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Decision Support System Combining Rank Sum and ARAS Methods for Job Promotion Selection

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Abstract−The promotion selection process within an organization is a crucial aspect that influences long-term performance and success. Proper selection can enhance employee motivation and productivity; however, traditional subjective methods often lead to bias and unfairness in the selection process. This study aims to develop a Decision Support System (DSS) for promotion selection using the Rank Sum and Additive Ratio Assessment (ARAS) methods to support more objective and structured decision-making. The Rank Sum method is used to objectively determine the weight of criteria based on their order of importance, while the ARAS method is employed to evaluate and rank alternatives based on various predetermined criteria. The combination of these two methods is expected to provide more accurate and transparent assessments of promotion candidates. The results of the study indicate that the developed DSS can provide the best alternative recommendations through ranking the relative performance values from highest to lowest. The case study shows that the highest utility value is Ahmad Nazir (A3) with a score of 0.9346, followed by Ricky Hamdani (A4) with a score of 0.9142, Andy Setiawan (A1) with a score of 0.8769, and Tati Maharani (A2) with a score of 0.8659. The consistency between the system output and manual calculations demonstrates the validity of the system results, while black box testing ensures that all main features function as expected.

Keywords: Additive Ratio Assessment; ARAS; Decision Support System; Promotion Selection; Rank Sum

1. INTRODUCTION

In an organization, the promotion selection process is one of the critical aspects that influence long-term performance and success. One strategic decision that significantly impacts organizational performance is job promotion [1]. Proper selection can enhance employee motivation and productivity, as well as ensure that individuals who best fit the qualifications and competencies are promoted to higher positions [2]. However, this process is often complex and challenging, especially when evaluating various candidates with diverse backgrounds and qualifications. Traditional methods for promotion selection often rely on subjective assessments by management or unstructured criteria. This can lead to bias and unfairness in the selection process and reduce employee trust in the existing promotion system. Therefore, a more objective and structured approach is needed to support decision-making in promotion selection.

Previous research on developing decision support systems (DSS) for recommending promotions has been conducted by several researchers using various methods. The first study discussed the development of a DSS for job promotion using the Simple Additive Weighting (SAW) method, which employs a weighted sum approach for each predetermined criterion to generate a total score for each alternative [3], [4]. Another study focused on the promotion selection process by applying the Analytical Hierarchy Process (AHP), which uses a hierarchical approach to evaluate alternatives considering the hierarchical relationships between relevant criteria and sub-criteria [5], [6]. Further research examined the implementation of the Simple Multi-Attribute Rating Technique (SMART) method to determine employees suitable for promotion [7]. The SMART method groups and evaluates alternatives based on predefined attributes. Additionally, there is research that uses the Profile Matching method for promotion selection, where this method compares candidates' profiles with an established ideal profile and assigns scores based on the match between candidates and the ideal profile [8].

From previous studies, it is evident that the approaches used have not yet utilized the utility value of evaluated alternatives, which can facilitate the final ranking of candidates. Furthermore, there has been no specific technique in determining the weights that help decision-makers determine the importance level of criteria. Therefore, this study focuses on resolving alternative evaluations and determining criteria weights that assist decision-makers. This research combines the Rank Sum and Additive Ratio Assessment (ARAS) methods. Criteria weights provide direction and relative significance to the factors considered in evaluating alternatives [9]. The Rank Sum weighting method is chosen for its simplicity and effectiveness in objectively determining criteria weights. Rank Sum allows the ranking of criteria based on their importance level and then assigns weights based on those ranks [10]. Meanwhile, the Additive Ratio Assessment (ARAS) method is chosen for its superior capability in evaluating and comparing alternatives based on various criteria comprehensively and objectively. ARAS enables the integration of calculated criteria weights, providing more accurate evaluations of each alternative by considering the relative importance of each criterion [11]. Another advantage of ARAS is its simplicity and ease of implementation in computerized systems, as well as its flexibility for use in various types of multi-criteria decision-making [12].

This study aims to develop a Decision Support System (DSS) for promotion selection using the Rank Sum and Additive Ratio Assessment (ARAS) methods. By combining these two methods, the resulting system is

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expected to provide objective, transparent, and reliable recommendations. This system will assist decision-makers in evaluating candidates for promotion through a web-based platform that is easy to use and access.

2. RESEARCH METHODOLOGY

2.1 Research Stages

This research was conducted through several systematic stages to ensure accuracy and effectiveness in developing a Decision Support System (DSS) for promotion selection. These stages are visualized in Figure 1.

