Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

A Hybrid SITDE Weighting and HYBSO Method in Decision Support Systems for Warehouse Employee Selection

Tri Widodo[1*], Okma Arnilia[2], Iryanto Chandra[3], Sahrial Ihsani Ishak[4], Setiawansyah[5]
[1]Computer Engineering Study Program, Universitas Teknokrat Indonesia, Indonesia
[2]Informatics Study Program, Universitas Islam Negeri Siber Syekh Nurjati Cirebon, Indonesia
[3]Library Science Study Program, Universitas Islam Negeri Sunan Kalijaga, Indonesia
[4]Informatics Engineering Study Program, Universitas Dian Nusantara, Indonesia
[5]Informatics Study Program, Universitas Teknokrat Indonesia, Indonesia
Email: [1*]tri_widodo@teknokrat.ac.id, [2]okmaarnilia@uinssc.ac.id, [3]iryanto.chandra@uin-suka.ac.id, [4]sahrial.ihsani.ishak@dosen.undira.ac.id, [5]setiawansyah@teknokrat.ac.id

Abstract

Warehouse employee selection is a complex process because it involves various heterogeneous criteria, both quantitative and qualitative, such as physical tests, accuracy, work experience, discipline, and teamwork ability. A selection process that still relies on subjective judgment risks producing inconsistent and suboptimal decisions. This study proposes a hybrid method that integrates skewness impact through distributional evaluation (SITDE) for objective determination of criteria weights with a hybrid solution algorithm (HYBSO) for systematic ranking of alternatives. The results of applying this method indicate that Work Experience has the highest weight of 0.2813, followed by the Discipline Test (0.1969) and Physical Test (0.1926), while the Accuracy Test (0.1641) and Teamwork Test (0.1652) have lower weights. The final ranking results show that Candidate HW ranks first with a score of 0.3596, followed by Candidate FN (0.7066) and Candidate DK (0.9162). The sensitivity analysis evaluates the stability of the ranking results under changes in criterion weights across 20 scenarios, demonstrating the robustness of the proposed SITDE-HYBSO method and identifying candidates whose ranking positions are more sensitive to variations in criterion importance. These findings confirm that the SITDE-HYBSO hybrid method is capable of producing objective, consistent, and accountable employee selection decisions, while also providing an adaptive mechanism to respond to changes in organizational priorities.
Keywords: Warehouse Employee Selection; Heterogeneous Criteria; SITDE; HYBSO; Sensitivity Analysis;

***Corresponding Author:**
Tri Widodo, Universitas Teknokrat Indonesia, Indonesia
Email: tri_widodo@teknokrat.ac.id

1. INTRODUCING

Warehouse employee selection is an important aspect in ensuring the efficiency of logistics and supply chain operations, as the quality of the workforce directly affects the speed, accuracy, and safety in the process of goods distribution[1], [2]. A proper selection process allows the company to identify candidates who not only have adequate physical capabilities but also technical skills such as inventory management, use of warehouse management systems, and understanding of workplace safety procedures. In addition, diligence and responsibility are crucial factors considering that small mistakes in recording or handling goods can have a significant impact on the overall logistics system. In the context of increasingly intense business competition, companies are required to implement objective and systematic selection methods in order to choose employees who best meet operational needs[3]. Utilizing criteria-based and technology-driven approaches can also increase accuracy in the decision-making process, thereby minimizing the risk of recruitment errors. Thus, effective warehouse employee

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

selection not only supports smooth operations but also contributes to enhancing overall company productivity and competitiveness.

The performance of warehouse employees affects inventory accuracy, distribution speed, as well as overall service quality within the company's logistics system[4]. The level of precision in recording and managing stock determines how reliable inventory data can be to support accurate decision-making. Additionally, employee efficiency in the processes of receiving, storing, and shipping goods greatly influences distribution speed, which ultimately impacts customer satisfaction[5]. Good performance also reflects employees' ability to adhere to standard operating procedures and maintain the quality of goods during handling. Conversely, poor performance can lead to recording errors, delayed shipments, and even damage to goods, which can potentially harm the company.

The selection process for warehouse employees often involves various criteria such as physical strength, accuracy, work experience, discipline, and teamwork skills because each criterion has a complementary role in supporting operational performance[6]–[8]. Physical strength is a fundamental aspect required to carry out tasks such as lifting, moving, and arranging large quantities of goods efficiently. Accuracy is also very important, especially in stock recording and inventory management activities, in order to minimize errors that can impact company losses. In addition, work experience provides its own advantages because experienced candidates generally understand warehouse workflows better and can quickly adapt to the systems in use[9]. Work discipline is an important factor in ensuring that every operational procedure and safety standard can be carried out consistently. Equally important, teamwork skills are highly required because warehouse activities demand good coordination among employees for smooth workflow. By considering all these criteria comprehensively, the company can obtain a workforce that is not only individually competent but also capable of contributing optimally in a team work environment.

The main challenge in the warehouse employee selection process lies in the subjectivity of assessments and the difficulty in combining various heterogeneous criteria. Subjectivity often arises when evaluators give different weights to criteria such as physical strength, accuracy, or discipline based on personal perception, making the selection results less consistent and potentially biased. In addition, each criterion has different characteristics, whether quantitative or qualitative, making it difficult to compare and make decisions objectively. Work experience, for example, can be measured in years, whereas teamwork ability is more difficult to quantify numerically and often depends on observation or behavioral assessment. This condition makes the process of integrating criteria complex and prone to producing suboptimal decisions. Therefore, an approach or method is needed that can systematically accommodate various types of criteria and reduce the level of subjectivity in assessments. With the right decision support system, the selection process can become more transparent, consistent, and accurate in determining the best candidate. Previous studies have applied various decision support systems (DSS) and multi-criteria decision making (MCDM) methods in employee selection. However, some research still focuses on using a specific method without considering the data characteristics and the objective contribution of each criterion. Also, the weighting and ranking processes are often done separately. Therefore, the study integrates weighting and ranking methods to produce more objective and consistent decisions in selecting warehouse employees.

The DSS approach based on MCDM can enhance objectivity and transparency in the warehouse employee selection process by systematically and structurally integrating various criteria.[10], [11] This method allows each criterion, such as physical strength, accuracy, work experience, discipline, and teamwork ability, to be assigned a clear weight according to its level of importance, thereby reducing the dominance of subjective assessment. In addition, MCDM-based DSS can process both quantitative and qualitative data into a preference value that can be fairly compared among candidates[12]–[14]. The standardized calculation process also improves the consistency of selection results, making the decisions taken more accountable. Transparency is also increased because each assessment stage can be traced and logically explained to the relevant parties.

The skewness impact through distributional evaluation (SITDE) method is used to objectively generate criterion weights by utilizing the characteristics of data distribution, particularly the skewness level of each assessed criterion[15], [16]. This approach focuses on how data distribution reflects the

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

variation and level of discrimination among alternatives, so that the resulting weights are not merely based on assumptions or the subjective preferences of decision-makers. By considering the distribution of values, SITDE can identify criteria that have a more significant influence in distinguishing candidate quality, making the assigned weights more representative of the actual data conditions. This is particularly important in the context of warehouse employee selection, which involves various heterogeneous criteria, as each criterion has a different distribution pattern. In addition, the use of SITDE also helps minimize bias in determining weights, making the evaluation results more-fair and consistent.

The hybrid solution algorithm (HYBSO) method is used as a ranking technique to systematically determine the best candidates by integrating various concepts in multi-criteria decision making[17]. This approach is designed to process the preference values of each alternative based on predetermined criteria weights, thereby producing a ranking order that comprehensively reflects the feasibility level of the candidates. HYBSO is capable of accommodating various types of data, both quantitative and qualitative, making it highly relevant for use in warehouse employee selection processes involving heterogeneous criteria. In addition, this method has the advantage of maintaining the consistency of ranking results by minimizing the influence of subjectivity in the evaluation process. The structured calculation process also allows for higher transparency, as each step can be traced and logically explained.

