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Optimization of Alternative Assessment with Modified MOORA Method: Case Study of Contract Employee Selection

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Abstract−Multi-Objective Optimization by Ratio Analysis (MOORA) is a multi-criteria decision-making method used to evaluate and select the best alternative based on multiple objectives or criteria. One of the main disadvantages of the MOORA method is subjectivity in the determination of the weight of criteria. In this method, the decision maker must determine the relative weight of each criterion used to evaluate alternatives. Subjectivity in the weighting of criteria can also lead to inconsistencies between different decision makers or experts, resulting decisions can be less transparent and less acceptable to all parties involved, reducing confidence in the validity and accuracy of the results. Optimization of alternative assessment with modified MOORA method is to develop alternative assessment methods that are more accurate and objective by integrating standard deviation into the MOORA method. This study aims to overcome the weaknesses of conventional MOORA methods in dealing with data variation and assessment subjectivity by introducing a more data-driven mechanism of calculating the weight of criteria. Through testing and comparing performance between modified MOORA methods and conventional methods, this study aims to demonstrate improved accuracy, consistency, and reliability in alternative assessment results. In addition, this research is expected to provide practical implementation guidance for the application of the modified MOORA method in the Decision Support System (DSS), so as to improve the efficiency and quality of decision making in various sectors. The ranking results showed that the results of rank 1 were obtained by Employee 6 with a final score of 0.3375, rank 2 was obtained by Employee 3 with a final score of 0.2904, and rank 3 was obtained by Employee 7 with a final score of 0.2756. The results of the comparison test of the original rank with SD-MOORA showed a correlation value of 1, so it can be concluded that there is a very strong and positive relationship between the original rating and the SD-MOORA rating. This shows that the rating produced by SD-MOORA is very consistent with the original ranking, thus giving validity to the effectiveness of SD-MOORA in replicating the original rating results more objectively and efficiently. The results of the SD-MOORA modification showed significant improvements in the accuracy and objectivity of decision making.

Keywords: Alternative Assessment; SD-MOORA; Modification; MOORA; Standard Deviation;

1. INTRODUCTION

Assessment of alternatives in a decision support system is critical because it allows decision makers to comprehensively evaluate various options before making a final choice[1], [2]. By evaluating alternatives, decision makers can consider factors such as benefits, disadvantages, costs, benefits, and risks associated with each option. This process helps in identifying the best solution that best suits the goals and needs of the organization. In addition, alternative assessments can also reduce assumptions and subjectivity in decision making, resulting in more objective and accountable decisions. An effective decision support system must be able to provide tools and methods for an in-depth and comprehensive assessment of alternatives. In addition, alternative assessments also facilitate transparency in the decision-making process. By documenting and comparing each option considered, interested parties can see the basis for choosing a decision, thereby increasing accountability and trust in the process. Alternative assessments can also reveal weaknesses or potential problems in an option that may not be apparent in the initial evaluation, thus providing an opportunity to improve or seek better solutions. Lastly, in dynamic and complex situations, alternative assessments allow decision makers to remain flexible and adaptive to changing conditions or new information, ensuring that decisions taken remain relevant and effective at all times.

The complexity of alternatives at hand often involves many interrelated variables and factors, which are not easily measured or compared directly. Effective methods must be able to handle large volumes of data and diverse variables, as well as provide in-depth and comprehensive analysis. Efficiency is also key, as decision makers often need to make decisions in a limited amount of time. Therefore, approaches such as mathematical modeling, multi-criteria analysis, and the use of technologies such as artificial intelligence and machine learning are becoming very important. This method can help in filtering and categorizing information, simulating various scenarios, and optimizing the selection of alternatives based on various relevant parameters. The application of effective and efficient methods not only improves the quality of decisions taken but also enables the organization to respond quickly and appropriately to changes. Effective and efficient methods for evaluating complex alternatives must also be able to accommodate the perspectives and preferences of various stakeholders. In many cases, decisions depend not only on quantitative data but also on qualitative and subjective values that differ between individuals or groups. The multi-objective optimization by ratio analysis method can be used to integrate these various perspectives into the evaluation process.

