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Decision Support System for Determining Promotion Using a Combination of Entropy and Weighted Aggregated Sum Product Assessment

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Abstrak

Pengambilan keputusan dalam menentukan promosi karyawan sering menghadapi tantangan karena subjektivitas penilaian. Untuk mengatasi masalah ini, penelitian ini mengembangkan sistem pendukung keputusan dengan menggabungkan metode Entropy dan Weighted Aggregated Sum Product Assessment (WASPAS). Metode Entropy digunakan untuk menentukan bobot kriteria secara objektif berdasarkan variasi data, sementara metode WASPAS diterapkan untuk meranking alternatif secara komprehensif melalui integrasi Weighted Sum Model (WSM) dan Weighted Product Model (WPM). Hasil pengujian pada tujuh kandidat menunjukkan bahwa Kandidat A-016 menduduki peringkat pertama dengan skor 0,9733, diikuti oleh Kandidat A-013 dengan skor 0,7454, dan Kandidat A-011 dengan skor 0,5386. Sementara kandidat dengan skor terendah adalah Kandidat A-017 dengan nilai 0,3456. Temuan ini membuktikan bahwa kombinasi metode Entropy dan WASPAS dapat menghasilkan dasar yang lebih objektif, transparan, dan kuat bagi manajemen untuk membuat keputusan yang adil dan rasional dalam proses promosi.

Kata Kunci: Pengambilan keputusan, Decision Support System, Entropy, Promosi Karyawan*,* WASPAS

Abstract

Decision-making in determining employee promotions often faces challenges due to the subjectivity of assessments. To address this issue, this research develops a decision support system by combining the Entropy method and the Weighted Aggregated Sum Product Assessment (WASPAS). The Entropy method is used to objectively determine the weights of criteria based on data variation, while the WASPAS method is applied to comprehensively rank alternatives through the integration of the Weighted Sum Model (WSM) and Weighted Product Model (WPM). The test results on seven candidates showed that Candidate A-016 ranked first with a score of 0.9733, followed by Candidate A-013 with a score of 0.7454, and Candidate A-011 with a score of 0.5386. Meanwhile, the candidate with the lowest score was Candidate A-017 with a value of 0.3456. These findings prove that the combination of Entropy and WASPAS methods can produce a more objective, transparent, and solid basis for management to make fair and rational decisions in the promotion process.

Keywords: Decision Making, Decision Support System, Entropy, Employee Promotion, WASPAS.

1. INTRODUCTION

The importance of a fair and objective employee promotion process is closely related to the organization's efforts to maintain motivation, loyalty, and performance of employees[1], [2]. Promotion is not just a reward for performance, but also a form of recognition of a person's competence, dedication, and contribution to achieving the company's goals. If the promotion process is carried out transparently and based on clear criteria, employees will feel valued, motivated to continuously improve their quality, and foster a healthy and productive work environment. On the other hand, unfair or subjective promotions can lead to dissatisfaction, decrease morale, and trigger internal conflicts among employees. This has the potential to hinder organizational effectiveness due to a growing distrust of the management system. Therefore, determining fair and objective employee promotions is crucial to creating a harmonious work environment, increasing employee trust in the organization, and ensuring that strategic positions are occupied by individuals who truly possess the skills and integrity required by the company.

Common problems in employee promotion processes often arise due to the subjectivity of managers in making decisions[3]. This can occur when promotions are more influenced by factors such as personal closeness, seniority, or other non-performance considerations, leading to unfairness among employees. In addition, the criteria used to assess eligibility for promotion are often inconsistent and may change depending on the situation, making the assessment process non-transparent and difficult for employees to understand. In addition, another challenge that is often faced is the difficulty of balancing various assessment factors, such as performance, competence, experience, and development potential. Differences in weight or priority for each factor can create dilemmas in determining who is most deserving of promotion. If these issues are not handled properly, the promotion process can lead to dissatisfaction, decrease motivation, and have a negative impact on the overall performance of the organization.