The integration of the SITDE and HYBSO methods is expected to be able to produce a warehouse employee selection model that is more accurate, objective, and stable by combining the advantages of each approach into a single integrated decision-making framework. SITDE plays a role in generating criterion weights objectively based on data distribution, thus being able to reflect the importance level of each criterion more realistically and factually. Meanwhile, HYBSO functions as a systematic ranking technique to process preference values and determine the order of the best candidates comprehensively. The combination of both allows the selection process to not only consider accurate weights but also produce consistent and accountable rankings. In addition, this integration can also reduce subjectivity and increase the stability of decision results, especially when there are changes in data or the addition of candidate alternatives.

This study aims to develop a more accurate, objective, and systematic warehouse employee selection model by integrating the SITDE and HYBSO methods within an MCDM-based DSS framework. Specifically, this study seeks to address issues of subjectivity in determining criteria weights and improve consistency in the candidate ranking process through a data-driven approach. In addition, this study also aims to evaluate the effectiveness of integrating SITDE and HYBSO in handling heterogeneous and complex criteria in the selection process. The main contribution of this study lies in a hybrid model that can combine the advantages of data distribution analysis from SITDE with the systematic ranking capability of HYBSO. Furthermore, this study provides a practical contribution in the form of a framework that can be implemented by companies to enhance the quality of the recruitment process, particularly in the logistics and warehousing sector.

2. RESEARCH METHODOLOGY

Research method is a systematic approach or way used by researchers to collect, process, analyze, and interpret data in order to answer research questions and achieve research objectives[18], [19]. Research methods include the selection of the type of research, data collection techniques, instruments used, as well as analysis procedures applied to ensure that research results are valid and scientifically accountable. In addition, research methods also serve as guidelines in carrying out each stage of research in a structured and consistent manner. Choosing the right method is very important because it will affect the quality of the results and the suitability between the problem being studied and the solutions produced.

2.1. Research Stage

The stages of research are a series of systematic steps carried out by researchers to achieve research objectives in a directed and logical manner[20], [21]. This process includes activities arranged

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

sequentially, from planning, implementation, to completion of the research. Each stage is designed to ensure that the research is conducted in a structured way, so that the results obtained can be scientifically accountable. In addition, the research stages also help researchers organize the workflow to be more efficient and controlled. By following clear stages, research can produce findings that are valid, reliable, and relevant to the issues being studied. The stages of research become an important foundation in every scientific research activity as shown in Figure 1.

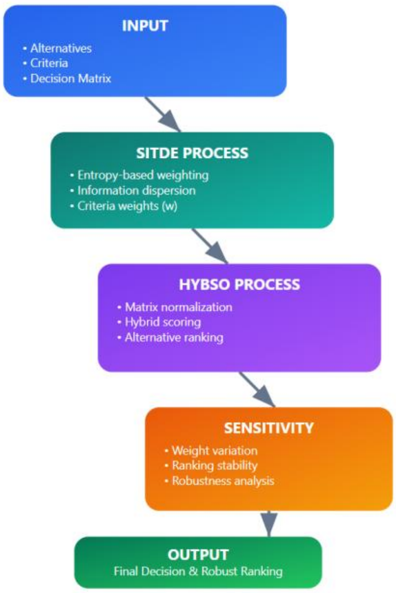

Figure 1. Research Stage

The research flowchart consists of five main stages: input, SITDE process, HYBSO process, sensitivity analysis, and output. The input stage involves preparing the decision-making data, including alternatives, evaluation criteria, and the decision matrix. The SITDE process is then applied to objectively determine the weight of each criterion based on the information contained in the dataset. Subsequently, the HYBSO process uses the resulting criterion weights and decision matrix to calculate the performance scores and rank the alternatives. The obtained ranking is further evaluated through sensitivity analysis by systematically varying the criterion weights to examine the stability and robustness of the ranking results. Finally, the output stage produces the final ranking of alternatives and a robust decision recommendation based on the results of the HYBSO method and the sensitivity analysis.

2.2. SITDE Weighting

SITDE Weighting is a method of weighting criteria in multi-criteria decision making that uses the Skewness Impact Through Distributional Evaluation approach to produce weights objectively based on the characteristics of data distribution[16], [22]. This method utilizes skewness values and the data distribution patterns of each criterion to determine its level of importance, so that the resulting weights reflect the ability of the criteria to differentiate the quality of alternatives. Unlike subjective approaches that rely on individual judgment, SITDE Weighting focuses on statistical information from the available data, thus being able to reduce bias in the weighting process. In addition, this method is also effective in handling heterogeneous data because it considers variations in the distribution of each criterion. The SITDE Weighting method provides a more rational, consistent, and data-based foundation for weighting, supporting more accurate decision making.

The steps of the SITDE Weighting method begin with the preparation of a decision matrix containing the values of each alternative against each criterion, which is calculated using (1). Next, a normalization process is carried out to equalize the value scales across criteria so that they can be compared fairly, which is calculated using (2). The next step is to calculate the skewness value for each criterion to

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

determine the degree of data distribution skewness, which is calculated using (3). After that, a distribution deviation calculation is carried out to measure the degree of data dispersion for each criterion, which is calculated using (4). The final stage is to calculate the criterion weights based on the results of skewness and distribution deviation so that the final weight of each criterion is obtained, which is calculated using (5). Through this stage, the SITDE method can produce objective criterion weights based on the characteristics of data distribution. The equation of the SITDE weighting method is presented as follows.

$$X = [x_{ij}]_{mxn} \tag{1}$$

$$z_{ij} = \begin{cases} \dfrac{\min_i x_{ij}}{x_{ij}}; benefit \\ \dfrac{x_{ij}}{\max_i x_{ij}}; cost \end{cases} \tag{2}$$

$$K_j = \frac{m}{(m-1)(m-2)} \sum_{j=1}^{m} \left(\frac{z_{ij} - \bar{z}_j}{\sigma_j} \right)^3 \tag{3}$$

$$LK_j = \log \left| \left((K_j + 1) + \left(\left| \min(K_j) \right| + 1 \right) \right) \right| \tag{4}$$

$$w_j = \frac{LK_j}{\sum_{j=1}^{n} LK_j} \tag{5}$$

The symbol X represents a decision matrix consisting of x_{ij} as the value of the i^{th} alternative for the j^{th} criterion, with m indicating the number of alternatives and n indicating the number of criteria. The symbol z_{ij} is the normalized value, where the calculation is differentiated based on the type of criterion, namely benefit (the larger the better) and cost (the smaller the better). The symbol K_j represents the skewness value for the j^{th} criterion, with m as the number of data, $\bar{z}_j$ as the average of the normalized values for the j^{th} criterion, and σ_j as the standard deviations of those normalized values. The symbol LK_j is the logarithmic transformation value aimed at stabilizing the skewness value, taking into account the minimum skewness value so that the result remains positive. The symbol w_j is the final weight for each j^{th} criterion, obtained by dividing the logarithmic value by the total of all logarithmic values of all criteria, thus producing a standardized weight that can be used in the decision-making process.

2.3. HYBSO Method

The HYBSO method is a method in multi-criteria decision making used to systematically rank alternatives by combining several evaluation approaches within an integrated framework[17]. This method is designed to process preference values based on predetermined criteria weights, thereby producing a ranking order of alternatives that reflects performance levels comprehensively. HYBSO has the ability to handle heterogeneous data, both quantitative and qualitative, making it suitable for complex problems such as employee selection. Additionally, the hybrid approach used allows for improved result accuracy by minimizing the weaknesses of a single method. The calculation process in HYBSO is carried out in a structured and transparent manner, so each stage can be traced and accounted for.