Multi-Objective Optimization by Ratio Analysis (MOORA) is a multi-criteria decision-making method used to evaluate and select the best alternative based on multiple objectives or criteria[3]–[5]. MOORA is designed to deal with issues involving a variety of objectives that may conflict with each other, such as cost, quality, time, and risk. This method offers a systematic and simple approach to assessing the performance of each alternative relative to predefined criteria. The MOORA process begins with data normalization, where the values of each criterion from different alternatives are converted into a form that can be directly compared. Next, the ratio for each alternative is calculated by dividing the criterion value of each alternative by the sum of the total values of all alternatives to that criterion. In this step, positive goals (such as profit) and negative goals (such as cost) are processed separately to ensure an accurate evaluation. The end result is a ranking of each alternative based on a calculated ratio, which allows decision makers to determine the optimal alternative. The main advantage of MOORA lies in its simplicity and flexibility[5], [6]. This method is easy to understand and apply, and can be adapted to different types of decision problems. In addition, MOORA is also capable of handling quantitative and qualitative data, and can be used in various contexts, including business, engineering, and management. MOORA provides effective tools for decision makers to evaluate and select alternatives that best suit their goals and criteria. One of the main disadvantages of the MOORA method is subjectivity in determining the weight of criteria. In this method, the decision maker must determine the relative weight of each criterion used to evaluate alternatives. This weighting process is often based on subjective judgment or intuition, which can lead to less objective and questionable results. Subjectivity in the determination of the weight of criteria can also lead to inconsistencies between different decision makers or experts, as well as make it difficult to explain or defend the reasoning behind the determination of weights to other parties[7], [8]. As a result, decisions generated by the MOORA method can be less transparent and less acceptable to all parties involved, reducing confidence in the validity and accuracy of the results.

Related research conducted by Viktor [9] using the MOORA method aims to solve the problem of selecting the best students as scholarship recipients by using alternative data as many as 7 students to determine scholarship recipients. Research conducted by Cakranegara [10] MOORA method shows that alternative A4 which has a score of 0.49024595 and is the best alternative for outstanding students has an alternative ranking of outstanding students with the highest score. Research from Teddy [11] a combination of the MOORA method and Rank Order Centroid (ROC) weighting is used to determine decisions based on criteria of efficiency levels and the selection process is accurate but has simplicity in providing recommendations for contraceptives that are suitable for as needed. Research from Ashish [12] combination Analytical hierarchy process (AHP) is used to weigh properties then MOORA are applied for optimization in reducing environmental problems. Research from Ranjith [13] developed Hybrid Multi-Criteria Decision Making (HMCDM) by integrating two potential optimization techniques Elimination Et Choix Traduisant la REalité (ELECTRE) and MOORA, the weight of the criteria is calculated using the ELECTRE method in providing the optimal composite weight percentage that provides the best tribological properties selected. Based on previous research conducted, the weight of criteria in the MOORA method is determined based on the subjective assessment of decision makers, as well as by using other methods to determine the weight of criteria from alternative assessment data.

The purpose of this study for modifications in the MOORA method involves the use of standard deviation to determine the weight of the criterion. This approach takes into account the degree of variability or dispersion of data for each criterion in decision making. By including standard deviation, the weight of the criteria can be adjusted based on the relative degree of variation of each criterion[14]–[16]. Criteria with higher standard deviations will be given lower weights, while criteria with lower standard deviations will be given higher weights, indicating a greater degree of certainty or consistency. This approach aims to increase accuracy in assessing the influence of each criterion on the final result, resulting in more stable and measurable decisions in complex decision situations. By applying standard deviation in the determination of criteria weighting, this modification of MOORA can improve accuracy and fairness in the decision-making process. Criteria that have high variation will be given a lower weight, reducing the potential dominance of criteria with low variation but have a large impact. It also helps reduce subjectivity in the determination of criteria weighting, since standard deviation is an objective measure of data variation. The use of standard deviation in this modification of MOORA can increase the effectiveness and reliability of the method in solving complex multi-criteria problems. In multi-criteria decision making, subjectivity in the determination of the weight of criteria can lead to biased and inconsistent results. By applying standard deviation in weight determination, the ultimate goal is to reduce that subjectivity. Standard deviation is an objective measure of data variation, so its use can give fairer and more balanced weight to each criterion, based on the actual degree of variation of the data[17], [18]. Thus, this modification of MOORA helps to increase objectivity in the determination of criteria weighting, which in turn increases fairness and consistency in decision making.

The benefit of using standard deviation in the determination of criteria weights in the MOORA method is that it helps reduce subjectivity in determining the weight of criteria, this increases fairness in the decision-making process. Taking standard deviation into account, MOORA modifications recognize that some criteria may have high variation, while others may be more stable. This helps in adjusting the weight of the criteria proportionally to the existing degree of variation. By reducing the dominance effect of criteria with low variation but large impact, the use of standard deviation can result in more consistent and reliable decisions. By integrating information about data variations into the decision-making process, MOORA modifications can improve accuracy in assessing the effect of each criterion on the final outcome. By considering data variations, MOORA modifications help decision makers to better understand the characteristics and complexity of each criterion, which in turn can help in taking more informed and informed decisions.