Decision Support Systems (DSS) have great potential in assisting the employee promotion decision-making process to be fairer and more objective because they are based on measurable data [4]–[6]. With DSS, assessments of employees can be conducted using various relevant criteria, such as performance, competence, experience, as well as aspects of personality or leadership, which are then processed systematically using certain analytical methods. This approach is capable of minimizing the subjectivity of managers because decisions are not only based on intuition but also on the results of calculations and more transparent data analysis [7]–[9]. DSS allows companies to balance various assessment factors with predetermined weights according to the needs of the organization. This way, the promotion process becomes more consistent, measurable, and easy to re-evaluate if necessary. DSS can also enhance employees' trust in the management system because decisions made have a clear and accountable basis. Ultimately, the implementation of DSS not only improves the quality of decision-making but also supports the creation of a healthy, fair, and productive work environment within the organization.

The Entropy method as an objective approach in determining weights lies in its ability to measure the level of uncertainty or variation of information from each criterion [10]–[12]. The greater the variation in values for a criterion, the more significant its contribution to distinguishing alternatives, making the weight assigned more significant. In this way, the Entropy method can provide proportional weights based on actual data without being influenced by the subjective opinions of decision-makers. The Entropy method is very useful when the amount of data is large and complex, as it can systematically identify the criteria that truly influence decision-making. Another advantage is the consistency and transparency in calculations, making the results scientifically accountable [9], [13], [14]. This makes Entropy an effective method to support decision support systems, especially in the process of determining fair, objective, and data-driven criteria weights.

The WASPAS method (Weighted Aggregated Sum Product Assessment) is one of the methods in Multi-Criteria Decision Making (MCDM) used to evaluate and rank alternatives based on several criteria [15], [16]. WASPAS combines two main approaches, namely the Weighted Sum Model (WSM) and the Weighted Product Model (WPM), providing more accurate and balanced results. In the process, the values of each alternative are normalized, then multiplied by the weights of the criteria, and finally calculated using a linear combination of the summation method (WSM) and multiplication (WPM). The advantages of WASPAS lie in its ability to minimize the weaknesses of each basic method (WSM and WPM) by combining both [17]–[19]. The final result provides a total relative importance score that can be used to rank alternatives objectively. With this advantage, WASPAS is widely used in decision-making, including employee promotion determination, supplier selection, business strategy determination, and risk assessment, as it can produce more stable, consistent, and easily applicable decisions.

The purpose of this research is to develop a DSS that combines the Entropy method as an objective weighting technique with the WASPAS method as an alternative ranking approach. By utilizing Entropy, the criteria weights can be systematically determined based on variations in actual data, thus freeing them from the subjectivity of decision-makers. Furthermore, WASPAS is used to generate more accurate and stable alternative rankings through a combination of weighted sum and weighted product methods. With the integration of these two methods, it is expected that the employee promotion process can be conducted in a more transparent, consistent, and fair manner. The main contribution of this research is to present a transparent, objective, and comprehensive decision-making method to support the employee promotion process. Transparency is reflected in a clear and traceable calculation flow, objectivity is achieved through the use of data-driven criteria weights using the Entropy method, while comprehensiveness is attained through the WASPAS ranking that integrates two different approaches to produce more robust results. Thus, this research not only strengthens the quality of promotion decisions but also enhances employee trust in the management system implemented by the organization.

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2. METHODOLOGY

The research methodology uses a DSS approach by combining two methods, namely Entropy for objective criterion weighting and WASPAS for the alternative ranking process [20], [21]. The research stages begin with identifying the problem and determining relevant criteria in employee promotion, followed by data collection on performance and other required attributes. Next, the Entropy method is used to calculate the weight of each criterion based on data variation, resulting in weight values that are free from subjective influence. The resulting weights are then integrated into the WASPAS method, which combines WSM and WPM to produce the final ranking of promotion candidates. With this methodology flow, the developed system is expected to provide promotion decisions that are fair, transparent, and accountable. Figure 1 is the research methodology that was conducted.

Figure 1. Methodology.

