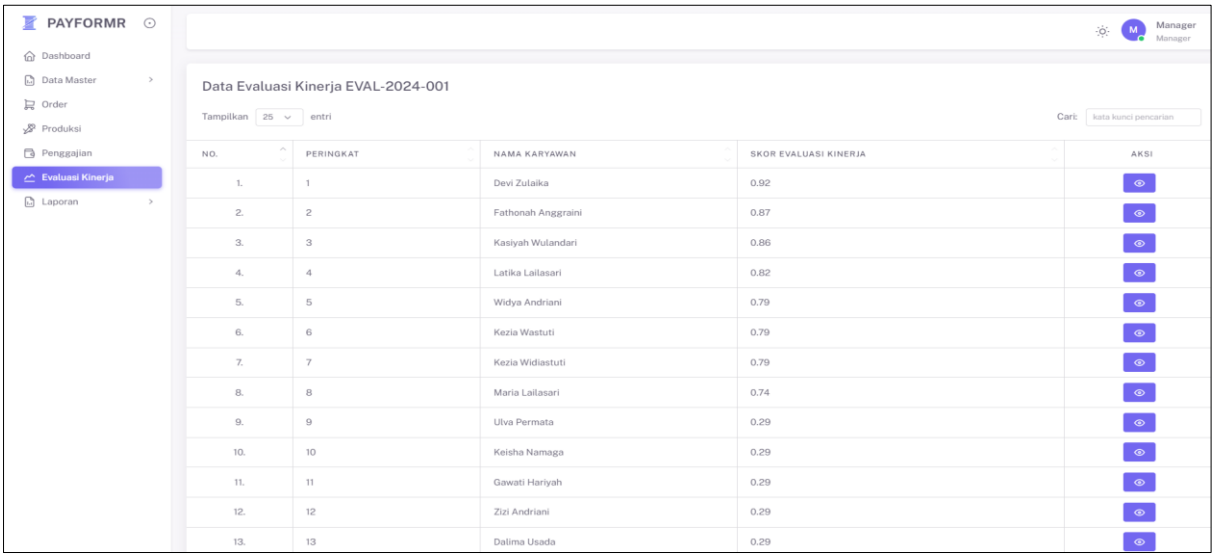

Fig. 4. Performance evaluation results interface.

4. Results and Discussion

The initial interface for users (super-admin, manager, and quality control) after logging in is the dashboard page. This payroll system implements role-based access control, so a different dashboard is displayed for each role. The manager dashboard (Fig. 3) displays various charts depicting system statistics, such as the number of employees, total production by item code, and daily production trends over a specific period.

To conduct a performance evaluation, the manager enters an evaluation code and a production date range. The evaluation code serves as a unique identifier for grouping evaluation results by the specified period. The system then calculates a SAW score for each employee, ranking them from highest to lowest, and allows the manager to generate a performance evaluation report based on the selected date (Fig. 4).

The payroll process is shown in Fig. 5, where managers can request employee payroll. The system calculates total daily production based on the selected date and provides incentive options based on the performance evaluation score as a token of appreciation.

The system was tested using black-box testing, which assesses the alignment between predetermined functional requirements and implementation results. Of all test cases, 97% passed the test scenarios. In addition, user acceptance testing was conducted to assess user experience and satisfaction. The results show that the developed payroll system meets user needs and improves objectivity, efficiency, and transpa-

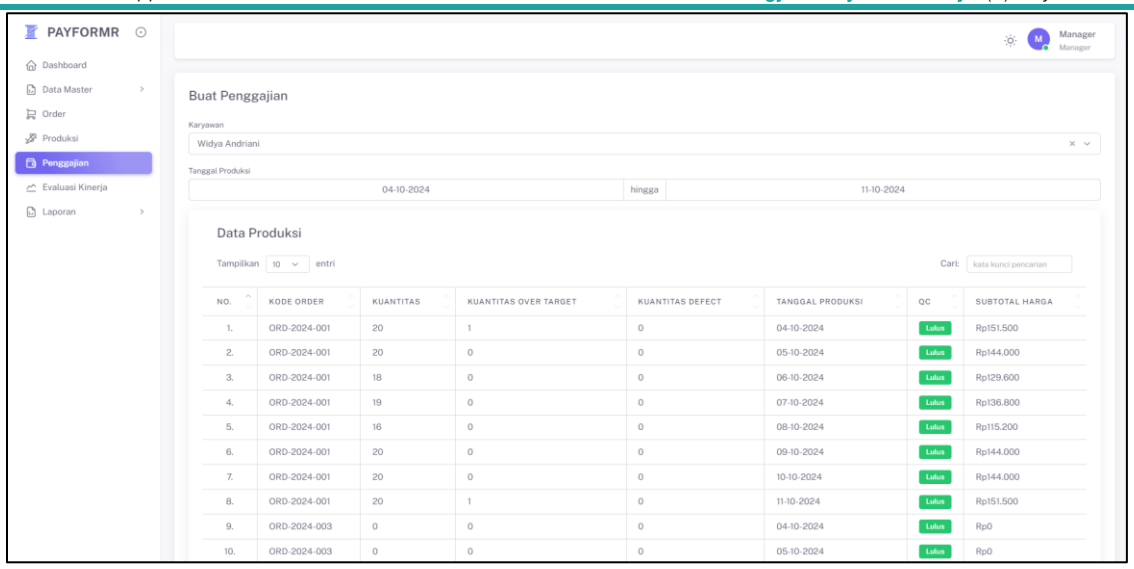

Fig. 5. Payroll creation interface.

rency in the performance evaluation and payroll processes at CV. XYZ.

Dashboard diagrams and visualizations help understand the performance evaluation flow and the roles of each actor, allowing for measurable and transparent implementation of KPIs and the SAW method.

5. Conclusions

This study aims to design and develop a KPI-based payroll information system using the SAW method to objectively assess the performance of production employees at CV. XYZ, a plastic sack manufacturing company. The application of the Waterfall model in system development allows for a structured and linear process, allowing each stage to be systematically controlled. The results show that the SAW method is effective for evaluating employee performance based on KPIs and provides an efficient, fair, and transparent basis for calculating incentives. The developed system is capable of recording daily production, calculating evaluation scores, processing payroll, and automatically generating employee ratings.

This study has limitations related to KPI weighting, where small changes in weighting can affect the final SAW score, as shown in Table 8. Therefore, companies need to objectively determine KPI weighting to ensure fairness in the evaluation process. Furthermore, because the study used a case study at CV. XYZ with a piece-rate pay system, the results may require adjustment if applied to other sectors or industries. Future research could consider cross-validation to test the suitability of SAW assessments with actual employee performance.

Academically, this research contributes to the application of the SAW method in a KPI-based payroll system, adding to the literature in the fields of Decision Sciences and Information Systems related to data-based performance evaluation. Practically, this system can be applied to MSMEs to support employee performance management, both in the production and non-production sectors that implement a piece-rate pay system. With automatic SAW-based calculations, companies can determine KPIs as performance targets and produce more objective, efficient, and transparent payroll. The strategic implication is that data-based managerial decisions enable fair HR management practices in small and medium-sized companies, especially those using a piece-rate pay system.

6. Credit Authorship Contribution Statement

Tegar Bangun Suganda: Conceptualization, Data Curation, Software, and Writing – Original Draft. **Intan Dzikria**: Supervision, Formal Analysis, Methodology, and Writing – Review & Editing.

7. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

8. Acknowledgments

The authors would like to thank the anonymous referees for their helpful comments and suggestions.

9. Data Availability

Data will be made available on request.

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