The HYBSO method stages begin with the preparation of a decision matrix containing the values of each alternative against each criterion, which is calculated using (1). Next, a normalization process is carried out to equalize the value scale among criteria for fair comparison, calculated using (6) and (7). The next stage is the calculation of the power weight of the weighted sequence value for each alternative as a form of strengthening the contribution of the weight to the performance value, calculated using (8). Then, the calculation of the power sum of the weighted power products value is performed to accumulate the results of the exponent-based weighting, calculated using (9). After that, the weighted average comparability value is calculated to obtain a measure of the weighted average comparison between alternatives, which is calculated using (10). The next stage is the calculation of the relative value as a basis for determining the preference level of each alternative, which is calculated using (11) and (12). The final stage is the calculation of the final value to determine the overall ranking of the best candidate, which is calculated using (13). The equation of the HYBSO method is presented as follows.

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

$$\delta_j = \sqrt{\sum_{i=1}^{n}\left(\max_i x_{ij} - x_{ij}\right)^2} \tag{6}$$

$$r_{ij} = \begin{cases} \dfrac{x_{ij} - \min_i x_{ij}}{\delta_j}; benefit \\ \dfrac{\max_i x_{ij} - x_{ij}}{\delta_j}; cost \end{cases} \tag{7}$$

$$S_i^1 = \frac{\sum_{j=1}^{n}\left(r_{ij} * w_j\right)^{w_j}}{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(r_{ij} * w_j\right)^{w_j}} \tag{8}$$

$$S_i^2 = \left(\prod_{j=1}^{n}\left(r_{ij}\right)^{w_j}\right)^{(1-0.001)} + \left(\prod_{j=1}^{n}\left(1 - r_{ij}\right)^{w_j}\right)^{0.001} \tag{9}$$

$$S_i^3 = \ln\left(\sum_{j=1}^{n}\exp(r_{ij} * w_j)\right) \tag{10}$$

$$H_i^1 = \left(\prod_{k=1}^{3} S_i^k\right)^{1/2} * \left[1 - \prod_{k=1}^{3} S_i^k\right]^{1/2} \tag{11}$$

$$H_i^2 = \sum_{k=1}^{3}\frac{S_i^k - \underline{S}^k}{\bar{S}^k - \underline{S}^k} \tag{12}$$

$$Y_i = \ln\left(\frac{H_i^1 \exp(H_i^1) + H_i^2 \exp\,(H_i^2)}{H_i^1 + H_i^2}\right) \tag{13}$$

The symbol δ_j represents the deviation value for each j[th] criterion, which is calculated from the difference between the maximum value of the alternatives for that criterion and the value of each alternative, then summed in squared form. The symbol r_{ij} is the normalization value for the i[th] alternative on the j[th] criterion, which is calculated based on the type of criterion, whether benefit or cost, by considering the minimum or maximum value and divided by δ_j as an adjustment factor. The symbol S_i^1 is the power weight of the weighted sequence value for the i-th alternative, obtained from the aggregation of r_{ij} values that have been multiplied by the criterion weight w_j and raised to the power according to its weight, then normalized against the overall total. The symbol S_i^2 is the power sum of the weighted power products value, calculated from the multiplication of r_{ij} values raised to their weights and the combination of their complementary values involving a small constant to maintain computational stability. The symbol S_i^3 represents the logarithm-based aggregate value of the exponential sum resulting from the multiplication between normalization and criteria weight. The symbol H_i^1 is the value obtained from the multiplicative combination of three S components, which is then processed using a root and a complement function to produce a measure of balance. The symbol H_i^1 represents the weighted average comparability value calculated from the difference between S_i^k values and their minimum and average values. The symbol Y_i is the final value or the preference value of the i-th alternative, calculated using the logarithmic function of the exponential combination of H_i^1 and H_i^2, which is then used to determine the ranking of alternatives.

3. RESULT AND DISCUSSIONS

A hybrid SITDE weighting and HYBSO method in decision support systems for warehouse employee selection is an integrated approach designed to improve the quality of the decision-making process in warehouse employee selection through a combination of objective weighting techniques and comprehensive ranking methods. In this model, SITDE is used to generate criterion weights based on data by considering distribution characteristics such as skewness, thereby reducing subjectivity in determining the importance level of each criterion. Furthermore, the HYBSO method is applied to process candidate preference values and produce a final ranking systematically by considering various evaluation aspects simultaneously. The integration of these two methods allows the combination of the

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

advantages of statistical analysis and robust aggregation mechanisms, resulting in more accurate, consistent, and stable decisions. This approach is also capable of handling criteria that are heterogeneous in nature, both quantitative and qualitative, which are commonly found in the warehouse employee selection process. With the support of a decision support system, this hybrid model not only enhances the transparency of the selection process but also provides a more rational and accountable basis for determining the best candidate.

3.1. Data Collection

Data collection in this study was conducted systematically to obtain accurate and relevant information related to the warehouse employee selection process. The data collected includes criterion data used in the assessment, such as work productivity, accuracy, work experience, discipline, and teamwork ability, as well as alternative data in the form of candidates to be selected. The data collection process can be carried out through several techniques, such as direct observation of work activities in the warehouse, interviews with management or supervisors, as well as document study of previous employee data. In addition, questionnaires can also be used to obtain assessments of qualitative aspects, such as work attitude and ability to work in a team. The obtained data is then verified to ensure its completeness and consistency before being used in the processing stage. With a structured and valid data collection process, this research is expected to produce accurate analysis and support more objective decision-making. Table 1 shows the results of the data collection conducted.

Table 1. Data Collection

Candidate Name	Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
Candidate AP	85	80	2	90	88
Candidate BS	78	85	3	87	82
Candidate CL	92	88	2	85	90
Candidate DK	75	82	4	88	80
Candidate ES	88	86	2	91	87
Candidate FN	80	78	3	86	83
Candidate GP	90	89	2	92	91
Candidate HW	77	81	4	84	79
Candidate IS	86	87	2	89	88

Table 1 presents the collected data for the warehouse employee selection process, which consists of nine candidates with each score based on five evaluation criteria: physical test, accuracy test, work experience, discipline test, and teamwork test. Each candidate, from Candidate AP to Candidate IS, has scores reflecting the evaluation results for each criterion, where most criteria are rated on a 0–100 scale, except for work experience, which is expressed in years. All five criteria are categorized as benefit criteria, meaning that higher values indicate better performance and are therefore more preferable in the employee selection process. The criteria include physical test (C1), accuracy test (C2), work experience (C3), discipline test (C4), and teamwork test (C5). This data shows variation in abilities among the candidates; for example, some candidates have high scores in physical aspects but lower in accuracy, or vice versa, reflecting heterogeneous characteristics. This information serves as the basis for forming a decision matrix that will be used in the data processing stage using the SITDE method for criteria weighting and HYBSO for alternative ranking.

3.2. Data Processing

The data processing stage in this research is carried out to process the collected data into information that can be used in the decision-making process systematically. This process begins with the preparation of a decision matrix based on the value of each candidate against all predetermined criteria. Next, data normalization is performed to equalize the scale between criteria so that they can be compared fairly even though they have different units. After that, the SITDE method is applied to calculate the weights

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

of the criteria objectively based on the characteristics of the data distribution, thus being able to reflect the level of importance of each criterion more accurately. The weighting results are then used in the HYBSO method to carry out the candidate ranking process through several structured calculation stages. This whole process aims to produce a final preference value that can be used as a basis for determining the best candidate.