Optimization of Alternative Assessment with Modified MOORA Method is to develop alternative assessment methods that are more accurate and objective by integrating standard deviation into the MOORA (Multi-Objective

Optimization on the basis of Ratio Analysis) method. This study aims to overcome the weaknesses of conventional MOORA methods in dealing with data variation and assessment subjectivity by introducing a more data-driven mechanism of calculating the weight of criteria. Through testing and comparing performance between modified MOORA methods and conventional methods, this study aims to demonstrate improved accuracy, consistency, and reliability in alternative assessment results. In addition, this research is expected to provide practical implementation guidance for the application of the modified MOORA method in the Decision Support System (DSS), so as to improve the efficiency and quality of decision making in various sectors.

2. RESEARCH METHODOLOGY

2.1 The Concept Framework

The concept framework of modifying the MOORA method by applying standard deviation in the determination of criteria weights aims to increase objectivity and accuracy in alternative evaluation processes. In traditional MOORA methods, the weight of criteria is often determined based on the subjective judgment of decision makers, which can lead to bias and inconsistency. By applying standard deviation, the weight of the criteria is determined based on the variability of the data of each criterion. Criteria with higher standard deviations are considered to have a greater degree of importance because they show more significant variability among alternatives. This approach ensures that criteria that are more varied and have a major impact on the final result are given greater attention in the assessment, resulting in a more balanced and accurate evaluation. Figure 1 is an overview of the concept framework in the MOORA method modification.

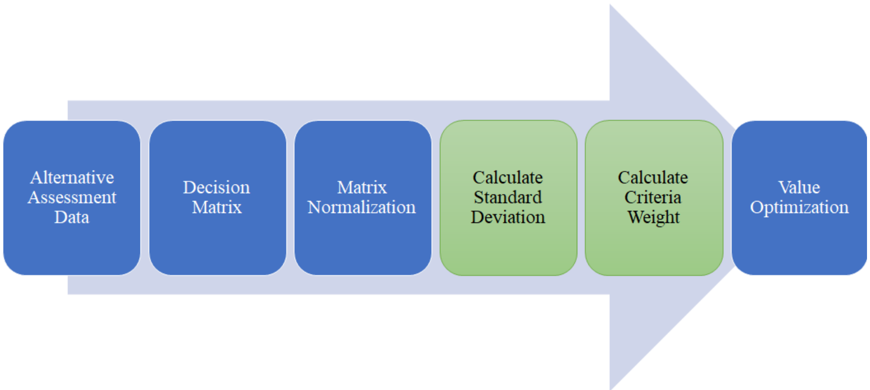

Figure 1. Concept Framework in the Modification of the MOORA Method

The concept framework of figure 1 in the MOORA method adds to the use of standard deviation in the determination of the weighting of criteria also provides more flexibility in data analysis, allowing more precise adjustments to the dynamics and specific needs of the situation being analyzed.

2.2 MOORA Modification with Standard Deviation (SD-MOORA)

Modification MOORA with Standard Deviation (SD-MOORA) is an improved version of the MOORA method that incorporates standard deviation from the weight of criteria into the decision-making process. SD-MOORA aims to reduce subjectivity in determining the weight of criteria by considering the variability of data for each criterion. By entering the standard deviation, SD-MOORA adjusts the weight of the criteria based on the actual degree of variability of the data. Criteria with higher standard deviations are given lower weights, while criteria with lower standard deviations are given higher weights, indicating a greater degree of certainty or consistency. These modifications help improve the accuracy and fairness of assessing the impact of each criterion on the final outcome, resulting in more stable and measurable decisions in complex decision-making situations. The first stage in SD-MOORA is creating a decision matrix using equation (1).

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

A decision matrix is an analytical tool used to facilitate the decision-making process in situations involving various criteria and alternatives. This matrix is in the form of a table that displays decision alternatives in rows and evaluation criteria in columns. Each cell in the matrix contains a value or scores that describe the performance of each alternative against each criterion.

The next step in SD-MOORA is calculating the normalized value of the matrix using equation (2).

$$x_{ij}^{*} = \frac{x_{ij}}{\sqrt{\left[\sum_{i=1}^{j} x_{ij}^{2}\right]}} \quad (2)$$

Matrix normalization is the process of converting the data in a decision matrix to a common scale so as to allow fair comparisons between various criteria. This process is important in multi-criteria analysis because different criteria often have different units and scales, making it difficult to compare and combine them directly.