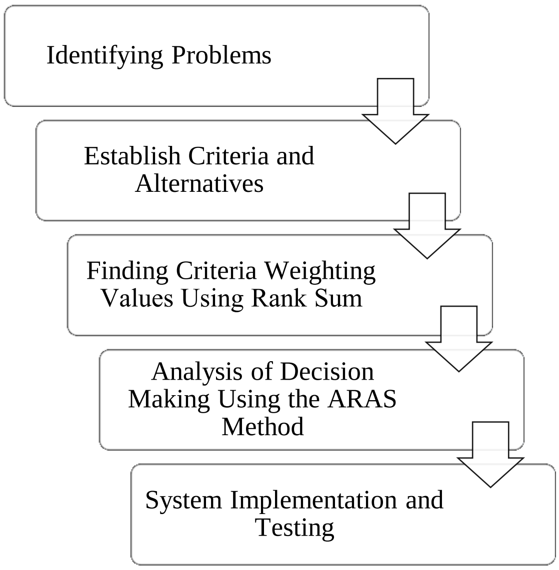

Figure 1. Research Steps

The following is a detailed elaboration of each research phase illustrated in Figure 1:

1. Identifying Problems
   In this phase, the existing issues in the current promotion selection process are identified. The aim of this problem identification is to determine the needs and requirements that must be met by the software to be developed [13]. Data collection is necessary to identify these problems. Data collection methods may include interviews with management regarding the challenges faced when determining employees eligible for promotion. The identified problems include a lack of objectivity in assessments, unclear promotion criteria, and bias in decision-making.
2. Establish Criteria and Alternatives
   Criteria are used to establish the factors or standards that will form the basis for evaluating the available alternatives [14]. Alternatives are the options or choices evaluated based on the established criteria [15]. The criteria considered in this case study were obtained through interviews with company leaders and the department responsible for determining employee promotions. The following criteria are used: Technical Competence, Target Achievement, Interpersonal Skills, Leadership, and Work Experience. Indicators for each criterion are determined by the decision-makers with the following criteria: Each option is rated on a scale from 1 to 5, where 1 indicates "Very Poor," 2 indicates "Poor," 3 indicates "Fair," 4 indicates "Good," and 5 indicates "Very Good." The alternative data is obtained from the employee data that will be evaluated for promotion.
3. Finding Criteria Weighting Values Using Rank Sum
   After determining the criteria, decision-makers are asked to assign weights to each criterion. Criteria weights refer to the values given to each criterion to indicate their relative importance compared to other criteria [16]. The weighting technique used is Rank Sum. The Rank Sum weighting method is chosen for its simplicity and effectiveness in objectively determining criteria weights [17]. Rank Sum allows the ranking of criteria based on their importance level and then assigns weights based on those ranks. This process avoids the subjectivity that often arises in manual weight determination. With Rank Sum, each criterion is given a proportional weight that reflects its importance in the decision-making context.
4. Analysis of Decision Making Using the ARAS Method
   To solve the decision problem and obtain the best recommendation, the ARAS (Additive Ratio Assessment) approach is used. This method is used to evaluate and rank various alternatives based on a set of predefined criteria. The method works by converting the performance values of each alternative into directly comparable ratios. The ARAS method allows decision-makers to systematically and objectively rank alternatives based on relevant criteria, making it easier to choose the most optimal alternative according to the established goals and

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preferences [18]. The final result of this phase is a ranking of the performance of each alternative, which is then arranged in order of rank.

5. System Implementation and Testing
   The implementation phase involves developing the software so it can be used [19]. This process begins with selecting the appropriate technology and programming language. In this study, the DSS is developed into a web application. The programming language used is PHP with a MySQL database to store data. After implementing the system, testing is carried out to ensure there are no errors and it is ready for use [20]. Black box testing is used to test the developed DSS. Black box testing focuses on the inputs and outputs of the system, as well as how the system responds to various usage scenarios that may occur [21]. The tester will execute various test cases designed based on functional requirements to verify that the system provides correct and expected results.

2.2 Rank Sum Weighting Technique

Criteria weights are numerical values assigned to each criterion in the evaluation process to indicate their relative importance compared to other criteria [22]. In decision support systems, determining the appropriate criteria weights is crucial because these weights influence the final evaluation results and the ranking of the alternatives. The Rank Sum weighting approach is a simple and effective method for objectively determining criteria weights [23]. This process begins by ranking each criterion based on its importance, with rank 1 assigned to the most important criterion, rank 2 to the next most important, and so on. Once all criteria are ranked, the weight for each criterion is calculated using a specific formula. The Rank Sum formula for calculating weights is given by equation (1).

$$w_j = \frac{n-r_j+1}{\sum(n-r_i+1)} \tag{1}$$

Where w_j is the weight of criterion j, n is the number of criteria, and r_j is the rank of criterion j.