The determination of criterion weights using the SITDE method is an objective approach based on the characteristics of data distribution for each criterion. This method utilizes statistical information, particularly the degree of skewness and data dispersion, to reflect how much a criterion can distinguish the quality of alternatives. Thus, criteria with more significant data variation will receive a higher weight because they are considered more influential in the decision-making process. This approach does not rely on subjective assessments but is entirely based on the available data, thereby enhancing fairness and consistency in weighting. Additionally, SITDE is also effective in handling heterogeneous data as it considers the distribution patterns of each criterion comprehensively.

The first stage of determining weights using the SITDE method is the preparation of a decision matrix that contains the values of each alternative against all predetermined criteria using (1). Each element in the matrix indicates the candidate's performance against a criterion, so the quality of the data at this stage greatly determines the final result of the weighting. The results of the SITDE method decision matrix are shown as follows.

$$X=\begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} \\ x_{31} & x_{32} & x_{33} & x_{34} & x_{35} \\ x_{41} & x_{42} & x_{43} & x_{44} & x_{45} \\ x_{51} & x_{52} & x_{53} & x_{54} & x_{55} \\ x_{61} & x_{62} & x_{63} & x_{64} & x_{65} \\ x_{71} & x_{72} & x_{73} & x_{74} & x_{75} \\ x_{81} & x_{82} & x_{83} & x_{84} & x_{85} \\ x_{91} & x_{92} & x_{93} & x_{94} & x_{95} \end{bmatrix} \Rightarrow X=\begin{bmatrix} 85 & 80 & 2 & 90 & 88 \\ 78 & 85 & 3 & 87 & 82 \\ 92 & 88 & 2 & 85 & 90 \\ 75 & 82 & 4 & 88 & 80 \\ 88 & 86 & 2 & 91 & 87 \\ 80 & 78 & 3 & 86 & 83 \\ 90 & 89 & 2 & 92 & 91 \\ 77 & 81 & 4 & 84 & 79 \\ 86 & 87 & 2 & 89 & 88 \end{bmatrix}$$

The second stage of determining weights using the SITDE method is the data normalization process to equalize the value scale across criteria. Normalization is carried out so that each criterion can be compared fairly even if they have different units or value ranges using (2).

$$z_{11}=\frac{x_{11}}{\max_{1} x_{ij}}=\frac{85}{92}=0.9239$$

The results of the normalization value calculations for all alternatives from all criteria are presented in Table 2 as a form of data scale equalization. Table 2 presents the normalization values for each candidate, which are then used as the basis for further calculations in using the SITDE method.

Table 2. Normalization Results of the SITDE Method

Candidate Name	Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
Candidate AP	0.9239	0.8989	0.5000	0.9783	0.9670
Candidate BS	0.8478	0.9551	0.7500	0.9457	0.9011
Candidate CL	1.0000	0.9888	0.5000	0.9239	0.9890
Candidate DK	0.8152	0.9213	1.0000	0.9565	0.8791
Candidate ES	0.9565	0.9663	0.5000	0.9891	0.9560
Candidate FN	0.8696	0.8764	0.7500	0.9348	0.9121
Candidate GP	0.9783	1.0000	0.5000	1.0000	1.0000
Candidate HW	0.8370	0.9101	1.0000	0.9130	0.8681
Candidate IS	0.9348	0.9775	0.5000	0.9674	0.9670

The third stage of determining weights using the SITDE method is the calculation of skewness values

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

for each criterion to determine the degree of data distribution skewness. This value reflects the data distribution pattern and indicates whether the data tends to be concentrated at certain values or evenly spread using (3).

$$K_1 = \frac{9}{(9-1)(9-2)} \sum_{j=1}^{9} \left(\frac{z_{i1} - \bar{z}_1}{\sigma_1}\right)^3 = (0.1607) * (-0.2548) = -0.0409$$

This information is important because it is used to assess a criterion's ability to differentiate alternatives. The results of the skewness values using the SITDE method are presented as follows table 3.

Table 3. Skewness Results of the SITDE Method

Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
-0.0409	-0.2971	0.9842	9.68645E-15	-0.2880

The fourth stage of determining weights using the SITDE method is the calculation of distribution deviation, which aims to measure the level of data dispersion for each criterion using (4). This value indicates the extent of data variation possessed by a criterion, thus depicting its level of contribution in the decision-making process.

$$LK_1 = \log\left|\left((K_1 + 1) + \left(\left|\min(K_j)\right| + 1\right)\right)\right| = \log\left|\left((1.2971) + (2.2561)\right)\right| = 0.3534$$

The calculation results of the distribution deviation values for all criteria are presented in Table 4 as a form of measuring the level of data spread for each criterion. These values indicate the amount of data variation each criterion has in differentiating the alternatives. Table 4 presents the distribution deviation values of each criterion, which are subsequently used as the basis for further calculations in the SITDE method.

Table 4. Results of Distribution Deviation Using the SITDE Method

Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
0.3534	0.3010	0.5160	0.3612	0.3030

The fifth stage of determining weights using the SITDE method is the determination of the final criterion weights based on the results of data distribution analysis using (5).

$$w_1 = \frac{LK_1}{\sum_{j=1}^{5} LK_j} = \frac{0.3534}{1.8346} = 0.1926$$

Table 5 presents the weight values of each criterion, which are subsequently used as the basis in the ranking process using the SITDE method.

Table 5. Results of Criteria Weights Using the SITDE Method

Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
0.1926	0.1641	0.2813	0.1969	0.1652

The weighting results of criteria using the SITDE method in the warehouse employee selection process. Based on the table, the Work Experience criterion has the highest weight of 0.2813, indicating that this criterion has the greatest influence in differentiating candidate quality. Furthermore, the Discipline Test and Physical Test criteria have relatively balanced weights, at 0.1969 and 0.1926 respectively, indicating a fairly significant contribution to the evaluation process. Meanwhile, the Teamwork Test and Accuracy Test have lower weights, at 0.1652 and 0.1641, indicating that their influence in the assessment is relatively smaller compared to the other criteria. Overall, this weight distribution reflects the level of importance of each criterion objectively based on the characteristics of the data, thus it can be used as a strong basis in the subsequent candidate ranking process.

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

The calculation of alternative values using the HYBSO method is carried out to determine the preference level of each candidate based on the previously obtained criteria weights. This method processes the values of each alternative through a series of calculations that integrate various aggregation approaches, thereby producing a comprehensive assessment. The value of each candidate is calculated by considering the contribution of each criterion according to its weight, thus reflecting the overall performance proportionally. This process is also capable of handling heterogeneous data by combining several evaluation measures within a single calculation framework. The result of this calculation is a preference value that indicates the feasibility level of each candidate for selection. Thus, the HYBSO method provides a systematic, objective, and consistent basis for determining the ranking of the best alternatives.

The first stage of alternative assessment using the HYBSO method is the preparation of a decision matrix containing the values of each alternative against all predetermined criteria using (1). The result of the HYBSO decision matrix is the same as the SITDE decision matrix. The second stage of alternative assessment using the HYBSO method is the data normalization process to equalize the value scales among criteria using (6) and (7).

$$\delta_1 = \sqrt{\sum_{i=1}^{5} \left(\max_{1} x_{ij} - x_{11}\right)^2} = \sqrt{959} = 30.9677$$

$$r_{11} = \frac{x_{11} - \min_{1} x_{ij}}{\delta_1} = \frac{85 - 75}{30.9677} = \frac{10}{30.9677} = 0.3229$$

The results of the normalization value calculations for all alternatives from all criteria are presented in Table 6 as a form of data scale equalization. Table 6 presents the normalization values for each candidate, which are then used as the basis for further calculations in using the HYBSO method.