The methodological stages in Figure 1 in the development of a DSS for determining employee promotions using a combination of the Entropy and WASPAS methods. The process begins with problem identification, which involves recognizing issues in employee promotions that have historically been less objective and consistent. The next stage is determining the criteria and alternatives, where relevant assessment factors such as performance, experience, and competence are established, along with the alternatives being the employees considered for promotion. After that, data collection is carried out, which involves gathering information related to the established criteria. The next step is the determination of weights using the Entropy method, which functions to calculate the weights of each criterion objectively based on data variation. These weights are then used in ranking with the WASPAS method, which combines the weighted summation model (WSM) and the weighted multiplication model (WPM) to produce more stable and accurate results. The final stage is determining the results and analysis, which involves interpreting the alternative rankings to identify the most suitable employee for promotion, while also providing a more transparent and accountable basis for decision-making

2.1. Entropy Method

The Entropy Method is one of the objective methods in Multi-Criteria Decision Making (MCDM) used to determine the weight of criteria based on the information or variation of data from each criterion [22], [23]. The basic concept is that the greater the data variation in a criterion, the greater its contribution to distinguishing alternatives, thus the weight assigned is higher. Conversely, if the data in a criterion is relatively homogeneous or uniform, its contribution is considered low and the resulting weight is smaller. The Entropy Method has several advantages that make it one of the commonly used objective approaches in determining criterion weights. Its main advantage is that the weights produced are entirely data-driven, thus free from the subjectivity of decision-makers and more transparent. Entropy is also capable of accurately measuring the variation in information, so criteria that have high value differences among alternatives will be assigned greater weights, while criteria with homogeneous data will receive lower weights. Additionally, this method is very suitable for application to large and complex data because its calculations are mathematical, systematic, and yield consistent and stable results. With these characteristics, Entropy becomes an effective method for supporting fair, objective, and accountable decision-making.

The first stage is to compile a decision matrix that includes the alternatives and criteria used in the decision-making process. Data obtained from assessments or measurements is placed into the matrix to make it more structured and easier to analyze.

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$$X = \begin{bmatrix} x_{11} & \cdots & x_{n1} \\ \vdots & \ddots & \vdots \\ x_{1m} & \cdots & x_{nm} \end{bmatrix} \quad (1)$$

After the decision matrix is formed, the next step is to perform data normalization. Normalization aims to equalize the scale among criteria so that different values can be compared proportionally without causing bias.

$$k_{ij} \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}} \quad (2)$$

The next step is to calculate the Entropy value for each criterion. This value is used to measure the level of uncertainty or variability of the data possessed by each criterion. The higher the variability, the greater the role of that criterion in distinguishing between alternatives.

$$E_j - \frac{1}{\ln ln\, m} \sum_{i=1}^{n} k_{ij} \ln ln\, (k_{ij}) \quad (3)$$

Based on the obtained Entropy values, the degree of diversification is then calculated for each criterion. This value describes the level of information diversity of a criterion, allowing us to determine its contribution to the decision-making process.

$$D_j 1 - E_j \quad (4)$$

The final stage is to calculate the final weight of each criterion. This weight is determined based on the degree of diversification values so that the results truly reflect the importance level of the criteria objectively. This final weight is then used in the next stage.

$$w_j \frac{D_j}{\sum_{j=1}^{n} D_j} \quad (5)$$

With its data-based nature, the Entropy method is very effective in producing weights that are objective, consistent, and free from the influence of the subjectivity of decision-makers

2.2. WASPAS Method

The WASPAS method is one of the methods in MCDM used to rank alternatives based on several criteria. This method is developed by combining two approaches, namely WSM and WPM. This combination is done to minimize the weaknesses of each method, so that the ranking results become more accurate, stable, and reliable [23], [24]. The WASPAS method has several advantages that make it superior in the multicriteria-based decision-making process. One of its strengths is its ability to combine two approaches, namely WSM and WPM, resulting in outcomes that are more accurate, stable, and not easily biased. With this combination, the weaknesses of each method can be minimized so that the quality of alternative ranking becomes better. In addition, the WASPAS method is relatively simple in calculations, yet still provides comprehensive results because it is able to balance various assessment factors. Another advantage is its flexibility, so it can be applied in various fields. This makes WASPAS a practical, efficient, and reliable method in supporting objective decision-making.