2.3 Additive Ratio Assessment (ARAS) Decision Completion Approach

The Additive Ratio Assessment (ARAS) method is one of the multi-criteria analysis techniques used to evaluate and select the best alternative based on various criteria [11]. The ARAS approach works by calculating the additive ratio of each alternative against an ideal solution determined based on the existing criteria [12]. The main advantages of the ARAS method lie in its simplicity and its ability to provide clear and easily understandable results [24]. This method allows decision-makers to quickly identify the best alternative without requiring complex calculations [25]. ARAS is also flexible in using various types of criteria and can be applied in different contexts. It is considered effective in handling decision problems involving many criteria because it can simultaneously consider various factors and assign weights according to their importance [26].

The ARAS calculation process consists of several key steps, involving normalization, weight determination, and utility value calculation. Here are the detailed steps and equations used in the ARAS method:

1. Finding the Optimum Value for Each Criterion
   The process begins by obtaining the optimum value for each criterion. The level of optimum varies depending on the type of criterion. For criteria seeking the highest value or benefit, equation (2) is used. Conversely, for criteria seeking the lowest value or cost, equation (3) is used.

   $$x_{0j} = max\{x_{ij}\} \tag{2}$$

   $$x_{0j} = min\{x_{ij}\} \tag{3}$$

   Where x_{0j} is the optimum value of the j-th criterion, and x_{ij} refers to the attribute i for criterion j.
2. Arranging All Attributes in a Decision Matrix
   Construct a decision matrix X containing the values of each alternative for each criterion. If there are m alternatives and n criteria, the decision matrix can be expressed as equation (4).

   $$X = \begin{bmatrix} x_{01} & x_{02} & \cdots & x_{0m} \\ x_{11} & x_{12} & \dots & x_{1m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \tag{4}$$

3. Normalizing the Decision Matrix
   Normalization is used to equalize the scale of performance values so they can be compared with each other. For benefit criteria, equation (5) is used, and for cost criteria, equation (6) is used.

   $$x'_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{5}$$

   $$x_{ij} = \frac{1}{x_{ij}^{*}};\ x'_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{6}$$

   Where x'_{ij} refers to the normalized value of the i-th alternative for the j-th criterion.

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4. Normalizing the Matrix with Weights
   Each element of the normalized decision matrix is multiplied by its corresponding criterion weight, resulting in a weighted normalized decision matrix, calculated using equation (7).

$$x''_{ij} = x'_{ij} \times w_{ij} \tag{7}$$

   Where x''_{ij} refers to the attribute that has been normalized with its weight, and w_{ij} denotes the weight value for the i-th alternative on the j-th criterion.
5. Obtaining Utility Values
   The utility value for each alternative is obtained by summing all the performance values of the alternative that have been normalized with their weights, as shown in equation (8).

$$S_i = \sum_{j=1}^{m} x''_{ij} \tag{8}$$

   Where S_i refers to the utility value of each alternative.
6. Obtaining the Relative Performance Value
   The relative performance value for each alternative is calculated by comparing the utility value of that alternative with the utility value of the ideal alternative. The higher the value of K_i, the better the relative performance of that alternative. The relative performance value is obtained using equation (9).

$$K_i = \frac{S_i}{S_{max}} \tag{9}$$

   Where K_i refers to the relative performance value of the i-th alternative, and S_{max} represents the highest utility value among all alternatives.

3. RESULT AND DISCUSSION

To address the case study of determining employees eligible for promotion, the first step is to assign weights to each criterion. This is essential because each criterion holds different levels of importance to the decision-makers. The Rank Sum approach is used to simplify the process of determining criteria weights. This approach involves ranking the criteria based on their importance and then assigning weights based on those rankings. Decision-makers are asked to rank each criterion relative to its importance. Consequently, they only need to set the priority order for each criterion. The highest priority criterion is given a rank of 1, the next highest a rank of 2, and so forth, as determined by the decision-makers. The priority ranking of criteria for this case study is shown in Table 1.

Table 1. Priority Ranking of Criteria

Criteria Code	Criteria	Criterion Character	Priority Ranking
C1	Technical Competence	Benefit	1
C2	Target Achievement	Benefit	2
C3	Interpersonal Skills	Benefit	3
C4	Leadership	Benefit	4
C5	Work Experience	Benefit	5

Table 1 shows the priority ranking determined by the decision-makers. Based on this ranking, the weights are calculated using the Rank Sum technique through equation (1). The calculation process for obtaining the weights is as follows:

$$w_1 = \frac{5-1+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{5}{15} = 0.3333$$

$$w_2 = \frac{5-2+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{4}{15} = 0.2667$$

$$w_3 = \frac{5-3+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{3}{15} = 0.2000$$

$$w_4 = \frac{5-4+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{2}{15} = 0.1333$$

$$w_5 = \frac{5-5+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{1}{15} = 0.0667$$

The weights obtained through the Rank Sum approach serve as the criteria weights. These values are presented in Table 2.