The next step in SD-MOORA is calculating the standard deviation value of the matrix normalization result using equation (3).

$$\sigma_j = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij}^{*} - \bar{x}_{ij}\right)^2} \quad (3)$$

Standard deviation is a statistical measure used to describe how scattered data is in a dataset relative to its mean. Standard deviation shows how far each data point is from the mean, giving an idea of the variability or consistency of the data. The smaller the standard deviation, the closer the data gathers around the mean; The greater the standard deviation, the more scattered the data will be.

The next step in SD-MOORA is calculating the final weight of the criteria using equation (4).

$$w_j = \frac{\sigma_j}{\sum_{j=1}^{n}\sigma_j} \quad (4)$$

The final weight of the criteria is a value that indicates the relative importance of each criterion in a multi-criteria decision-making process. The determination of these weights is an important step because it affects how each alternative is evaluated and compared. Final weight helps ensure that more important criteria have a greater impact on the final decision.

The last stage in SD-MOORA calculates the optimization value of the alternative using equation (5).

$$y_i = \sum_{j=1}^{n} w_j * x_{ij}^{*} - \sum_{j=g+1}^{n} w_j * x_{ij}^{*} \quad (5)$$

Value optimization in the SD-MOORA method is the end result of the evaluation process used to rank and select the best alternative based on various criteria. The MOORA method is a multi-criteria decision-making technique that helps in optimizing options by considering multiple objectives simultaneously. Value the ratio for each alternative by summing the product of the normalized value by weighting the criteria for the benefit criterion and subtracting for the cost criterion.

3. RESULT AND DISCUSSION

Optimization of alternative assessments with modified MOORA methods in contract employee selection case studies showed significant improvements in the accuracy and objectivity of the decision-making process. By integrating standard deviation in the determination of criteria weighting, this modification succeeded in reducing subjectivity and assigning a more proportional weight based on the variability of the data of each criterion. This process results in a more representative optimization value for each prospective employee, allowing for a more fair and comprehensive evaluation. This case study proves that the modified SD-MOORA method can help organizations select candidates that best suit the needs and requirements of the job, increasing effectiveness and efficiency in contract employee selection. The implementation of the modified SD-MOORA method allows companies to more transparently and systematically document the selection process, which is important for audit and accountability purposes. A more detailed evaluation of the candidate also helps in identifying each candidate's strengths and weaknesses, providing useful insights for future development and training. The study also shows that the application of standard deviation in the SD-MOORA method enriches the analysis by accommodating variations in the data, ensuring that the final decision is based not only on the mean but also on a wider distribution of data. This leads to the selection of employees who not only meet the minimum criteria but also demonstrate consistent and high-performance potential. Thus, the modified SD-MOORA method provides a more holistic and trusted approach to the contract employee selection process, supporting the organization's strategic objectives in human resource management.

3.1 Case Study Assessment Alternative Contract Employee Selection

Alternative assessment in the selection of contract employees is an evaluation method that focuses on assessing candidates. The goal is to get a more holistic picture of the candidate's abilities, adaptability, and fit into the company culture. Using alternative assessments, companies can identify prospective contract employees who not only meet technical qualifications, but also have good problem-solving, teamwork, and communication skills, all of which are essential for success in the contract position. Alternative assessments not only contribute to more appropriate employee selection, but also improve the overall candidate experience, which in turn can reinforce the company's positive image in the eyes of prospective employees. Table 1 is the data from the assessment of alternative contract employees conducted by the company.

Table 1. Results of Alternative Assessment of Contract Employees

Employees Name	Age of Employees	Educational Qualifications	Work Experience	Interview Value	Administrative Files
Employee 1	25	S1	3	90	Complete
Employee 2	27	S1	3	91	Complete
Employees 3	30	D3	5	90	Complete and There is a Certificate
Employees 4	23	D3	4	90	Complete
Employees 5	29	S1	3	90	Complete
Employees 6	33	S1	7	93	Complete
Employees 7	31	D3	6	94	Complete
Employees 8	24	S1	1	89	Incomplete
Employees 9	26	S1	4	92	Complete

Table 1 assessment data is obtained from a case study, namely companies that select contract employee acceptance, this data will be used in this study by applying the SD-MOORA method. There is still assessment data that is linguistic and will be converted, the results of the assessment data conversion in table 2.