Table 6. Normalization Results of the HYBSO Method

Candidate Name	Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
Candidate AP	0.3229	0.1077	0.0000	0.4201	0.4266
Candidate BS	0.0969	0.3769	0.2132	0.2100	0.1422
Candidate CL	0.5490	0.5384	0.0000	0.0700	0.5215
Candidate DK	0.0000	0.2154	0.4264	0.2801	0.0474
Candidate ES	0.4198	0.4307	0.0000	0.4901	0.3792
Candidate FN	0.1615	0.0000	0.2132	0.1400	0.1896
Candidate GP	0.4844	0.5922	0.0000	0.5601	0.5689
Candidate HW	0.0646	0.1615	0.4264	0.0000	0.0000
Candidate IS	0.3552	0.4845	0.0000	0.3501	0.4266

The third stage of alternative assessment using the HYBSO method is the calculation of the power weight of the weighted sequence for each alternative, which is calculated using (8).

$$S_1^1 = \frac{\sum_{j=1}^{5} (r_{1j} * w_j)^{w_j}}{\sum_{i=1}^{9} \sum_{j=1}^{5} (r_{1j} * w_j)^{w_j}} = \frac{2.3588}{20.7566} = 0.1136$$

Table 7 displays values that reflect a combination of the normalization values and the criteria weights for each candidate, which are subsequently used as the basis for further calculation stages in the HYBSO method.

Table 7. Results of the Power Weight of the Weighted Sequence HYBSO Method

Candidate Name	Power Weight of the Weighted
Candidate AP	0.1136
Candidate BS	0.1264

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

Candidate CL	0.1165
Candidate DK	0.1032
Candidate ES	0.1218
Candidate FN	0.0975
Candidate GP	0.1272
Candidate HW	0.0738
Candidate IS	0.1201

The fourth stage of alternative assessment using the HYBSO method is the calculation of the power sum of the weighted power products, which aims to accumulate the results of multiplication- and exponentiation-based weighting, and is calculated using (9).

$$S_1^2 = \left(\prod_{j=1}^{5} (r_{1j})^{w_j}\right)^{(1-0.001)} + \left(\prod_{j=1}^{5} (1 - r_{1j})^{w_j}\right)^{0.001} = 0 + 0.9997 = 0.9997$$

Table 8 displays values derived from multiplying and summing the weighted normalized scores of each criterion, reflecting the overall contribution of the criteria in a more integrated manner. These values serve as the basis for the next stages in the HYBSO method, providing a comprehensive measure to compare and rank all candidates systematically.

Table 8. Results of the Power Sum of the Weighted Power Products HYBSO Method

Candidate Name	Power Sum of the Weighted
Candidate AP	0.9997
Candidate BS	1.1876
Candidate CL	0.9996
Candidate DK	0.9997
Candidate ES	0.9996
Candidate FN	0.9998
Candidate GP	0.9994
Candidate HW	0.9998
Candidate IS	0.9996

The fifth stage of alternative evaluation using the HYBSO method is the calculation of the weighted average comparability value to obtain the weighted average comparison measure between alternatives, calculated using (10).

$$S_1^3 = \ln\left(\sum_{j=1}^{5} \exp(r_{1j} * w_j)\right) = \ln(9.9438) = 2.2969$$

Table 9 displays values derived from averaging the weighted contributions of all criteria, providing an integrated view of how each candidate stands in relation to the group. These values serve as the basis for the subsequent stages in the HYBSO method, enabling a systematic and objective comparison to determine the ranking of all candidates.

Table 9. Results of the Weighted Average Comparability HYBSO Method

Candidate Name	Weighted Average Comparability
Candidate AP	2.2969
Candidate BS	2.3319
Candidate CL	2.3193
Candidate DK	2.2386
Candidate ES	2.3465
Candidate FN	2.2019
Candidate GP	2.3811
Candidate HW	2.0918

E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

Candidate IS	2.3358

The sixth stage of alternative evaluation using the HYBSO method is the calculation of the relative value that reflects the preference level of each alternative based on the previous aggregation results, calculated using (11) and (12).

$$H_1^1 = \left(\prod_{k=1}^{3} S_1^k\right)^{1/2} * \left[1 - \prod_{k=1}^{3} S_1^k\right]^{1/2} = 0.5108 * 0.8597 = 0.4392$$

$$H_1^2 = \sum_{k=1}^{3} \frac{S_1^k - \underline{S}^k}{\bar{S}^k - \underline{S}^k} = 0.7464 + 0.0015 + 0.7091 = 1.4571$$

Table 10 displays values that reflect how each candidate performs relative to the others, providing a clear picture of their comparative standing. These relative values serve as the basis for the final stage in the HYBSO method, supporting a systematic and objective determination of the overall ranking of all candidates.

Table 10. Relative Score Results of the HYBSO Method

Candidate Name	H_i^1	H_i^2
Candidate AP	0.4392	1.4571
Candidate BS	0.4770	2.8151
Candidate CL	0.4440	1.5866
Candidate DK	0.4215	1.0604
Candidate ES	0.4517	1.7796
Candidate FN	0.4105	0.8264
Candidate GP	0.4594	2.0000
Candidate HW	0.3612	0.0020
Candidate IS	0.4492	1.7116

The seventh stage of alternative evaluation using the HYBSO method is the calculation of the final value used to determine the overall ranking of alternatives, calculated using (13).

$$Y_1 = \ln\left(\frac{H_1^1 \exp(H_1^1) + H_1^2 \exp(H_1^2)}{H_1^1 + H_1^2}\right) = \ln\left(\frac{6.9368}{1.8962}\right) = \ln(3.6583) = 1.2970$$

Table 11 displays values that integrate all previous calculations, reflecting the combined effect of weighted criteria and relative assessments. These final values serve as the definitive basis for ranking the candidates, enabling a systematic, objective, and data-driven determination of the most suitable individuals for selection.

Table 11. Final Value Results of the HYBSO Method

Candidate Name	Final Value
Candidate AP	1.2970
Candidate BS	2.6748
Candidate CL	1.4253
Candidate DK	0.9162
Candidate ES	1.6185
Candidate FN	0.7066
Candidate GP	1.8413
Candidate HW	0.3596
Candidate IS	1.5502

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

The HYBSO method provides a systematic and comprehensive framework for assessing and ranking candidates based on various objectively weighted criteria. By combining normalization values, power weight, exponentiation-based aggregation, weighted average comparability, and relative value to produce a final value, this method is able to capture the contribution of each criterion proportionally and consider comparisons between candidates comprehensively. This approach not only improves accuracy and consistency in the selection process but also minimizes the subjectivity that usually arises in manual assessments. The final result, which is an objective ranking of candidates, allows for more transparent and accountable decision-making. Overall, HYBSO has proven to be an effective tool to support decision support systems in selecting the best warehouse employees according to organizational needs.

3.3. Analysis Result

The analysis of results is an important stage in this research as it functions to assess the effectiveness and accuracy of applying the SITDE and HYBSO methods in warehouse employee selection. At this stage, all processed data—ranging from the normalization of candidate scores, calculation of criteria weights, to the calculation of alternative values using HYBSO—are interpreted to provide a clear picture of each candidate's performance. The analysis is conducted by comparing the contribution of each criterion to the final results and observing the differences in the rankings produced, enabling the identification of candidates who are most suitable for the organization's needs. In addition, this stage also allows for an evaluation of the method's stability in handling heterogeneous data and measures the extent to which the method is capable of minimizing subjectivity in decision-making. The analysis results not only provide quantitative information in the form of scores and rankings but also offer qualitative insights.