The stages of the WASPAS method can generally be explained in three main steps. The first is to compile the decision matrix, which presents the assessment data of each alternative against the predetermined criteria. This matrix serves as the basis for calculations and functions to map the values of each alternative in a structured manner using equation (1).

The second step is the normalization of the decision matrix, which is done to standardize the scale across criteria so that all values can be compared proportionally. This normalization process is important because the criteria usually have different units or measurements, so they need to be standardized first before further processing.

$$N_{ij} = \frac{x_{ij}}{xj^{max}} \quad (6)$$

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$$N_{ij} = \frac{xj^{min}}{x_{ij}} \quad (7)$$

The final stage is to calculate the preference value, where the normalized results are then multiplied by the criteria weights and calculated using the WASPAS approach. The preference value is obtained from the combination of the WSM and the WPM, resulting in a final score for each alternative. The highest score indicates the best alternative which serves as the basis for the ranking and decision-making process.

$$Q_i = 0,5 \sum n_{ij} w_j + 0,5 \Pi_{j=1}^{n} n_{ij}^{w_j} \quad (8)$$

The WASPAS method is that this method is an effective and efficient approach in solving multi-criteria decision-making problems. The results obtained are not only objective and consistent, but also easy to understand, thus increasing transparency and trust in the decision-making process.

3. RESULT AND DISCUSSION

The Decision Support System for Determining Promotion Using a Combination of Entropy and WASPAS is an approach designed to enhance fairness, objectivity, and transparency in the employee promotion process. This system combines two methods, namely Entropy and WASPAS, to generate more accurate criteria weights and alternative rankings. The Entropy method is used to determine the weight of each criterion objectively based on data variation, thus making decisions no longer dependent on the subjective opinions of decision-makers. Meanwhile, the WASPAS method functions to rank alternatives, making the final results more stable, balanced, and reliable. With this combination, the decision support system is able to balance various important factors in promotions, such as performance, experience, competencies, and leadership potential. The transparent and systematic calculation results not only help organizations place the best employees in the appropriate positions but also build trust among employees regarding management's fairness. Ultimately, the application of the Entropy–WASPAS based Decision Support System can be an effective strategy to support the achievement of organizational goals through a promotion process that is fairer, more consistent, and accountable.

3.1. Identify the Problem

The main issue in the employee promotion determination process lies in the lack of objectivity, consistency, and transparency in decision-making. In many organizations, promotions are often still influenced by the subjectivity of managers, such as factors of closeness, seniority, or personal bias, thus not being entirely based on measurable performance and competence. This condition can lead to dissatisfaction among employees, decrease work motivation, and even potentially trigger internal conflicts in the workplace. Another challenge is the inconsistency of the criteria used in the promotion process. Often, organizations do not have clear and measurable evaluation standards, making the promotion process difficult to understand and accountable. Furthermore, balancing various criteria such as performance, experience, leadership, and other skills is not an easy task, as each factor has a different level of importance. Therefore, a DSS is needed that can systematically process data, objectively determine the weights of criteria, and rank alternatives fairly so that the promotion process can be conducted transparently, consistently, and based on merit.

3.2. Determination of Criteria and Alternatives

In the development of a DSS for employee promotion, determining criteria and alternatives is an important stage that ensures the decision-making process is conducted systematically and fairly. Criteria are factors or indicators used to assess employees, namely performance, competency, experience, leadership ability, discipline, and teamwork. Each criterion reflects an aspect that contributes to the overall assessment, thus it must be relevant to the organization's goals and measurable to avoid ambiguity. Choosing the right criteria will ensure that employee assessments are carried out comprehensively and objectively. Meanwhile, alternatives refer to employees who are eligible or considered for promotion. These alternatives become a set of choices that will be evaluated based on established criteria. With the establishment of clear alternatives and criteria, the Decision Support System (DSS) can process data systematically, determine objective weights using the Entropy method, and produce fair rankings with the WASPAS method. This structured approach ensures that promotion decisions are not only data-driven but also transparent and aligned with the organization's needs.