Table 2. Criteria Weighting Results

Criteria Code	Criteria	Criterion Character	Weighting Results
C1	Technical Competence	Benefit	0.3333

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Criteria Code	Criteria	Criterion Character	Weighting Results
C2	Target Achievement	Benefit	0.2667
C3	Interpersonal Skills	Benefit	0.2000
C4	Leadership	Benefit	0.1333
C5	Work Experience	Benefit	0.0667

Table 2 shows the criteria weighting results using the Rank Sum technique, which are then used to determine the best alternative. The next step is to evaluate each option. In this case, four employees are considered for promotion: Andy Setiawan, Tati Maharani, Ahmad Nazir, and Ricky Hamdani. Each option is rated on a scale of 1 to 5, where 1 indicates "Very Poor," 2 "Poor," 3 "Fair," 4 "Good," and 5 "Very Good." The decision-makers then assess each option based on the given criteria. The ratings for each alternative are listed in Table 3.

Table 3. Ratings for Each Alternative

Alternative Code	Alternative	Criteria				
		C1	C2	C3	C4	C5
A1	Andy Setiawan	4	4	5	3	4
A2	Tati Maharani	4	3	5	5	4
A3	Ahmad Nazir	5	4	4	4	4
A4	Ricky Hamdani	4	4	5	5	3

In Table 4, the alternative evaluations are based on the existing criteria. The initial step in the decision-making process using the Additive Ratio Assessment (ARAS) method is to determine the optimum values for the criteria. The optimum values depend on the type of criterion. For benefit criteria, the optimum value is calculated using equation (2). Conversely, for cost criteria, equation (3) is used. In this case, all criteria are benefits, so the optimum values for each criterion are {5; 4; 5; 5; 4}. The resulting decision matrix is as follows:

$$X = \begin{bmatrix} 5 & 4 & 5 & 5 & 4 \\ 4 & 4 & 5 & 3 & 4 \\ 4 & 3 & 5 & 5 & 4 \\ 5 & 4 & 4 & 4 & 4 \\ 4 & 4 & 5 & 5 & 3 \end{bmatrix}$$

After creating the initial decision matrix, the next step is to normalize each value in the matrix to form the normalized decision matrix. For benefit criteria, equation (5) is used, and for cost criteria, equation (6) is used. Since all criteria are benefits, the normalization process is as follows:

$$X_{01} = \frac{5}{5+4+4+5+4} = 0.2273$$

$$X_{11} = \frac{4}{5+4+4+5+4} = 0.1818$$

$$X_{21} = \frac{4}{5+4+4+5+4} = 0.1818$$

$$X_{31} = \frac{5}{5+4+4+5+4} = 0.2273$$

$$X_{41} = \frac{4}{5+4+4+5+4} = 0.1818$$

$$X_{02} = \frac{4}{4+4+3+4+4} = 0.2105$$

$$X_{12} = \frac{4}{4+4+3+4+4} = 0.2105$$

$$X_{22} = \frac{3}{4+4+3+4+4} = 0.1579$$

$$X_{32} = \frac{4}{4+4+3+4+4} = 0.2105$$

$$X_{42} = \frac{4}{4+4+3+4+4} = 0.2105$$

$$X_{03} = \frac{5}{5+5+5+4+5} = 0.2083$$

$$X_{13} = \frac{5}{5+5+5+4+5} = 0.2083$$

$$X_{23} = \frac{5}{5+5+5+4+5} = 0.2083$$

$$X_{33} = \frac{4}{5+5+5+4+5} = 0.1667$$

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$X_{44} = \frac{5}{5+5+5+4+5} = 0.2083$

$X_{04} = \frac{5}{5+3+5+4+5} = 0.2273$

$X_{14} = \frac{3}{5+3+5+4+5} = 0.1364$

$X_{24} = \frac{5}{5+3+5+4+5} = 0.2273$

$X_{34} = \frac{4}{5+3+5+4+5} = 0.1818$

$X_{44} = \frac{5}{5+3+5+4+5} = 0.2273$

$X_{05} = \frac{4}{4+4+4+4+3} = 0.2105$

$X_{15} = \frac{4}{4+4+4+4+3} = 0.2105$

$X_{25} = \frac{4}{4+4+4+4+3} = 0.2105$

$X_{35} = \frac{4}{4+4+4+4+3} = 0.2105$

$X_{45} = \frac{3}{4+4+4+4+3} = 0.1579$

From the normalization results, the normalized matrix is formed:

$$X_{ij} = \begin{bmatrix} 0.2273 & 0.2105 & 0.2083 & 0.2273 & 0.2105 \\ 0.1818 & 0.2105 & 0.2083 & 0.1364 & 0.2105 \\ 0.1818 & 0.1579 & 0.2083 & 0.2273 & 0.2105 \\ 0.2273 & 0.2105 & 0.1667 & 0.1818 & 0.2105 \\ 0.1818 & 0.2105 & 0.2083 & 0.2273 & 0.1579 \end{bmatrix}$$

