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Multi-criteria Group Decision Making Model to Selecting the Most Appropriate Performance of Contract Employees Using the Weighted Aggregated Sum Product Assessment and Borda Methods

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Abstract: This research aims to evaluate the performance of contract employees using the Weighted Aggregated Sum Product Assessment and Borda methods. The Weighted Aggregated Sum Product Assessment approach uses mathematical calculations, thereby producing precise and accurate results. The Borda technique is useful because it efficiently aggregates diverse rankings of alternatives through voting groups that combine many preferences. The choice of these two methodologies has the ability to produce more efficient solutions to complex problems by guiding or making decisions more quickly in resolving problems. The determining criteria for assessing the performance of contract employees are punctuality or attendance, skills, knowledge, communication, decision making, discipline, adaptation to the work environment, work safety and initiative. The results of the calculation process from the ranking combination of the weighted aggregate sum product assessment and the borda method were obtained by placing alternative 5 as an employee who is worthy of being a permanent employee and getting the highest score of 0.288. All calculations using this method can be a guide in making decisions at PT SMART Tbk Surabaya, because the accuracy of contract employee performance evaluations has a significant influence on achieving company goals in the permanent employee recruitment process.

Keywords: Borda; Criteria weighting; Group decision support system; Weighted aggregated sum product assesment

Introduction

Human resource management has an important influence on the development of organizational performance (Johansen et al., 2019). The success of a company can be assessed from how well it manages and coordinates employees. Company development requires management of human resources (HR), especially in determining contract employees until they are appointed as permanent employees. Every year, the company needs to conduct employee performance evaluations which are useful for motivating employees to work better so that the company will continue to develop from more competent human resources (J. Zhao et al., 2019). However, employee performance evaluation is difficult to do manually because the assessor has their own preferences which can cause subjectivity in the evaluation.

Subjective assessments often arise because the assessor sees what is happening, but the main problem

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that arises is the inability to balance subjectivity and data analysis to determine priorities in performance evaluation (Setiyowati et al., 2019). If subjective elements are prioritized, it means that there will be bias in the assessment and create unhealthy competition and create an uncompetitive environment. However, performance evaluations must be carried out as fairly as possible, so that they will have a positive impact on employee engagement. This performance evaluation will have an impact on whether or not a company develops (X. Zhao et al., 2017).

Performance evaluation can be done by utilizing a group decision support system that can help the management team in solving problems such as facilitating analysis and identification of priorities, providing facilities and solutions to problems and being able to provide group decision considerations (Wang et al., 2017). Employee performance assessments cannot be decided unilaterally but involve groups to provide preference criteria for each individual so as to obtain more optimal decision results (López et al., 2017). Therefore, a performance evaluation is needed by combining Weighted Aggregated Sum Product Assessment (WASPAS) and Borda.

WASPAS is a method in a decision support system that uses the Multi-Criteria Decision Making (MCDM) approach (Kumar et al., 2020). The Weighted Aggregated Sum Product Assessment (WASPAS) and Borda methods can help companies make decisions to assess the performance of employees who are eligible to be appointed as permanent employees. The WASPAS method combines two approaches: the Weighted Sum Model, which calculates each employee's performance criteria score as a weighted sum of each employee's scores, and the Weighted Product Model, which addresses the problem of poor performance criteria by assigning scores based on poor performance criteria. scale. Evaluating each employee with the same emphasis and significance weight can produce more precise results (Gupta et al., 2019). This method is also very practical and refers to ranking accuracy (Baykasoğlu et al., 2021). The Borda method is a decision-making technique used to select one winner or multiple winners from a group. In this method, voters assess candidates based on their preferences (Liao et al., 2020). The purpose of using the Borda technique is to aggregate the assessments made by each evaluator to determine a final result, which identifies the contract employees who are most qualified for permanent employment.