Ranking alternatives is a crucial stage in the warehouse employee selection process because it determines the order of candidates based on their performance across all criteria that have been weighted objectively. This process integrates data processing results, ranging from normalized scores, criterion weights obtained through the SITDE method, to alternative scores calculated using the HYBSO method, so that each candidate is evaluated thoroughly and proportionally. Ranking not only considers the individual contribution of each criterion but also combines comparative information among candidates to ensure that performance differences between alternatives are accurately reflected. With this approach, decisions regarding the best candidates can be made systematically, transparently, and accountably, reducing the risk of subjectivity that often arises in manual evaluations. The results of this ranking process are then presented in the form of a table that shows the order of candidates based on their final scores, providing a clear and easily understandable overview of selection priorities. The ranking of alternatives is shown in Table 12.

Table 12. Alternative Ranking Using Hybrid Weighting of SITDE and HYBSO

Candidate Name	Final Value	Rank
Candidate HW	0.3596	1
Candidate FN	0.7066	2
Candidate DK	0.9162	3
Candidate AP	1.297	4
Candidate CL	1.4253	5
Candidate IS	1.5502	6
Candidate ES	1.6185	7
Candidate GP	1.8413	8
Candidate BS	2.6748	9

The results of ranking alternatives using a hybrid approach between the SITDE and HYBSO methods in warehouse employee selection, which include nine candidates along with their final values and respective rankings. The final value reflects the overall performance of the candidates based on the contribution of criteria weights and comparative evaluation among candidates, so the lower the value,

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

the higher the candidate's ranking. According to the table, Candidate HW occupies the first rank with a value of 0.3596, followed by Candidate FN in second place with a value of 0.7066, and Candidate DK in third place with a value of 0.9162. Other candidates occupy the following ranks, namely Candidate AP in fourth place with a score of 1.297, Candidate CL in fifth place with a score of 1.4253, Candidate IS in sixth place with a score of 1.5502, Candidate ES in seventh place with a score of 1.6185, Candidate GP in eighth place with a score of 1.8413, and Candidate BS in ninth place with the highest score of 2.6748. This table provides a complete overview of candidate selection priorities, enabling objective, transparent, and data-based decision-making to determine the warehouse employee best suited to the organization's needs.

The ranking results using the HYBSO method in descending order show the order of alternatives from the highest to the lowest final values, reflecting each one's overall performance based on the contribution of criteria weights and relative evaluation among alternatives. Higher final values indicate stronger performance in the specified criteria, while lower values indicate a relatively less dominant position. Presenting the results in descending order makes it easier to understand the performance differences between alternatives and provides a clear picture of selection priorities. With this approach, the decision-making process becomes more systematic, objective, and transparent, as each alternative can be compared directly based on the final values generated by the HYBSO method.

Sensitivity analysis is an important stage in this research aimed at evaluating the extent to which changes in criterion weights affect the ranking results of candidates, thereby assessing the stability, reliability, and robustness of the method in decision-making[23], [24]. This process is carried out by simulating various scenarios of weight changes, both increases and decreases in values, to observe their impact on the ranking order of the resulting alternatives. Sensitivity analysis allows for the identification of the most influential criteria, thereby providing insights into the aspects that significantly determine the selection results[24], [25]. This becomes very relevant in the context of managerial decision-making, because the weight of criteria is often subjective or can change according to organizational priorities, so the method used must be able to provide consistent results even when variations occur. By evaluating the ranking response to changes in weights, sensitivity analysis also helps to minimize the risk of decision errors and ensures that candidate selection remains objective, fair, and transparent. The results of the sensitivity analysis of weight changes are shown in Table 13, which illustrates how variations in weights affect the ranking of each candidate.

Table 13. Sensitivity Analysis Scenario with Changes in Criteria Weights

Scenario	Physical Test	Accuracy Test	Work Experience	Discipline Test	Teamwork Test
Initial Weight	0.1926	0.1641	0.2813	0.1969	0.1652
Scenario 1: Physical Test Weight +0.05	0.2310	0.1563	0.2679	0.1875	0.1573
Scenario 2: Accuracy Test Weight +0.05	0.1834	0.2039	0.2679	0.1875	0.1573
Scenario 3: Work Experience Weight +0.05	0.1834	0.1563	0.3155	0.1875	0.1573
Scenario 4: Discipline Test Weight +0.05	0.1834	0.1563	0.2679	0.2351	0.1573
Scenario 5: Teamwork Test Weight +0.05	0.1834	0.1563	0.2679	0.1875	0.2049
Scenario 6: Physical Test Weight -0.05	0.1501	0.1727	0.2961	0.2072	0.1739
Scenario 7: Accuracy Test Weight -0.05	0.2027	0.1201	0.2961	0.2072	0.1739
Scenario 8: Work Experience Weight -0.05	0.2027	0.1727	0.2434	0.2072	0.1739

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

Scenario 9: Discipline Test Weight -0.05	0.2027	0.1727	0.2961	0.1546	0.1739
Scenario 10: Teamwork Test Weight -0.05	0.2027	0.1727	0.2961	0.2072	0.1213
Scenario 11: Physical Test Weight +0.1	0.2786	0.1563	0.2679	0.1875	0.1097
Scenario 12: Accuracy Test Weight +0.1	0.1834	0.2515	0.2679	0.1875	0.1097
Scenario 13: Work Experience Weight +0.1	0.1834	0.1563	0.3631	0.1875	0.1097
Scenario 14: Discipline Test Weight +0.1	0.1834	0.1563	0.2679	0.2827	0.1097
Scenario 15: Teamwork Test Weight +0.1	0.1751	0.1492	0.2557	0.179	0.2411
Scenario 16: Physical Test Weight -0.1	0.1029	0.1823	0.3125	0.2188	0.1835
Scenario 17: Accuracy Test Weight -0.1	0.214	0.0712	0.3125	0.2188	0.1835
Scenario 18: Work Experience Weight -0.1	0.214	0.1823	0.2014	0.2188	0.1835
Scenario 19: Discipline Test Weight -0.1	0.214	0.1823	0.3125	0.1077	0.1835
Scenario 20: Teamwork Test Weight -0.1	0.214	0.1823	0.3125	0.2188	0.0724

General sensitivity analysis on changes in criteria weights in warehouse employee selection, as presented in Table 13, shows how variations in each criterion's weight affect the overall distribution. This table includes scenarios of positive and negative weight adjustments with small changes (+/-0.05) up to larger changes (+/-0.1) for each criterion, such as Physical Test, Accuracy Test, Work Experience, Discipline Test, and Teamwork Test. The table shows that each weight adjustment impacts the relative proportion of the other criteria, thereby affecting the calculation of final scores and candidate rankings. This analysis provides an overview of the method's stability in facing weight variations, identifies the most sensitive criteria, and assesses the risk of ranking shifts due to weight changes.

Ranking based on scenarios of changes in criteria weights is conducted to evaluate how variations in the weights of each criterion affect the order of candidates in the warehouse employee selection process. This stage allows for a comparative analysis of the stability of alternative rankings when criterion weights are increased or decreased according to predetermined scenarios. With this approach, it is possible to see the extent to which each candidate is impacted by changes in weights and which criteria have the most significant influence on the final results. Scenario-based weight ranking also helps assess the reliability of the SITDE and HYBSO methods in producing consistent rankings, while providing an overview of the potential risk of changes in selection decisions. The results of this process are compiled to show how each scenario affects the relative position of candidates, thereby facilitating more adaptive and data-driven decision-making. The ranking results from the scenario of changing the criteria weights are shown in Figure 2. Changes in the criteria weights in Table 13 become an important tool to ensure that selection results remain consistent, reliable, and accountable even when weight adjustments occur in managerial practice.