Table 2. Assessment Data Conversion Results

Employees Name	Age of Employees	Educational Qualifications	Work Experience	Interview Value	Administrative Files
Employee 1	25	2	3	90	2
Employee 2	27	2	3	91	2
Employees 3	30	1	5	90	3
Employees 4	23	1	4	90	2
Employees 5	29	2	3	90	2
Employees 6	33	2	7	93	2
Employees 7	31	1	6	94	2
Employees 8	24	2	1	89	1
Employees 9	26	2	4	92	2

The assessment data in table 2 has been converted, then this data will be used in the SD-MOORA method to assess the selection of contract employees.

3.2 Implementation of SD-MOORA Method in Contract Employee Selection

The implementation of the SD-MOORA (Standard Deviation Multi-Objective Optimization by Ratio Analysis) method in the selection of contract employees is a cutting-edge approach that improves the decision-making process. This method integrates various criteria, such as Age of Employees, Educational Qualifications, Work Experience, Interview Value, and Administrative Files, into a comprehensive framework for evaluating candidates. Using mathematical modeling and ratio analysis, SD-MOORA enables decision makers to objectively assess the importance of each criterion and rank candidates appropriately, resulting in more informed and transparent hiring decisions. In addition, this method makes it easy to identify optimal solutions that are balanced between different objectives, such as maximizing qualifications while minimizing costs or time constraints. The implementation of SD-MOORA in the selection of contract employees not only simplifies the selection process but also ensures the selection of candidates that best suit the needs and goals of the organization. The first stage in SD-MOORA is creating a decision matrix using equation (1).

$$X = \begin{bmatrix} 25 & 2 & 3 & 90 & 2 \\ 27 & 2 & 3 & 91 & 2 \\ 30 & 1 & 5 & 90 & 3 \\ 23 & 1 & 4 & 90 & 2 \\ 29 & 2 & 3 & 90 & 2 \\ 33 & 2 & 7 & 93 & 2 \\ 31 & 1 & 6 & 94 & 2 \\ 24 & 2 & 1 & 89 & 1 \\ 26 & 2 & 4 & 92 & 2 \end{bmatrix}$$

The next step in SD-MOORA is to calculate the normalization value of the matrix based on the decision matrix that has been made in the previous stage, the normalization of the matrix is calculated using equation (2).

$$x_{11}^{*} = \frac{x_{11}}{\sqrt{x_{11}^2 + x_{12}^2 + x_{13}^2 + x_{14}^2 + x_{15}^2 + x_{16}^2 + x_{17}^2 + x_{18}^2 + x_{19}^2}}$$

$$x_{11}^{*} = \frac{25}{\sqrt{25^2 + 27^2 + 30^2 + 23^2 + 29^2 + 33^2 + 31^2 + 24^2 + 26^2}}$$

$$x_{11}^{*} = \frac{25}{\sqrt{6923}} = \frac{25}{83.223} = 0.3004$$

Table 3 shows the overall results of the calculation of the SD-MOORA method matrix normalization for all alternatives based on the criteria used.

Table 3. Overall Result of Matrix Normalization of SD-MOORA Method

Employees Name	Age of Employees	Educational Qualifications	Work Experience	Interview Value	Administrative Files
Employee 1	0.3004	0.3849	0.2301	0.3296	0.3244
Employee 2	0.3244	0.3849	0.2301	0.3333	0.3244
Employees 3	0.3605	0.1925	0.3835	0.3296	0.4867
Employees 4	0.2764	0.1925	0.3068	0.3296	0.3244
Employees 5	0.3485	0.3849	0.2301	0.3296	0.3244
Employees 6	0.3965	0.3849	0.5369	0.3406	0.3244
Employees 7	0.3725	0.1925	0.4602	0.3443	0.3244
Employees 8	0.2884	0.3849	0.0767	0.3260	0.1622
Employees 9	0.3124	0.3849	0.3068	0.3369	0.3244

The next step in SD-MOORA is calculating the standard deviation value of the matrix normalization result using equation (3).

$$\sigma_1 = \sqrt{\frac{1}{9}\left(\begin{array}{c}\left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) \\ + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + v + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right) + \left(\left(x_{11}^{*} - x_{11;19}^{max}\right)^2\right)\end{array}\right)}$$

$$\sigma_1 = \sqrt{\frac{1}{9}\left(\begin{array}{c}((0.3004 - 0.3965)^2) + ((0.3244 - 0.3965)^2) + ((0.3605 - 0.3965)^2) + ((0.2764 - 0.3965)^2) \\ +((0.3485 - 0.3965)^2) + ((0.3965 - 0.3965)^2) + ((0.3725 - 0.3965)^2) + ((0.2884 - 0.3965)^2) \\ +((0.3124 - 0.3965)^2)\end{array}\right)}$$

$$\sigma_1 = \sqrt{\frac{1}{9}(0.05183367)} = \sqrt{0.005759297} = 0.07589$$

Table 4 is the overall result of the calculation of the standard deviation value for each criterion.