The WASPAS method is one of the methods used to minimize the defects in a determination result to find out the highest and lowest values (Syaripudin et al., 2022). Previous studies have shown that the use of the WASPAS method can improve decision-making on complex problems by offering more efficient solutions and speeding up the decision-making process. The WASPAS approach is an optimal alternative in staff selection. The way this method works is by grouping problems based on criteria and their weighting so that the value of each criterion is obtained (Daulay et al., 2021). Evaluations carried out by several assessors will produce different preferences, so a group decision-making method is needed to determine a number of alternatives from several alternatives. If the results of the WASPAS evaluation have the same value, then it is processed using the Borda method, which is a way to make group decisions by making one analysis result from several assessors to determine the number of alternatives (Ashaf et al., 2019). The application of this method is to collect different alternative rankings by group voting, so that it can be used to combine several preferences to select contract employees who are eligible to become permanent employees. This study focuses on the analysis of the decision support system method using WASPAS and Borda. This system aims to improve the performance of contract employees and provide assistance to the company.

Method

This study aims to determine the decision-making performance of contract employees who are eligible to be permanent employees. Human Resource Management is one of the crucial components of a company that has a significant influence on several factors that contribute to the success of the work (Aziz et al., 2020). Having competent staff is an important step in achieving company goals. Companies rely on employees as a means to run their operations and provide them with the skills and workforce needed to remain competitive and sustainable. There are two types of employment agreements based on their duration, namely fixed-term employment agreements (PKWT) and permanent employment agreements (PKWTT). Usually, companies are subject to sanctions if they employ without an employment agreement because the worker really needs a job to support their family or themselves. In cases like this, workers agree to do the job in the hope that the employer will fulfill their obligations fairly (Any et al., 2020). According to Law Number 13 of 2003, employee contracts are limited to a maximum duration of 3 years (Elfaladonna et al., 2022).

Group Decision Support System is a concept used to determine the alternative chosen from several available alternatives through a group decision-making process. The benefits of GDSS can be used to support the management team in structuring unclear problems and analyzing and making group decisions (Wang et al., 2017). Everyone involved in GDSS will exchange ideas, opinions and choices between one group member and

another to produce a joint decision (X. Zhao et al., 2017). Joint decision-making will certainly involve several parties and a large number of alternatives (Morente-Molinera et al., 2018). This concept also does not have complete information related to decision-making so that a combination of several methods is needed to choose a more accurate decision (Capuano et al., 2018). This study used two combinations of the Weighted Aggregated Sum Product Assessment (WASPAS) and Borda methods.