The next step is to multiply the normalized matrix elements by their respective weights and arrange the resulting values into the weighted normalized decision matrix. To get the normalized weight values, the calculation is based on equation (7). These weights refer to Table 2 discussed earlier. The detailed calculation steps are as follows:

$D_{01} = 0.2273 \times 0.3333 = 0.0750$

$D_{11} = 0.1818 \times 0.3333 = 0.0600$

$D_{21} = 0.1818 \times 0.3333 = 0.0600$

$D_{31} = 0.2273 \times 0.3333 = 0.0750$

$D_{41} = 0.1818 \times 0.3333 = 0.0600$

$D_{02} = 0.2105 \times 0.2667 = 0.0568$

$D_{12} = 0.2105 \times 0.2667 = 0.0568$

$D_{22} = 0.1579 \times 0.2667 = 0.0426$

$D_{32} = 0.2105 \times 0.2667 = 0.0568$

$D_{42} = 0.2105 \times 0.2667 = 0.0568$

$D_{03} = 0.2083 \times 0.2000 = 0.0417$

$D_{13} = 0.2083 \times 0.2000 = 0.0417$

$D_{23} = 0.2083 \times 0.2000 = 0.0417$

$D_{33} = 0.1667 \times 0.2000 = 0.0333$

$D_{43} = 0.2083 \times 0.2000 = 0.0417$

$D_{04} = 0.2273 \times 0.1333 = 0.0295$

$D_{14} = 0.1364 \times 0.1333 = 0.0177$

$D_{24} = 0.2273 \times 0.1333 = 0.0295$

$D_{34} = 0.1818 \times 0.1333 = 0.0236$

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$D_{44} = 0.2273 \times 0.1333 = 0.0295$

$D_{05} = 0.2105 \times 0.0667 = 0.0147$

$D_{15} = 0.2105 \times 0.0667 = 0.0147$

$D_{25} = 0.2105 \times 0.0667 = 0.0147$

$D_{35} = 0.2105 \times 0.0667 = 0.0147$

$D_{45} = 0.1579 \times 0.0667 = 0.0111$

After normalizing each attribute with its weight, the values are arranged into the following matrix:

$$D_{ij} = \begin{bmatrix} 0.0750 & 0.0568 & 0.0417 & 0.0295 & 0.0147 \\ 0.0600 & 0.0568 & 0{,}0417 & 0.0177 & 0.0147 \\ 0.0600 & 0.0426 & 0.0417 & 0.0295 & 0.0147 \\ 0.0750 & 0.0568 & 0.0333 & 0.0236 & 0.0147 \\ 0.0600 & 0.0568 & 0.0417 & 0.0295 & 0.0111 \end{bmatrix}$$

The next step is to calculate the utility score for each alternative using equation (8). The calculation process is as follows:

$S_0 = 0.0750 + 0.0568 + 0.0417 + 0.0295 + 0.0147 = 0.2178$

$S_1 = 0.0600 + 0.0568 + 0.0417 + 0.0177 + 0.0147 = 0.1910$

$S_2 = 0.0600 + 0.0426 + 0.0417 + 0.0295 + 0.0147 = 0.1886$

$S_3 = 0.0750 + 0.0568 + 0.0333 + 0.0236 + 0.0147 = 0.2035$

$S_4 = 0.0600 + 0.0568 + 0.0417 + 0.0295 + 0.0111 = 0.1991$

The calculated utility values are used to measure the relative performance of each alternative using equation (9). The results of the relative performance calculations for each alternative are as follows:

$K_1 = \frac{0.1910}{0.2178} = 0.8769$

$K_2 = \frac{0.1886}{0.2178} = 0.8659$

$K_3 = \frac{0.2035}{0.2178} = 0.9346$

$K_4 = \frac{0.1991}{0.2178} = 0.9142$

The performance ranking of each alternative is used as the basis for recommending the best choice. Based on the K_i values, the alternatives are ranked according to their scores, as shown in Table 4.

Table 5. Utility Ranking

Alternative Code	The Alternative	Utility Value	Ranking
A3	Ahmad Nazir	0.9346	1
A4	Ricky Hamdani	0.9142	2
A1	Andy Setiawan	0.8769	3
A2	Tati Maharani	0.8659	4

In Table 4, it is shown that the highest utility value is Ahmad Nazir (A3) with a result of 0.9346; followed by Ricky Hamdani (A4) with a result of 0.9142; Andy Setiawan (A1) with a result of 0.8769; and Tati Maharani (A2) with a result of 0.8659.

