A selection system for the position ideal of football players based on the AHP and TOPSIS methods

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Abstract Football is a fun, attractive, entertaining sport and provides satisfaction for the audience. However, Madura United, Indonesia, still not in good condition as the selection of the right players requires a long time. Several studies have overcome many of these problems using decision support systems, however, it has not reached good results. Therefore, this research develops a system using the Analytical Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The contribution of this research is to create a new framework by integrating AHP and TOPSIS methods with controlling iteration of consistency ratios, and automatic assessment of coaches for the right players' selection in each position with to make comparison matrices in each criterion. So, a selection system can be supported to make a correct decision in selecting the right players for the team. The test results obtained the accuracy reached an average of 83.9% out of the four trials of the forwards, midfielders, defenders, and goalkeepers. In summary, the test results show the effectiveness of AHP and TOPSIS methods in supporting the decision to select the right football players.

Keywords: Selection, Football Players, Decision Support Systems, AHP, TOPSIS.

1. Introduction

Football is one of the most popular types of sports at the moment and a place for the competition from both regional and international levels in the world. One of the most important factors in a soccer match is the player.[1][2]. Therefore, determining the success of a soccer match requires the selection of soccer players by the management or coach to find the best player according to the needs of the team. The selection of these players is done by taking into account the evaluation of criteria and criteria weights. To optimize the process of evaluating suitable player positions, decision making is needed. Decision support system is a system used as a tool for decision-makers in alternative decisions, but not to replace the judgment of decision makers[3]. The decision support system is needed by the selection team because it can solve multi-objective and multi-criteria problems that will select the best alternatives so that this system will make it easy for the coaches in the process of selecting the best and more objective soccer player candidates.

The method used in this research as decision making in selecting suitable soccer players based on team needs is AHP and TOPSIS. AHP method is a method for determining the ratio scale obtained from preference [4]. The AHP process begins with the process of identifying problems that have many
complex criteria and structures. The TOPSIS method is a multi-criteria decision support method that has the closest distance from the positive perfect solution based on the Euclidean space [5]. The optimal solution of the TOPSIS method results from the relative neighborhoods of an alternative to the positive ideal solution. The workings of the TOPSIS method are to rank alternatives based on the value of the relative proximity of the alternatives to achieve a positive solution[6]. Based on the advantages possessed by both methods, several studies have developed decision-making techniques to deal with problems quantitatively, such as[7] research that conducts the selection of a multi-media authorization system (MAS) with the AHP method which is proven to be better and able to help group members focus discussions around objectives based on alternatives. Also, the research conducted[8] for performance alternatives that relate to predetermined criteria and provide recommendations for the determination of steel industry suppliers in Iran with three levels of the supply chain and the level of macroeconomic (international) using the TOPSIS method. In this research, the TOPSIS method can help solve problems with an accuracy of up to 90%. The difference between this research and previous studies is that there is a data analysis process using the combination of both methods by controlling the iteration of the consistency ratio, and the automatic assessment of the trainer for selecting the right players in each position by making a comparison matrix for each criterion[9].

The purpose of this research is to design a decision support system with a comparison matrix in each criterion and determine the average value of each criterion and then rank to produce criteria weights that can determine the best player for each position according to the team's needs, including the position of the front, middle, back, and goalkeeper so this can help the coach in deciding to decide the best player with suitable positions according to criteria.

2. Research Methods

The research method of the selection system for the best players in football has several stages that need to be prepared to produce a system capable of achieving goals as a decision-making system in determining the best players for 4 player positions, including forwarding players, midfielder, defender, goalkeeper based on 12 criteria, such as First Touch, Passing, Crossing, Shooting, Heading, Dribbling, Agility, Speed, Endurance, Intercept, Tackling, and Balance. Each criterion has a weight value of each alternative with a scale of importance from 1 to 9 as a basic scale, as can be seen in Table 1. Finding the best soccer player based on the desired criteria will require a decision support system[10].

| Intensity of Interest | Explanation of Element Value |
|-----------------------|-----------------------------|
| One                   | An equally important        |
| Three                 | Not too important           |
| Five                  | Important                   |
| Seven                 | Very important              |
| Nine                  | Absolutely essential        |
| Even Value            | Two adjacent values         |