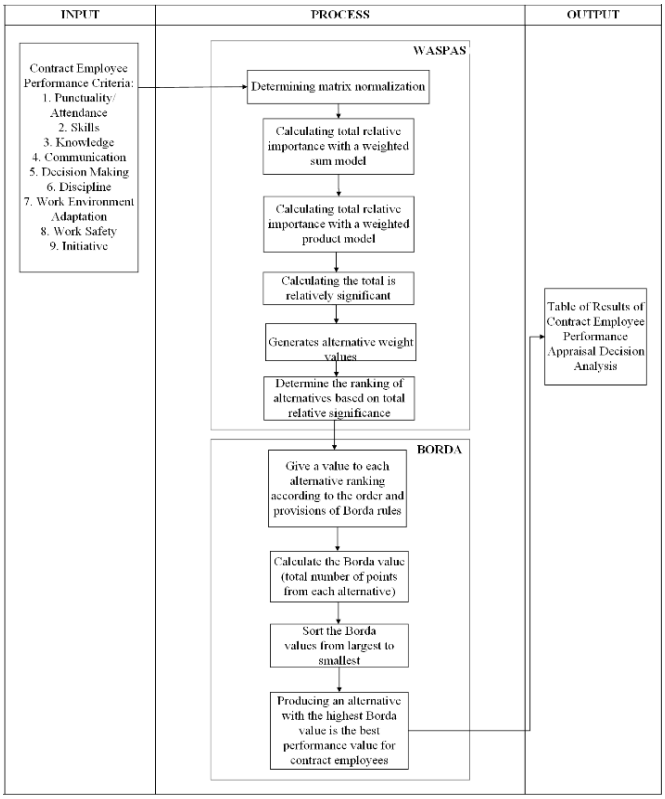

Figure 1. Method system framework

Weighted Aggregated Sum Product Assessment (WASPAS) is very practical and refers to the concept of ranking accuracy (Baykasoğlu et al., 2021). The WASPAS method is a combination of two methods, namely the weighted sum model (WSM) and the weighted product model (WPM). The combination of the two methods can increase the accuracy of the WASPAS method in ranking alternatives rather than using only one of the WPM or WSM methods (Senapati et al., 2021). This method also has benefits in overcoming various problems with the ultimate goal of determining the final result of minimization or maximization (Vaid et al., 2022). Below will be explained the completion of the calculation using WASPAS which has five main steps, namely:

Determining the matrix

First, the criterion value is changed to matrix normalization with the equation as below:

$$X = \left[x_{ij}\right]_{m+n} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ x_{21} & \cdots & x_{2n} \\ x_{31} & \cdots & x_{3n} \end{bmatrix} \quad (1)$$

Description:
x_{ij} : overall performance value
m : number of alternatives
n : number of criteria

Determining the normalization of criteria

Second, the criteria value is changed to the normalization of criteria with the following equation:

$$\bar{x}_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \quad (2)$$

Description:
x : unnormalized criteria value
$\bar{x}$: normalized criteria value
i : alternative - i
j : criteria - j

Equation (2.2) is used to assess the requirements for a profitable outcome. The benefit criterion is a highly sought-after criterion because it is associated with a high value, while the cost criterion is desired with a low value. The normalization of the cost criterion is then carried out using formula (2.3) as presented below.

$$\bar{x}_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \quad (3)$$

Calculation using the weighted sum model (WSM) formula in the equation below.

$$Q_i^{(1)} = \sum_{j=1}^{n} w_j \overline{x_{ij}} \quad (4)$$

Description:
$Q_i^{(1)}$: weighted sum model (WSM) value
$\bar{x}$: normalized criteria value
w : criteria weight
i : alternative - i
j : criteria - j

Calculation using the weighted product model (WPM) formula in the following equation:

$$Q_i^{(2)} = \prod_{j=1}^{n} w_j \overline{x_{ij}} \quad (5)$$

Description:
$Q_i^{(2)}$: weighted product model (WPM) value
$\bar{x}$: normalized criteria value
w : criteria weight
i : alternative - i
j : criteria - j

Calculation of the Weighted Aggregated Sum Product Assessment (WASPAS) value by combining the

calculation results of the weighted sum model (WSM) and weighted product model (WPM) equation formulas using the following equation.

$$Q_i = 0.5Q_i^{(1)} + 0.5Q_i^{(2)} \quad (6)$$

Description:
Q_i : WASPAS value
$Q_i^{(1)}$: weighted sum model (WSM) value
$Q_i^{(2)}$: weighted product model (WPM) value

Furthermore, using the Borda method created by Jean Charles de Borda in the 18th century is a technique used to determine the optimal alternative (Murti et al., 2021). Each alternative choice will be evaluated according to its ranking weight. The Borda counting method is a voting method carried out by assessor candidate rankers according to preference. In the Borda method, each candidate will be ranked by giving a number of points according to the candidate's position (Tian et al., 2018). Borda determines the best alternative by accumulating the most points obtained. Borda gives a number of points to each candidate depending on the ranking set by the decision maker. The winner will be determined by the number of points each candidate receives (Ashaf et al., 2019). The lowest Borda score is selected to be eliminated (Orouskhani et al., 2018). In the Borda calculation procedure, each candidate's score is determined by the number of voters who rank first, second, to the last rank (Kilgour et al., 2022). The winner is the candidate with the highest total score. A standard way of representing the Borda calculation as a scoring rule is as a vector of weights $\{n-1, n-2, \ldots\ldots, 2, 1, 0\}$ (Grofman et al., 2017). In this representation it is clear that the Borda rule requires voters to assign a rank to each alternative. The stages of completing the calculation using the Borda method can be explained as follows: (1) To determine the ranking value in a series of alternatives, consider the row with the highest ranking based on the value n-1, where n represents the total number of choices. Then the value given to the second slot is n-2, and this process is repeated until the last position is 0. (2) The value of n functions as a factor that multiplies the votes obtained in a certain rank. (3) The Borda calculation reveals the various possibilities used, with the highest value option being the most popular or preferred option among respondents.