Table 4. Overall Result of the Calculation of the Standard Deviation Value of SD-MOORA Method

Employees Name	Age of Employees	Educational Qualifications	Work Experience	Interview Value	Administrative Files
σ_j	0.07589	0.11111	0.26445	0.01239	0.17934

The next step in SD-MOORA is calculating the final weight of the criteria using equation (4).

$$w_1 = \frac{\sigma_1}{\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4 + \sigma_5} = \frac{0.07589}{0.07589 + 0.11111 + 0.26445 + 0.01239 + 0.1793} = 0.1181$$

$$w_2 = \frac{\sigma_2}{\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4 + \sigma_5} = \frac{0.11111}{0.07589 + 0.11111 + 0.26445 + 0.01239 + 0.1793} = 0.1728$$

$$w_3 = \frac{\sigma_3}{\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4 + \sigma_5} = \frac{0.26445}{0.07589 + 0.11111 + 0.26445 + 0.01239 + 0.1793} = 0.4111$$

$$w_4 = \frac{\sigma_4}{\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4 + \sigma_5} = \frac{0.01239}{0.07589 + 0.11111 + 0.26445 + 0.01239 + 0.1793} = 0.0192$$

$$w_5 = \frac{\sigma_5}{\sigma_1 + \sigma_2 + \sigma_3 + \sigma_4 + \sigma_5} = \frac{0.1793}{0.07589 + 0.11111 + 0.26445 + 0.01239 + 0.1793} = 0.2788$$

The final weighted result of this criterion will be used in calculating the optimization value of each alternative. The last stage in SD-MOORA calculates the value of alternative optimization using equation (5), the criteria used in the assessment of selection of contract employees are benefits.

$$y_1 = (w_1 * x_{11}^{*}) + (w_2 * x_{21}^{*}) + (w_3 * x_{31}^{*}) + (w_4 * x_{41}^{*}) + (w_5 * x_{51}^{*})$$

$$y_1 = (0.1181 * 0.3004) + (0.1728 * 0.3849) + (0.4111 * 0.2301) + (0.0192 * 0.3296) + (0.2788 * 0.3244)$$

$y_1 = 0.0354 + 0.0665 + 0.0946 + 0.0063 + 0.0905 = 0.2225$

$y_2 = (w_1 * x_{12}^*) + (w_2 * x_{22}^*) + (w_3 * x_{32}^*) + (w_4 * x_{42}^*) + (w_5 * x_{52}^*)$

$y_2 = (0.1181 * 0.3244) + (0.1728 * 0.3849) + (0.4111 * 0.2301) + (0.0192 * 0.3333) + (0.2788 * 0.3244)$

$y_2 = 0.0383 + 0.0665 + 0.0946 + 0.0064 + 0.0905 = 0.2197$

$y_3 = (w_1 * x_{13}^*) + (w_2 * x_{23}^*) + (w_3 * x_{33}^*) + (w_4 * x_{43}^*) + (w_5 * x_{53}^*)$

$y_3 = (0.1181 * 0.3605) + (0.1728 * 0.1925) + (0.4111 * 0.3835) + (0.0192 * 0.3296) + (0.2788 * 0.4867)$

$y_3 = 0.0425 + 0.0332 + 0.1577 + 0.0063 + 0.1357 = 0.2904$

$y_4 = (w_1 * x_{14}^*) + (w_2 * x_{24}^*) + (w_3 * x_{34}^*) + (w_4 * x_{44}^*) + (w_5 * x_{54}^*)$

$y_4 = (0.1181 * 0.2764) + (0.1728 * 0.1925) + (0.4111 * 0.3068) + (0.0192 * 0.3296) + (0.2788 * 0.3244)$

$y_4 = 0.0326 + 0.0332 + 0.1261 + 0.0063 + 0.0905 + 0.2236 = 0.2236$

$y_5 = (w_1 * x_{15}^*) + (w_2 * x_{25}^*) + (w_3 * x_{35}^*) + (w_4 * x_{45}^*) + (w_5 * x_{55}^*)$