3.3. Data Collection

In the development of a DSS for employee promotion, data collection is a fundamental stage that provides critical input for subsequent analysis. The data collected must be relevant to the established criteria, such as performance, experience, competence, leadership, and discipline. This information can be obtained from various sources, such as performance evaluation reports, human resources (HR) databases, questionnaires, interviews, and direct observations. The accuracy and reliability of the data collected greatly determine the quality of the analysis results. The results of the assessment data collection are displayed in Table 1.

Table 1. Assessment Data

Candidate Name	Performance	Experience	Competence	Leadership	Discipline
Candidate A-011	85	5	8	7	2
Candidate A-012	90	7	9	8	1
Candidate A-013	80	6	7	9	3
Candidate A-014	88	8	8	6	1
Candidate A-015	92	4	9	8	2
Candidate A-016	76	9	6	7	4
Candidate A-017	83	5	8	8	1

Based on the assessment data of seven employees who are alternatives in the promotion process, it can be concluded that each employee has their own strengths and weaknesses in the established criteria. Performance, experience, competence, leadership, and discipline are the main aspects used in the evaluation. From the assessment table, it is evident that there are employees who excel in performance and competence but lack in discipline, while others have high work experience but relatively lower performance scores. Given the variation in each criterion, an objective analysis method is needed to determine the weight of importance of each criterion and produce a fair final ranking. Through the combination of the Entropy method for weighting and WASPAS for ranking, this assessment data can be processed systematically to produce a transparent, objective promotion decision that meets the organization's needs.

Data collection conducted through inter-rater reliability or data validation plays an important role in maintaining the objectivity of research results and assessment systems. Inter-rater reliability ensures that the scores given by different evaluators remain consistent, thereby reducing individual bias and increasing confidence in the final results. Meanwhile, data validation serves to verify whether the information collected truly reflects the conditions being measured, whether through consistency tests, source triangulation, or comparison with existing standards. With these two aspects in place, the data used in the analysis process becomes more valid and reliable, allowing decisions or rankings to be scientifically accountable.

3.4. Weight Determination Using the Entropy Method

The Entropy Method is one of the objective approaches in determining the criteria weights in MCDM systems. The basic concept of this method is rooted in information theory, where entropy is used to measure the level of uncertainty or randomness of certain data. In the context of decision-making, the greater the variation or spread of data in a criterion, the more information that criterion contains, hence its weight is considered more significant. Thus, this method helps provide objective weighting without being influenced by the subjective preferences of the decision-maker.

The first stage is to compile a decision matrix that includes the alternatives and criteria used in the decision-making process. The data obtained from the assessment in Table 2 is entered into the matrix to make it more structured and easier to analyze using equation (1).

$$X = \begin{bmatrix} 85 & 5 & 8 & 7 & 2 \\ 90 & 7 & 9 & 8 & 1 \\ 80 & 6 & 7 & 9 & 3 \\ 88 & 8 & 8 & 6 & 1 \\ 92 & 4 & 9 & 8 & 2 \\ 76 & 9 & 6 & 7 & 4 \\ 83 & 5 & 8 & 8 & 1 \end{bmatrix}$$

After the decision matrix is formed, the next step is to perform data normalization. The purpose of normalization is to standardize the scale among criteria so that different values can be compared equally using equation (2).

$$k_{11} = \frac{x_{11}}{x_{11}+x_{12}+x_{13}+x_{14}+x_{15}+x_{16}+x_{17}} = \frac{85}{85+90+80+88+92+76+83} = \frac{85}{594} = 0.1431$$

The overall results of the calculations from the entropy normalization method are presented in Table 2.