Result and Discussion

From the results of the interviews that have been conducted, there are 9 criteria and 10 employee value data supporting the decision to assess the performance of contract employees who are worthy of becoming permanent employees, namely punctuality/attendance, skills, knowledge, communication, decision making, discipline, work environment adaptation, work safety, and initiative. However, the data displayed only uses 6 criteria and 5 employee assessment data while 3 criteria and 5 assessment data are not displayed in order to shorten the article. Furthermore, the determination of the measurement weight comes from the assessment data that has been carried out previously. Table 1 displays a list of criteria and their weights.

Table 1. Criteria and Criteria Weighting

Name Criteria	Notation	Category	Weight Criteria
Punctuality/Attendance	C1	Benefit	0.15
Skills	C2	Benefit	0.10
Knowledge	C3	Benefit	0.10
Communication	C4	Benefit	0.10
Decision Making	C5	Benefit	0.10
Discipline	C6	Benefit	0.15

The initial stage, the alternative value for each assessor criteria is calculated using the weighted aggregated sum product assessment method, then the ranking results for each alternative are recalculated using the Borda method to determine the subjective value of each assessor by voting. The steps for each calculation from the combination of methods will be explained as follows.

Creating a decision matrix with the WASPAS method by presenting the criteria values changed into a normalized matrix form. The alternative assessment data matrix is carried out by the first, second and third assessors sequentially in tables 2, 3 and 4.

Normalization of the alternative assessment data matrix using equation (2) because this study uses the benefit category. The results of the normalization of the first, second and third assessor matrices are respectively in tables 5, 6 and 7.

Table 2. Assessor Assessment Matrix 1

Id	C1	C2	C3	C4	C5	C6
A1	60	80	90	65	60	80
A2	70	65	85	70	70	65
A3	80	80	80	80	80	80
A4	80	90	80	70	80	90
A5	90	90	75	70	90	90

Table 3. Assessor Assessment Matrix 2

Id	C1	C2	C3	C4	C5	C6
A1	90	70	70	70	90	70
A2	65	70	65	80	65	70
A3	75	70	80	75	75	70
A4	70	95	80	75	70	95
A5	70	90	90	80	70	90

Table 4. Assessor Assessment Matrix 3

ID	C1	C2	C3	C4	C5	C6
A1	70	65	70	70	70	65
A2	70	75	60	70	70	75
A3	70	80	90	60	70	80
A4	80	80	85	80	80	80
A5	80	80	90	90	80	80

Table 5. Normalization of Matrix Assessor 1

ID	C1	C2	C3	C4	C5	C6
A1	0.667	0.889	1	0.684	0.667	0.889
A2	0.778	0.722	0.944	0.736	0.778	0.722
A3	0.889	0.889	0.889	0.842	0.889	0.889
A4	0.889	1	0.889	0.736	0.8889	1
A5	1	1	0.833	0.736	1	1

Table 6. Normalization of Matrix Assessor 2

ID	C1	C2	C3	C4	C5	C6
A1	1	0.736	0.778	0.778	1	0.736
A2	0.722	0.736	0.722	0.889	0.722	0.736
A3	0.833	0.736	0.889	0.833	0.833	0.736
A4	0.778	1	0.889	0.833	0.778	1
A5	1	1	0.833	0.736	1	1

Table 7. Normalization of Matrix Assessor 3

ID	C1	C2	C3	C4	C5	C6
A1	0.778	0.813	0.778	0.778	0.778	0.813
A2	0.778	0.938	0.667	0.778	0.778	0.938
A3	0.778	1	1	0.667	0.778	1
A4	0.889	1	0.944	0.889	0.889	1
A5	0.889	1	1	1	0.889	1

Calculation using the weighted sum model (WSM) and weighted product model (WPM) formulas. The following calculates the weighted sum model (WSM) with equation (4) and the weighted product model (WPM) with equation (5) from the results of the normalization of each assessor's matrix. The results of the WSM and WPM calculations in the first, second and third assessor assessment calculations are respectively in tables 8, 9 and 10.