The next step is system implementation, where the system is built using PHP for coding and MySQL for database management to realize the DSS. To access the system, users must authenticate by entering a username and password. For new users, a registration option is available to create an account. After successful verification, the system directs the user to the main interface or dashboard. This page serves as a control center, providing access to various functional modules required in the evaluation and promotion decision process. Visualization of the promotion DSS dashboard is shown in Figure 2.

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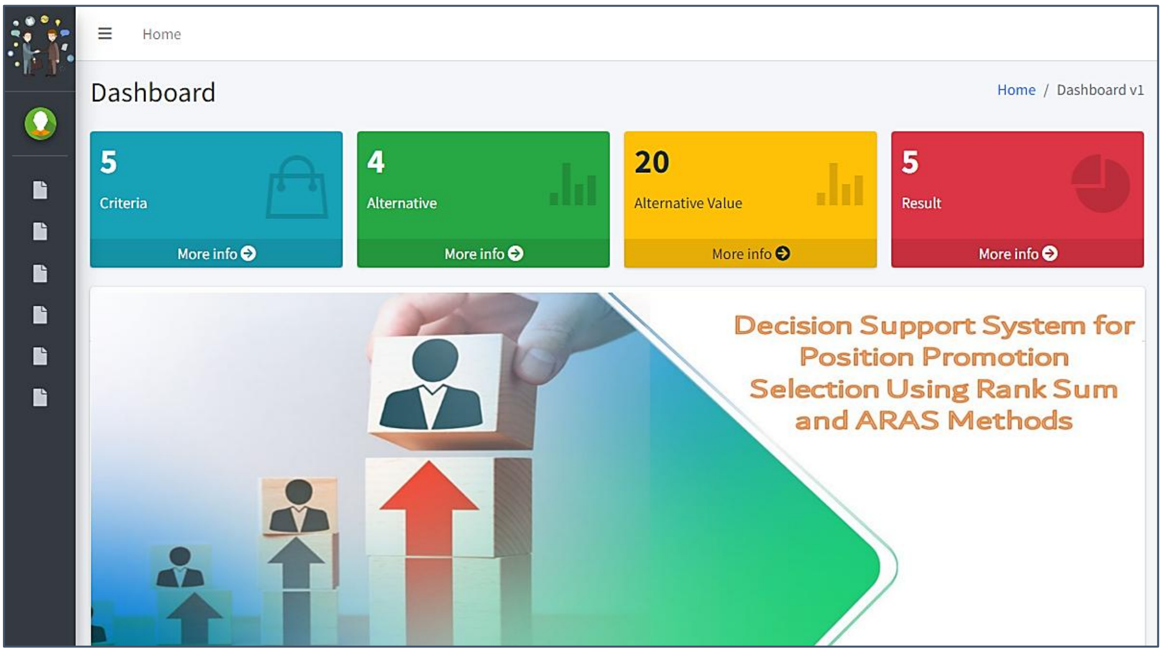

Figure 2. Dashboard of the DSS for Promotion Selection

Figure 2 shows the dashboard that provides a comprehensive overview of the main features available to users. These features include criteria management, employee alternatives for promotion, alternative performance ratings, and analysis results visualization using the ARAS method. The initial step in this process is the management of criteria data, which must be done before users can proceed to the promotion selection stage. The menu provides users the flexibility to add new criteria, modify existing parameters, or delete irrelevant criteria. To give a more concrete example of this process, the criteria feature interface is shown in Figure 3.