$y_5 = (0.1181 * 0.3485) + (0.1728 * 0.3849) + (0.4111 * 0.2301) + (0.0192 * 0.3296) + (0.2788 * 0.3244)$

$y_5 = 0.0411 + 0.0665 + 0.0946 + 0.0063 + 0.0905 + 0.2168 = 0.2168$

$y_6 = (w_1 * x_{16}^*) + (w_2 * x_{26}^*) + (w_3 * x_{36}^*) + (w_4 * x_{46}^*) + (w_5 * x_{56}^*)$

$y_6 = (0.1181 * 0.3965) + (0.1728 * 0.3849) + (0.4111 * 0.5369) + (0.0192 * 0.3406) + (0.2788 * 0.3244)$

$y_6 = 0.0468 + 0.0665 + 0.2207 + 0.0066 + 0.0905 + 0.3375 = 0.3375$

$y_7 = (w_1 * x_{17}^*) + (w_2 * x_{27}^*) + (w_3 * x_{37}^*) + (w_4 * x_{47}^*) + (w_5 * x_{57}^*)$

$y_7 = (0.1181 * 0.3725) + (0.1728 * 0.1925) + (0.4111 * 0.4602) + (0.0192 * 0.3443) + (0.2788 * 0.3244)$

$y_7 = 0.0440 + 0.0332 + 0.1892 + 0.0066 + 0.0905 + 0.2756 = 0.2756$

$y_8 = (w_1 * x_{18}^*) + (w_2 * x_{28}^*) + (w_3 * x_{38}^*) + (w_4 * x_{48}^*) + (w_5 * x_{58}^*)$

$y_8 = (0.1181 * 0.2884) + (0.1728 * 0.3849) + (0.4111 * 0.0767) + (0.0192 * 0.326) + (0.2788 * 0.1622)$

$y_8 = 0.0340 + 0.0665 + 0.0315 + 0.0063 + 0.0452 + 0.1155 = 0.1155$

$y_9 = (w_1 * x_{19}^*) + (w_2 * x_{29}^*) + (w_3 * x_{39}^*) + (w_4 * x_{49}^*) + (w_5 * x_{59}^*)$

$y_9 = (0.1181 * 0.3124) + (0.1728 * 0.3849) + (0.4111 * 0.3068) + (0.0192 * 0.3369) + (0.2788 * 0.3244)$

$y_9 = 0.0369 + 0.0665 + 0.1261 + 0.0065 + 0.0905 + 0.2527 = 0.2527$

Results of alternative assessment of contract employee acceptance selection in figure 2.

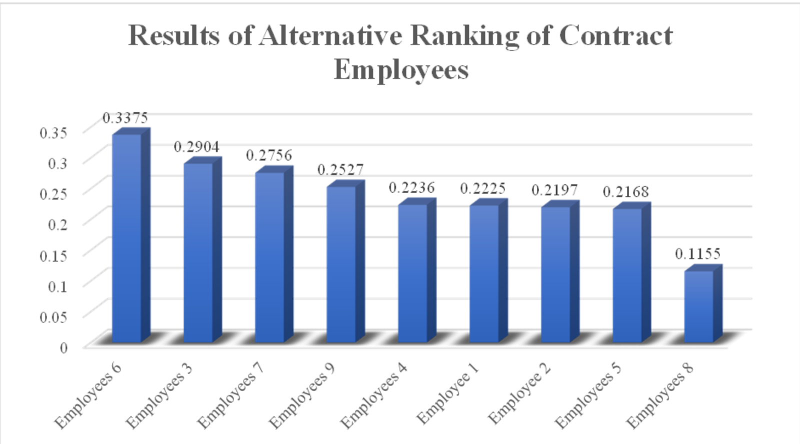

Figure 2. Result of Alternative Rangking of Contract Employees

The ranking results of figure 2 show that the results of rank 1 were obtained by Employees 6 with a final value of 0.3375, rank 2 was obtained by Employees 3 with a final value of 0.2904, rank 3 was obtained by Employees 7 with a final value of 0.2756, rank 4 was obtained by Employees 9 with a final value of 0.2527, rank 5 was obtained by Employees 4 with a final value of 0.2236, rank 6 was obtained by Employees 1 with a final value of 0.2225, rank 7 was obtained by

Employees 2 with a final value of 0.2197, rank 8 was obtained by Employees 5 with a final value of 0.2168, and rank 9 was obtained by 8 Employees with a final value of 0.1155.