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Table 2. Normalization of Entropy Method

Candidate Name	Performance	Experience	Competence	Leadership	Discipline
Candidate A-011	0.1431	0.1136	0.1455	0.1321	0.1429
Candidate A-012	0.1515	0.1591	0.1636	0.1509	0.0714
Candidate A-013	0.1347	0.1364	0.1273	0.1698	0.2143
Candidate A-014	0.1481	0.1818	0.1455	0.1132	0.0714
Candidate A-015	0.1549	0.0909	0.1636	0.1509	0.1429
Candidate A-016	0.1279	0.2045	0.1091	0.1321	0.2857
Candidate A-017	0.1397	0.1136	0.1455	0.1509	0.0714

The results of the sum normalization values using the Entropy method shown in Table 2 represent an important stage in criteria weighting because they function to convert the initial values from the decision matrix into proportionate values, so that each matrix element is divided by the total value in the relevant criteria column. In this way, the normalization values fall within the range of 0–1 and allow for fairer comparisons among alternatives without being influenced by different scales or units. The advantages of this approach include its simplicity in calculation, the consistency of results, and its ability to maintain the relative distribution of data, thereby representing uncertainty information more objectively in subsequent entropy calculations.

The next step is to calculate the Entropy value for each criterion. This value is used to measure the level of uncertainty or variability of the data possessed by each criterion using equation (3).

$$E_1 = -\frac{1}{\ln ln\, 7} \left(\left(k_{11} \ln ln \left(k_{11}\right)\right) + \left(k_{12} \ln ln \left(k_{12}\right)\right) + \left(k_{13} \ln ln \left(k_{13}\right)\right) + \left(k_{14} \ln ln \left(k_{14}\right)\right) + \left(k_{15} \ln ln \left(k_{15}\right)\right) + \left(k_{16} \ln ln \left(k_{16}\right)\right) + \left(k_{17} \ln ln \left(k_{17}\right)\right)\right)$$

$$E_1 = -0.5139 * (-1.9440) = 0.9990$$

The overall results of the calculations from the entropy values using the entropy method are displayed in Table 3.

Table 3. Entropy Value of Entropy Method

	Performance	Experience	Competence	Leadership	Discipline
Entropy Value	0.9990	0.9820	0.9958	0.9963	0.9299

The next step is to calculate the level of diversification and then compute it for each criterion. This value reflects the level of information diversification of a criterion, which allows us to determine its contribution to the decision-making process using equation (4).

$$D_1 = 1 - E_1 = 1 - 0.9990 = 0.0100$$

$$D_2 = 1 - E_2 = 1 - 0.9820 = 0.0180$$

$$D_3 = 1 - E_3 = 1 - 0.9958 = 0.0042$$

$$D_4 = 1 - E_4 = 1 - 0.9963 = 0.0037$$

$$D_5 = 1 - E_1 = 1 - 0.9299 = 0.0701$$

The final stage is to calculate the final weight of each criterion. This weight is determined based on the level of value diversification so that the results truly reflect the importance level of the criteria objectively using equation (5).

$$w_1 = \frac{D_1}{D_1 + D_2 + D_3 + D_4 + D_5} = \frac{D_1}{0.0010 + 0.0180 + 0.0042 + 0.0037 + 0.0701} = 0.0102$$

The overall results of the calculations from the final weight of each criterion using the entropy method are displayed in Table 4.

Table 4. Final Weight Value of Entropy Method

	Performance	Experience	Competence	Leadership	Discipline
Weight Value	0.0102	0.1852	0.0434	0.0383	0.7229

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The application of the Entropy method in determining criterion weights provides an objective and rational basis in the multi-criteria decision-making process. By measuring the level of uncertainty and data variation, this method can produce weights that more accurately represent the relative importance of each criterion. This makes Entropy one of the effective methods to reduce subjective bias and ensures that the decisions made are truly based on the information contained in the data. The use of this method not only enhances the accuracy of the analysis but also assists decision-makers in determining priorities more fairly and proportionally. Therefore, Entropy is worthy of being used as an objective weighting method in various practical decision-making applications.

The criterion weights generated from the Entropy method in the table show a very uneven distribution, with Discipline having a dominant weight of 0.7229, while Performance is very small at 0.0102, followed by Experience (0.1852), Competence (0.0434), and Leadership (0.0383). This condition indicates that the Discipline criterion is considered the most informative in distinguishing alternatives because its lower level of variation results in a small entropy value, making its diversification weight very high. Conversely, although Performance has a wider range of values, its entropy is relatively high, resulting in a low weight. These results underscore the characteristic of the Entropy method, which emphasizes the structure of data uncertainty rather than organizational priority perceptions.