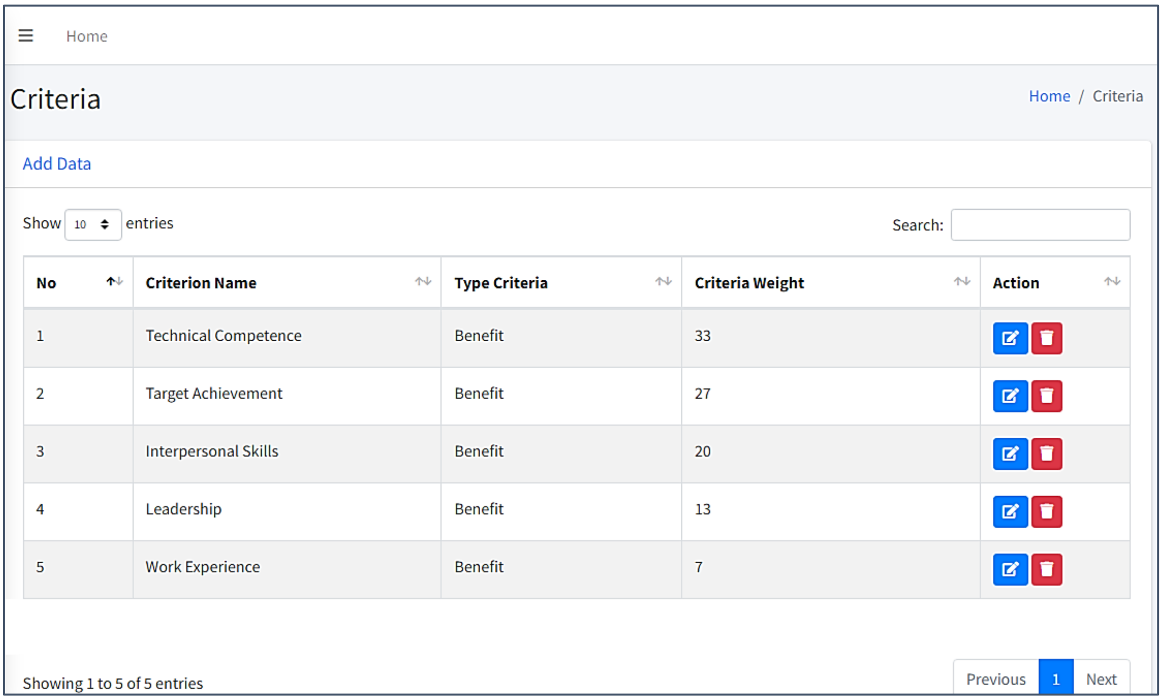

Figure 3. Criteria Feature Interface

Figure 3 visualizes the criteria feature. After managing the criteria data, users can proceed to the alternative management feature to determine promotion candidates. This feature provides alternative data management, allowing users to add employee data, update existing information, or delete data. The next step is the evaluation process, where users can input performance ratings for each alternative based on the previously defined criteria. The alternative rating feature interface is shown in Figure 4.

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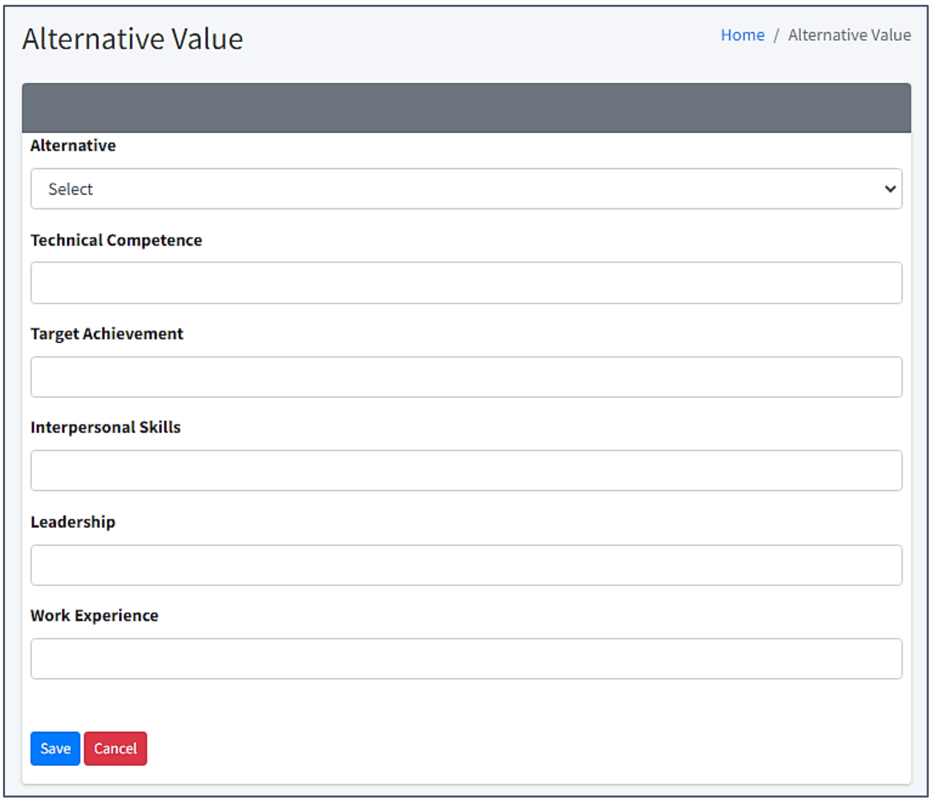

Figure 4. Alternative Rating Data Input Feature

Figure 4 shows the alternative rating data input interface, where users can rate alternatives based on the established criteria. After entering all criteria, alternatives, and performance ratings for each alternative, the system is ready for comprehensive analysis using the ARAS method. Users can access the ARAS calculation module, which presents a structured analysis process. This feature allows users to follow each calculation step, providing a deep understanding of how the final decision is obtained. The final analysis results are presented as rankings based on the relative performance values of each alternative, offering clear recommendations on the alternatives to be promoted. To give a concrete visual example, Figure 6 shows the interface of the final performance value analysis module for each alternative using the ARAS method.