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344 Page 593-611

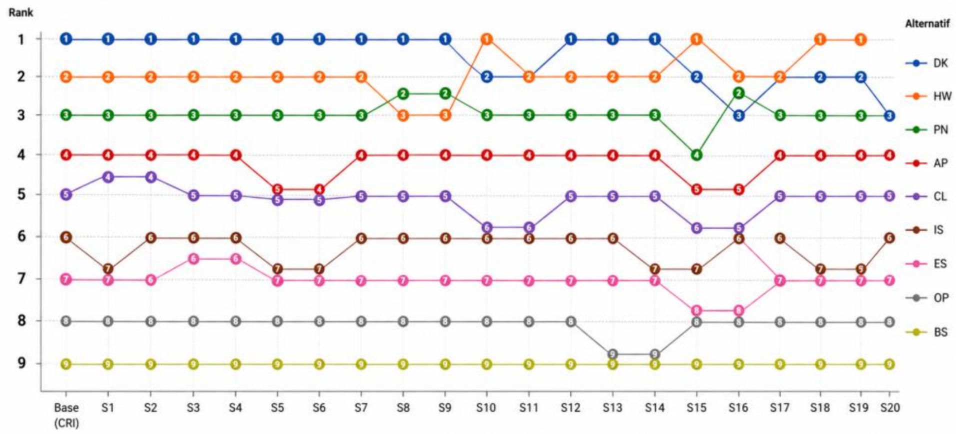

Figure 2. Ranking Results from the Scenario of Changes in Criteria Weights

The visualization of the sensitivity analysis results for candidate ranking based on scenarios of changes in criteria weights is displayed in the form of a radar diagram in Figure 2. Each axis in the diagram represents one of the 20 scenarios of weight changes, starting from the initial scenario (Rank ORI) to positive and negative adjustments for each criterion, while the concentric circles indicate the position of candidate rankings from rank 1 to 9. From the diagram, it can be seen that Candidate HW is relatively stable at the first to second rank in most scenarios, Candidate FN and Candidate DK tend to occupy middle positions, whereas Candidate BS is at the bottom rank in almost all scenarios. Different colored lines in the diagram show the movement of each candidate's ranking across all scenarios, illustrating the candidates' sensitivity to changes in criteria weights. This visualization confirms that some candidates have consistent rankings despite variations in weight, whereas other candidates are more sensitive to changes, especially in criteria with weights that experience significant increases or decreases. The results of this ranking sensitivity analysis provide a clear picture of the stability of the ranking results and help ensure that selection decisions remain objective, reliable, and accountable.

3.4. Discussion

The implementation of the hybrid SITDE and HYBSO methods in a decision support system for warehouse employee selection demonstrates significant capability in improving the quality of decision-making through the integration of objective criteria weighting with a comprehensive ranking mechanism. The SITDE method, which utilizes data distribution characteristics such as skewness and value spread, can determine criteria weights in a data-driven manner, thereby reducing the subjectivity that commonly arises in manual assessments. This aligns with the principles of MCDM, which emphasize the importance of objectivity and transparency in multi-criteria-based decision-making processes. Meanwhile, HYBSO allows the processing of candidate preference values through a series of steps including normalization, weighted aggregation, and relative value calculation, resulting in rankings that are comprehensive and proportional to the contribution of each criterion. The integration of SITDE and HYBSO creates a synergy between statistical analysis and robust aggregation mechanisms, resulting in more accurate, stable, and consistent selection decisions for heterogeneous candidates.

The analysis of the research results shows that the weighting of criteria plays an important role in differentiating candidate performance. The Work Experience criterion has the highest weight (0.2813), indicating its dominance in distinguishing candidate quality, followed by the Discipline Test and Physical Test, which also contribute significantly to the evaluation. The final ranking obtained through HYBSO places candidates HW, FN, and DK at the top positions, consistently maintaining superior rankings across various sensitivity scenarios. These findings support MCDM literature, which emphasizes that methods capable of assessing the relative contribution of each criterion proportionally tend to produce more objective and reliable candidate rankings. Thus, the SITDE-HYBSO hybrid

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

method not only reflects the candidates' performance comprehensively but also provides a basis for transparent and accountable decision-making.

Sensitivity studies on changes in criteria weights reinforce the reliability of this hybrid method in a managerial context. Scenario analysis shows that some candidates, such as Candidate HW, maintain a stable ranking even with weight changes of up to ±0.1, while other candidates show sensitivity to certain fluctuations. This indicates that some criteria have a dominant influence on the selection results, which aligns with the MCDM principle that criteria weights can significantly determine the priority of alternatives. Sensitivity evaluation provides guidance for management to identify critical criteria, minimize the risk of ranking shifts due to changing priorities, and enhance the resilience of the selection process against organizational dynamics, ensuring that decisions remain objective, consistent, and data-driven.

The application of the hybrid SITDE-HYBSO in a decision support system provides a comprehensive and adaptive MCDM framework for warehouse employee selection. This approach is capable of handling heterogeneous data, both quantitative and qualitative, minimizing subjectivity, and supporting transparent and accountable decision-making. With the integration of objective criteria weighting and systematic evaluation of alternatives, this method not only generates reliable candidate rankings but also strengthens managerial capacity in selecting employees best suited to the organization's needs. These findings confirm the effectiveness of the hybrid SITDE-HYBSO as an MCDM-based decision-making strategy in the warehouse operational context and provide methodological contributions to research and practice in employee selection based on decision support systems.

4. CONCLUSION

The application of the hybrid SITDE and HYBSO methods in a decision support system for warehouse employee selection has proven effective in producing decisions that are more objective, accurate, and transparent. The SITDE method is able to determine the weights of criteria in a data-driven manner by considering value distribution and skewness, thereby reducing the subjectivity that generally arises in manual assessments, while HYBSO allows the processing of alternative values through stages of normalization, weighted aggregation, and comprehensive relative value calculation, resulting in proportional and consistent candidate rankings. Analysis of the results shows that the criteria of Work Experience, Discipline Test, and Physical Test have a dominant influence on candidate rankings, with candidates HW, FN, and DK consistently occupying the top positions across various scenarios of criterion weight sensitivity, confirming the stability and reliability of this method in facing changes in managerial priorities. The sensitivity study also emphasizes the capability of this hybrid method to minimize the risk of ranking shifts due to changes in weights, identify critical criteria, and ensure the selection process remains accurate, fair, and accountable. Thus, the combination of SITDE and HYBSO provides a comprehensive and adaptive MCDM framework, capable of handling heterogeneous data, as well as enhancing decision-making capacity based on decision support systems in the context of warehouse operations. Nevertheless, this study has several limitations. The analysis was conducted using a relatively limited number of candidates and only five evaluation criteria, which may not fully represent the complexity of warehouse employee selection in larger organizations. In addition, all criteria considered in this study are benefit criteria, so cost criteria and more complex qualitative factors were not included in the analysis. The findings are also based on a specific warehouse employee selection dataset; therefore, the results may not be directly generalizable to other organizations or operational contexts without further validation. For further development, research can expand the implementation of this method by integrating more complex additional qualitative criteria, testing the method on a larger candidate scale, or combining machine learning techniques to predict employee performance in real-time, so that the decision support system is not only evaluative but also predictive and adaptive to changing organizational needs.

Journal of Artificial Intelligence and Technology Information
Website : https://ejournal.techcart-press.com/index.php/jaiti
E-ISSN 2985-6396
P-ISSN 2985-5306
Volume 4, Number 3, September 2026
https://doi.org/10.58602/jaiti.v4i3.344
Page 593-611

REFERENCES

[1] N. Batarlienė and A. Jarašūnienė, "Improving the Quality of Warehousing Processes in the Context of the Logistics Sector," *Sustainability*, vol. 16, no. 6. p. 2595, 2024. doi: 10.3390/su16062595.