3.5. Ranking with the WASPAS Method

The WASPAS method is one of the techniques in MCDM used to rank alternatives based on a number of specific criteria. This method combines two calculation approaches, resulting in more accurate and comprehensive assessments. By merging the advantages of WPM and WSM, WASPAS is able to improve the reliability of determining the best alternative compared to using only one method.
The first step is to compile a decision matrix, which presents the assessment data of each alternative against the predetermined criteria. This matrix serves as the basis for calculations and is used to map the values of each alternative in a structured manner using equation (1).

$$X = \begin{bmatrix} 85 & 5 & 8 & 7 & 2 \\ 90 & 7 & 9 & 8 & 1 \\ 80 & 6 & 7 & 9 & 3 \\ 88 & 8 & 8 & 6 & 1 \\ 92 & 4 & 9 & 8 & 2 \\ 76 & 9 & 6 & 7 & 4 \\ 83 & 5 & 8 & 8 & 1 \end{bmatrix}$$

The second step is the normalization of the decision matrix, which is done to standardize the scale across all criteria so that all values can be proportionally compared using equation (6) since all criteria are of the benefit type.

$$N_{11} = \frac{x_{11}}{x1^{max}} = \frac{85}{92} = 0.9239$$

The overall results of the calculations from the WASPAS normalization method are presented in Table 2.

Table 5. Normalization of WASPAS Method

Candidate Name	Performance	Experience	Competence	Leadership	Discipline
Candidate A-011	0.9239	0.5556	0.8889	0.7778	0.5000
Candidate A-012	0.9783	0.7778	1.0000	0.8889	0.2500
Candidate A-013	0.8696	0.6667	0.7778	1.0000	0.7500
Candidate A-014	0.9565	0.8889	0.8889	0.6667	0.2500
Candidate A-015	1.0000	0.4444	1.0000	0.8889	0.5000
Candidate A-016	0.8261	1.0000	0.6667	0.7778	1.0000
Candidate A-017	0.9022	0.5556	0.8889	0.8889	0.2500

Min-max normalization in the WASPAS method is carried out by dividing each alternative value for a given criterion by the maximum value of that criterion, as shown in Table 5, resulting in a max normalization value for benefit criteria and a min normalization value for cost criteria. Since all the criteria used are benefit criteria, the max normalization calculation is applied. The advantages of min-max normalization include its ability to maintain the proportionality of alternative rankings, ease of result interpretation because all values are standardized against the best performance, and efficiency in calculation since it only depends on the extreme values of each criterion.

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The final stage is calculating the preference values. The normalization results are then multiplied by the criterion weights and calculated using the WASPAS approach. The preference values are obtained from the combination of WSM and WPM, which results in final scores for each alternative using equation (8). The results of the preference value calculations are displayed in Table 6.

Table 6. Preference Value of WASPAS Method

Candidate Name	Final Value
Candidate A-011	0.5386
Candidate A-012	0.3805
Candidate A-013	0.7454
Candidate A-014	0.3854
Candidate A-015	0.5252
Candidate A-016	0.9733
Candidate A-017	0.3456

The application of the WASPAS method provides an effective and comprehensive approach in the multi-criteria decision-making process. By combining the advantages of the WSM and WPM methods, WASPAS is capable of producing a more accurate, stable, and reliable ranking of alternatives. This method not only simplifies the calculation process but also provides clear results, thus helping decision-makers determine the best choice among various alternatives.

3.6. Determination of Results and Analysis

Determining results and analysis is an important stage in both research and decision-making processes, as in this stage the data that has been collected and processed will be interpreted to obtain meaningful conclusions. Through the determination of results, every calculation, measurement, and data processing is displayed systematically to provide a clear picture of the conditions being studied. Furthermore, analysis is conducted to link the obtained results with the research objectives or the problems to be solved, thus providing appropriate and relevant answers. This stage also serves as a basis for evaluating the effectiveness of the methods used and seeing to what extent the results obtained can serve as a reference in decision-making. By conducting an in-depth analysis, research results not only present raw data but also uncover meanings, patterns, and implications contained within. Therefore, determining results and analysis becomes a crucial part in ensuring the quality, accuracy, and tangible contributions of both research and decision support systems. The ranking results of alternatives are shown in Figure 2.