Optimum Value and Utility Value

No	Alternative	Technical Competence	Target Achievement	Interpersonal Skills	Leadership	Work Experience	Optimum Value (S_i)	Nilai Utilitas (K_i)
-	Bobot	33 % (Benefit)	27 % (Benefit)	20 % (Benefit)	13 % (Benefit)	7 % (Benefit)		
	A0	0.0750000000001	0.056842105263	0.0416666666666	0.0295454545455	0.0147368421052	0.21779106858	
1	Andy Setiawan	0.0599999999999	0.056842105263	0.0416666666666	0.0177272727273	0.0147368421052	0.190972886762	0.876862802534
2	Tati Maharani	0.0599999999999	0.0426315789473	0.0416666666666	0.0295454545455	0.0147368421052	0.188580542265	0.865878217571
3	Ahmad Nazir	0.0750000000001	0.056842105263	0.0333333333334	0.0236363636363	0.0147368421052	0.203548644338	0.934605104172
4	Ricky Hamdani	0.0599999999999	0.056842105263	0.0416666666666	0.0295454545455	0.0110526315789	0.199106858054	0.914210391419

Rangking

No	Alternative	Utility Value
1	Ahmad Nazir	0.934605104172
2	Ricky Hamdani	0.914210391419
3	Andy Setiawan	0.876862802534
4	Tati Maharani	0.865878217571

Figure 6. ARAS Calculation and Ranking Results Feature

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Figure 6 visualizes the ARAS analysis results, revealing the relative performance rankings of various promotion alternatives. It shows that the highest score is Ahmad Nazir (A3) with a result of 0.9346; followed by Ricky Hamdani (A4) with a result of 0.9142; Andy Setiawan (A1) with a result of 0.8769; and Tati Maharani (A2) with a result of 0.8659. The significance of these results lies in their consistency with the manual calculations performed earlier, demonstrating the accuracy and reliability of the developed Decision Support System (DSS). The consistency between the system output and manual calculations is strong evidence that the DSS for promotion selection has successfully implemented the ARAS method accurately and validly.

The next step after developing the DSS is system testing to verify its alignment with the design and requirements. The testing method applied is black box testing, which focuses on examining the system's inputs and outputs and its response to various operational scenarios. The tester executes various test cases designed based on functional requirements to verify that the system provides correct and expected results. The results of all test cases and their outcomes are summarized in Table 6.

Table 6. Test Results

Test Case	Desired Outcome	Result
Dashboard Feature	The system displays all available features within the system.	Pass
Criteria Feature	The system can manage information, including adding, modifying, and deleting data.	Pass
Alternative Feature	The system can manage alternative data, including adding, updating, and deleting data.	Pass
Criteria Rating Feature	The system can manage data values for each alternative, including input, updating, and deleting data.	Pass
ARAS Calculation Feature	The system shows the steps in calculating using the ARAS approach in detail.	Pass
Ranking Results	The system displays the ranking results of the best alternatives.	Pass

Based on the black box testing results shown in Table 6, it is evident that the developed DSS functions as expected in all the main tested features. All tested features have shown compliance with the expected results, indicating that the system is ready for implementation in line with the established goals.

4. CONCLUSION

The research has successfully developed a Decision Support System (DSS) for promotion selection using the Rank Sum and Additive Ratio Assessment (ARAS) methods. The ARAS approach has demonstrated its ability to evaluate and rank alternatives based on predetermined criteria by converting performance values into directly comparable ratios, allowing decision-makers to systematically and objectively choose the most optimal alternative according to their goals and preferences. This study has produced a DSS for promotion selection that can provide the best alternative recommendations through the ranking of relative performance values from highest to lowest. The case study results showed that the highest utility value is Ahmad Nazir (A3) with a result of 0.9346, followed by Ricky Hamdani (A4) with 0.9142, Andy Setiawan (A1) with 0.8769, and Tati Maharani (A2) with 0.8659. The consistency between the system output and manual calculations strongly indicates that the calculations produced by the system are valid. Furthermore, based on the black box testing results, the developed DSS has functioned as expected in all the main tested features. All tested features have shown compliance with the expected results, indicating that the system is ready for implementation in line with the established goals. However, there are some improvements needed for future research. Future studies can consider integrating other methods or exploring hybrid methods to improve the system's accuracy and reliability. Additionally, testing the system in various real-world scenarios and gathering feedback from end-users can provide additional insights for further refinement.

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