Table 8. WSM and WPM Assessor Calculation 1

Alternative	Wsm	Wpm
A1	0.570	0.258
A2	0.557	0.849
A3	0.633	0.931
A4	0.649	0.947
A5	0.671	0.969

Table 9. WSM and WPM Assessor Calculation 2

Alternative	Wsm	Wpm
A1	0.599	0.891
A2	0.537	0.827
A3	0.575	0.869
A4	0.627	0.922
A5	0.631	0.926

Table 10. WSM and WPM Assessor Calculation 3

Alternative	Wsm	Wpm
A1	0.577	0.873
A2	0.598	0.891
A3	0.635	0.929
A4	0.683	0.983
A5	0.681	0.983

Calculation of the Weighted Aggregated Sum Product Assessment (WASPAS) value by combining the results of the calculation of the weighted sum model (WSM) and weighted product model (WPM) equation formulas using equation (6). The results of the WASPAS calculation on the first, second and third assessor assessment calculations are sequentially in tables 11, 12 and 13.

Table 11. WASPAS Calculation and Assessor Rank Results 1

Alternative	Qi	Rank
A1	0.414	5
A2	0.703	4
A3	0.783	3
A4	0.798	2
A5	0.819	1

Table 12. WASPAS Calculation and Assessor Rank Results 2

Alternative	Qi	Rank
A1	0.746	3
A2	0.682	5
A3	0.722	4
A4	0.775	2
A5	0.779	1

Table 13. WASPAS Calculation and Assessor Rank Results 3

Alternative	Qi	Rank
A1	0.725	5
A2	0.744	4
A3	0.782	3
A4	0.833	1
A5	0.832	2

Conduct final ranking using the Borda method. Determine the voting results based on the calculation provisions of the Borda method. The voting results are seen according to the ranking from the highest to the

lowest total wins from the assessment of the three assessors as follows.

The results of the calculation process of the combined ranking of the weighted aggregated sum product assessment and Borda methods are in Table 14. The final ranking obtained with alternative 5 is that employees are eligible to become permanent employees and are entitled to the highest value of 0.288, followed by alternative 4, alternative 3, alternative 2 and alternative 1.

Table 14. Results of Group Decision Calculations Using the Borda Method

Id	Rank						Point	Value
	1	2	3	4	5	6		
A1	-	-	2.982	-	2.278	-	5.261	0.11
A2	-	-	-	4.342	1.363	-	5.7061	0.119
A3	-	-	7.912	2.166	-	-	10.079	0.211
A4	4.997	7.867	-	-	-	-	12.859	0.269
A5	9.596	4.159	-	-	-	-	13.752	0.288
Weight	6	5	4	3	2	1	47.658	

Conclusion

The implementation of the weighted aggregated sum product assessment and borda methods in the group decision support system in employee performance assessment evaluation produces alternative decision values that are worthy of becoming permanent employees through several stages of calculation. The results of the calculation of the two methods can be concluded that these two methods, if combined, are in accordance with the needs of employee performance evaluation by combining several assessor preferences into one decision result in the form of an alternative ranking. Alternative ranking 5 has the highest score with a value of 0.288, which indicates that this alternative is the best alternative in employee performance evaluation.

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Author Contributions

Conceptualization, Y. C, P, B. S, J. E, S.; methodology, Y. C, P, B. S, J. E, S.; validation, Y. C, P.; formal analysis, Y. C, P.; investigation, Y. C, P.; resources, Y. C, P.; data curation, Y. C, P.; writing—original draft preparation, Y. C, P.; writing—review and editing, Y. C, P, B. S, J. E, S.; visualization, Y. C, P. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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