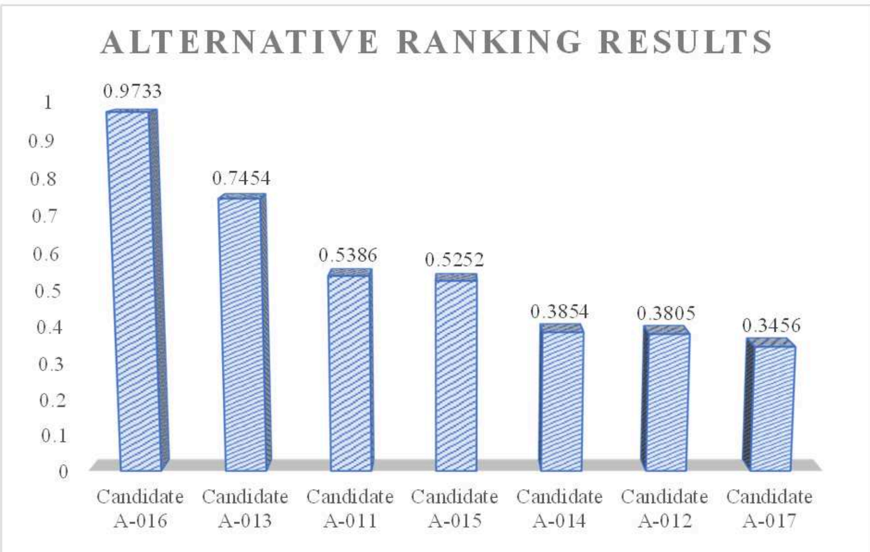

Figure 2. Alternative Ranking Results.

The ranking results of alternative candidates in Figure 2 are based on the scores obtained from the calculations of the method used. It shows that Candidate A-016 occupies the highest position with a score of 0.9733, indicating that this candidate is the best alternative compared to others. Followed by Candidate A-013 with a score of 0.7454, then Candidate A-011 with a score of 0.5386, and Candidate A-015 with a score of 0.5252. Meanwhile, the candidate with the lowest score is Candidate A-017 with a value of 0.3456, followed by Candidate A-012 at 0.3805, and Candidate A-014 at 0.3854. These results demonstrate a significant difference between the candidates with the highest and lowest scores, which can serve as a basis for decision-makers in making more objective final choices.

The advantages of this system can be seen from its ability to integrate the WASPAS method with Entropy weighting, resulting in more objective calculation of criteria weights because it is based on data variations, not merely subjective assessments. Although it was only tested on seven candidates, this demonstrates the method's flexibility in handling a limited number of alternatives while still providing clear and systematic ranking results. In addition, the use of both synthetic and real data shows that the system can be applied to various types of datasets, whether for initial simulations or real-world cases. The WASPAS and Entropy combination also provides a balance between additive and multiplicative approaches, making the evaluation results more stable and able to reflect the performance of alternatives more comprehensively.

4. CONCLUSION

The research results regarding the Decision Support System for Determining Promotion Using a Combination of Entropy and WASPAS conclude that this system is capable of providing an objective and accurate ranking in determining the candidates eligible for promotion. The determination of criterion weights using the Entropy method successfully reduces the element of subjectivity, while the WASPAS method combines the advantages of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM), resulting in a more comprehensive calculation. The ranking results show that Candidate A-016 received the highest score of 0.9733, thus being declared the most eligible candidate for promotion. The next rank is held by Candidate A-013 with a score of 0.7454, followed by Candidate A-011 with a score of 0.5386, and Candidate A-015 with a score of 0.5252. The candidate with the lowest score is Candidate A-017 with a score of 0.3456. The differences in scores emphasize that the developed system is capable of providing clear recommendations and can serve as a basis for decision-makers in determining employee promotions more fairly, transparently, and rationally.

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