[2] B. Y. Ekren, U. Venkatadri, F. Sgarbossa, and E. H. Grosse, "Warehousing 5.0 for the future of the logistics industry," *Int. J. Prod. Res.*, vol. 64, no. 5, pp. 1587–1597, Mar. 2026, doi: 10.1080/00207543.2026.2617791.

[3] J. Li, R. He, and T. Wang, "A data-driven decision-making framework for personnel selection based on LGBWM and IFNs," *Appl. Soft Comput.*, vol. 126, p. 109227, 2022, doi: https://doi.org/10.1016/j.asoc.2022.109227.

[4] Afolabi Ogbeyemi, Akinola Ogbeyemi, and Wenjun Zhang, "Integrating human factors into the distribution model of goods and fast-moving consumer goods for effective inventory control," *Int. J. Eng. Bus. Manag.*, vol. 16, p. 18479790241266350, May 2024, doi: 10.1177/18479790241266352.

[5] M. A. Rahman and E. D. Kirby, "The Lean Advantage: Transforming E-Commerce Warehouse Operations for Competitive Success," *Logistics*, vol. 8, no. 4. p. 129, 2024. doi: 10.3390/logistics8040129.

[6] S. Jahangir, R. Xie, A. Iqbal, and M. Hussain, "The Influence of Sustainable Human Resource Management Practices on Logistics Agility: The Mediating Role of Artificial Intelligence," *Sustainability*, vol. 17, no. 7. p. 3099, 2025. doi: 10.3390/su17073099.

[7] T. De Lombaert, K. Braekers, R. De Koster, S. Lizin, and K. Ramaekers, "Eliciting and integrating order picker preferences in the evaluation of job assignment mechanisms in warehousing," *Comput. Ind. Eng.*, vol. 211, p. 111613, 2026, doi: https://doi.org/10.1016/j.cie.2025.111613.

[8] Ziyao Li and Xiaobo Jia, "Analysis of Logistics Curriculum and Recruitment Requirements Based on Text Mining: A Case Study of China," *Sage Open*, vol. 14, no. 2, p. 21582440241239840, Apr. 2024, doi: 10.1177/21582440241239839.

[9] Trung-Hieu Nguyen, "Research on Factors Influencing the Employees' Digital Transformation Engagement and Job Performance in Logistics Companies," *Sage Open*, vol. 15, no. 3, p. 21582440251353390, Jul. 2025, doi: 10.1177/21582440251353391.

[10] A. R. Mishra, P. Rani, F. Cavallaro, I. M. Hezam, and J. Lakshmi, "An Integrated Intuitionistic Fuzzy Closeness Coefficient-Based OCRA Method for Sustainable Urban Transportation Options Selection," *Axioms*, vol. 12, no. 2, p. 144, Jan. 2023, doi: 10.3390/axioms12020144.

[11] K. Kara, E. Akagün Ergin, G. Cihan Yalçın, T. Çelik, M. Deveci, and S. Kadry, "Sustainable brand logo selection using an AI-Supported PF-WENSLO-ARLON hybrid method," *Expert Syst. Appl.*, vol. 260, p. 125382, 2025, doi: https://doi.org/10.1016/j.eswa.2024.125382.

[12] D. Pamucar, V. Simic, Ö. F. Görçün, and H. Küçükönder, "Selection of the best Big Data platform using COBRAC-ARTASI methodology with adaptive standardized intervals," *Expert Syst. Appl.*, vol. 239, p. 122312, 2024, doi: https://doi.org/10.1016/j.eswa.2023.122312.

[13] S. M. Durmuşoğlu and Ö. Atlam, "A methodological framework for evaluating thermal fluids in solar power applications via the simple additive weighting technique," *J. Therm. Anal. Calorim.*, 2026, doi: 10.1007/s10973-025-15276-4.

[14] A. Keshtpour and R. K. Chakrabortty, "The selection of saltwater desalination technology using new measurement alternatives by a combination of angle and distance (MACAD) method: a case study," *Environ. Syst. Decis.*, vol. 45, no. 3, p. 41, 2025, doi: 10.1007/s10669-025-10034-1.

[15] Y. B. Gopisetty and H. R. Sama, "Skewness impact through distributional evaluation (SITDE) method: a new method in multi-criteria decision making," *J. Oper. Res. Soc.*, vol. 76, no. 6, pp. 1204–1224, Jun. 2025, doi: 10.1080/01605682.2024.2416910.

[16] L. K. V, S. Kamruddin, V. K. K.S, S. Kalvakolanu, V. Nalluri, and J.-R. Chang, "A Multi-Criteria Decision-Making Approach to Improve Criteria Ranking and Weighting: Integrating SITDE Weighting With PIV and RAM Techniques," *Asian J. Interdiscip. Res.*, vol. 8, no. 2 SE-Articles, pp. 1–20, Apr. 2025, doi: 10.54392/ajir2521.

[17] Y. Djeddi, "Hybrid Solution (HYBSO) based on Hybrids Normalization and Aggregation for the Multi-criteria Decision-Making Problems," *Yugosl. J. Oper. Res.*, vol. 36, no. 1, pp. 1–24, 2026, doi: 10.2298/YJOR241020020D.

[18] F. Mizrak, K. C. Mizrak, and G. R. Akkartal, "Developing a strategic framework for airline destination selection: A multi-criteria decision-making approach applied to Turkish airlines," *Transp. Res. Interdiscip. Perspect.*, vol. 29, p. 101322, 2025, doi: https://doi.org/10.1016/j.trip.2025.101322.

[19] I. Tronnebati, F. Jawab, Y. Frichi, and J. Arif, "Green Supplier Selection Using Fuzzy AHP, Fuzzy TOSIS, and Fuzzy WASPAS: A Case Study of the Moroccan Automotive Industry," *Sustainability*, vol. 16, no. 11. 2024. doi: 10.3390/su16114580.

[20] M. A. Hatefi, "A new method for weighting decision making attributes: an application in high-tech selection in oil and gas industry," *Soft Comput.*, vol. 28, no. 1, pp. 281–303, 2024, doi: 10.1007/s00500-023-

09282-7.

[21] S. Ashraf, W. Iqbal, M. S. Hameed, V. Simic, and N. Bacanin, "An enhanced CRADIS decision model for optimizing radioactive waste reduction through transmutations based on Disc Spherical Fuzzy information," *Appl. Soft Comput.*, vol. 167, p. 112289, 2024, doi: https://doi.org/10.1016/j.asoc.2024.112289.

[22] T. Van Dua, "A Novel Approach for Criteria Weight Determination: A Case Study in Machine Ranking," *Eng. Technol. Appl. Sci. Res.*, vol. 16, no. 1 SE-, pp. 31333–31337, Feb. 2026, doi: 10.48084/etasr.15778.

[23] A. Biswas, K. H. Gazi, P. M. Sankar, and A. Ghosh, "A Decision-Making Framework for Sustainable Highway Restaurant Site Selection: AHP-TOPSIS Approach based on the Fuzzy Numbers," *Spectr. Oper. Res.*, vol. 2, no. 1 SE-Articles, pp. 1–26, Jan. 2025, doi: 10.31181/sor2120256.

[24] E. Carnia *et al.*, "An Integrated Weighted Fuzzy N-Soft Set–CODAS Framework for Decision-Making in Circular Economy-Based Waste Management Supporting the Blue Economy: A Case Study of the Citarum River Basin, Indonesia," *Mathematics*, vol. 14, no. 2. p. 238, 2026. doi: 10.3390/math14020238.

[25] S. S. Yildiz, "Spatial multi-criteria decision making approach for wind farm site selection: A case study in Balıkesir, Turkey," *Renew. Sustain. Energy Rev.*, vol. 192, p. 114158, 2024, doi: https://doi.org/10.1016/j.rser.2023.114158.