3.3 Discussion

The results of research from the modification of MOORA under the name SD-MOORA (Standard Deviation Multi-Objective Optimization on the basis of Ratio Analysis) show that this method contributes significantly to the development of Decision Support Systems (DSS). SD-MOORA combines ratio analysis with the use of standard deviation to measure and optimize the performance of various alternatives based on various criteria. This approach improves the accuracy and reliability of evaluations by reducing subjectivity and giving more objective weight to diverse criteria. The implementation of SD-MOORA in DSS enables a more transparent and structured decision-making process, assisting decision makers in identifying the best options by considering data variability. In addition, this method improves DSS's ability to address complex multi-criteria problems, resulting in more informed decisions supported by in-depth analysis. With the ability to handle the complexity and variability of data, SD-MOORA also improves the efficiency of the decision-making process in DSS. This method allows for a faster and comprehensive analysis, which is especially important in situations where decisions have to be taken in a short time. In addition, SD-MOORA can be integrated with modern technologies such as artificial intelligence and big data analytics to process and analyze large volumes of data more effectively. With this integration, DSS using SD-MOORA can provide more accurate and relevant recommendations based on more in-depth and contextual data analysis. This not only improves the quality of decisions generated, but also allows organizations to be more responsive and adaptive to changes and challenges that arise. Overall, SD-MOORA contribution to DSS development includes increased accuracy, efficiency, and relevance in decision-making processes, ultimately supporting the achievement of organizational goals more effectively. Table 5 is the result of a comparison of rankings obtained from companies with SD-MOORA.

Table 5. Result of a Comparison of Rankings Obtained from Companies with SD-MOORA

Employees Name	Original Ranking	Rank SD-MOORA
Employees 6	1	1
Employees 3	2	2
Employees 7	3	3
Employees 9	4	4
Employees 4	5	5
Employee 1	6	6
Employee 2	7	7
Employees 5	8	8
Employees 8	9	9

To evaluate the comparison of ranking results between the original method and SD-MOORA, Spearman rank correlation coefficient was used as a statistical tool to measure the strength and direction of the relationship between the two sets of ranking data[19]–[21]. Spearman rank correlation coefficient ranges from -1 to 1, with a value of 1 indicating a perfect monotone relationship (identical ranking), a value of -1 indicating a perfectly opposite monotonous relationship, and a value of 0 indicating no monotonous relationship. With a correlation value of 1, it can be concluded that there is a very strong and positive relationship between the original rating and the SD-MOORA rating. This shows that the ratings generated by SD-MOORA are highly consistent with the original ratings, giving validity to SD-MOORA's effectiveness in replicating the original ranking results more objectively and efficiently.

The results of the SD-MOORA modification showed significant improvements in the accuracy and objectivity of decision making. This modification introduced a more adaptive and data-driven method of weighting, using standard deviation to reduce subjectivity and provide a more accurate assessment of different criteria. Thus, this method allows for a more detailed and thorough analysis, identifying small differences that traditional methods may have missed[22], [23]. The modified SD-MOORA implementation in DSS results in a more consistent and reliable ranking of alternatives, assisting decision makers in choosing the best option on a stronger and more transparent basis. This not only increases confidence in decision outcomes, but also speeds up the decision-making process through more efficient and objective evaluation mechanisms.

4. CONCLUSION

Optimization of Alternative Assessment with Modified MOORA Method is to develop alternative assessment methods that are more accurate and objective by integrating standard deviation into the MOORA (Multi-Objective Optimization on the basis of Ratio Analysis) method. This study aims to overcome the weaknesses of conventional MOORA methods in dealing with data variation and assessment subjectivity by introducing a more data-driven mechanism of calculating the weight of criteria. Through testing and comparing performance between modified MOORA methods and conventional methods, this study aims to demonstrate improved accuracy, consistency, and reliability in alternative assessment results. In addition, this research is expected to provide practical implementation guidance for the application of the modified

MOORA method in the Decision Support System (DSS), so as to improve the efficiency and quality of decision making in various sectors. The test results from the comparison of the original ranking with SD-MOORA showed a correlation value of 1, it can be concluded that there is a very strong and positive relationship between the original rating and the SD-MOORA rating. This shows that the ratings generated by SD-MOORA are highly consistent with the original ratings, giving validity to SD-MOORA effectiveness in replicating the original ranking results more objectively and efficiently. The results of the SD-MOORA modification showed significant improvements in the accuracy and objectivity of decision making. This modification introduced a more adaptive and data-driven method of weighting, using standard deviation to reduce subjectivity and provide a more accurate assessment of different criteria.

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