There are several models used for decision support systems. AHP method is one of the comprehensive and structured decision-making models[11]. The AHP model as decision support that can solve complex multi-criteria problems. Steps of the AHP method, such as [12]: (a) Arrange the hierarchy of existing problems, (b) Determination of element priority is to compare two elements are the same and fit the criteria in the matrix, (d) Determine the assignment value (CI) and all consistency values (CR) as in Equations 1 and 2, (e) Add up the values of each matrix and divide by the number of elements to get the average value and the final result in the form of global priority as the value used by the taker decisions based on the highest value, (f) Check the structure of consistency, if it has a value of the fixed rate of less than or equal to 0.1, then obtained priority weights from each alternative to each of the existing criteria. AHP method has advantages based on a pair comparison matrix and doing consistency analysis[13].
if CR < 0.1 then consistency value and if CR ≥ 0.1 value is not consistent. So if it is not consistent, then calculate the priority vector in the comparison matrix or alternative elements must be repeated.

In addition to the advantages of the AHP method, AHP has disadvantages, such as: if the criteria are more numerous it becomes more difficult to determine and make decisions when evaluating pair comparisons between criteria and AHP also requires grouping criteria for problems that have many criteria [14]. The shortfall of AHP method can be solved by TOPSIS method, where this method can make a grouping of criteria by using the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest from the negative ideal solution can be solved by using the Euclidean distance to determine the relative proximity of an alternative with an optimal solution[15]. Therefore, this study uses the integration of AHP and TOPSIS methods for practical decision making in choosing the right players in football, because both of these methods have simple concepts, are easy to understand, are computationally efficient, and have the ability to measure the relative performance of decision alternatives[16]. TOPSIS method is a method that can identify solutions to multi-criteria problems by minimizing the ideal point distance and maximizing the lowest distance [17][18]. Steps to the TOPSIS method, such as [19]: (a) Determine the normalized decision matrix, can be seen in equation 3, (b) Determine the weighted decision matrix as in equation 4, determine positive matrix (A+) and negative matrix (A-) in equation 5, (c) Determine the range of alternative values from the absolute of solution matrix (di+) and the rejection matrix (di-), the positive distance (di+) with equation 6, (d) Determine the priority value of the vector for each alternative, the formula can be seen in equation 7. And the preference value is the proximity value of the alternatives.

\[
\eta_j = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij}^2}},
\]

where \( x_{ij} \) is the i-alternative rating of j attribute and \( r_{ij} \) is an element of the normalized matrix. \( y = (y_{11}, y_{12}, y_{13}, y_{1j}) \) for \( y_{ij} = w_j r_{ij} \),

\[
y = (y_{21}, y_{22}, y_{23}, \ldots, y_{2j}) \quad \text{and} \quad A^+ = (y_{11}^+, y_{21}^+, \ldots, y_{j1}^+),
\]

with

\[
y_{ij}^+ = \begin{cases} \max_{j=1}^{m} y_{ij}, j \text{ika } j = \text{Best Value} \\ \min_{j=1}^{m} y_{ij}, j \text{ika } j = \text{Bad Value} \end{cases}
\]

\( d_i^+ = \sqrt{\sum_{j=1}^{m} (y_{ij}^+ - y_j^+)^2} \) and \( d_i^- = \sqrt{\sum_{j=1}^{m} (y_{ij} - y_j^-)^2} \),

where \( y_{ij}^+ \) is an element of the positive and ideal solution matrix \( y_i^- \) is an element of the negative ideal solution matrix.

\[
c_i = \frac{d_i^-}{d_i^+ + d_i^-}
\]

The selected alternative produces the shortest distance from the positive ideal solution called the optimal solution. The positive ideal solution is the sum of all the best values obtained from each attribute, while the negative ideal solution is the opposite. The solution of the TOPSIS method is a value that has relative proximity to a positive ideal solution[20].

3. Results And Discussion

Based on the steps to resolve the problem in the selection of suitable positions in a soccer match, such as the position of the front, middle, rear and goalkeeper using the AHP and TOPSIS methods, the first step is the assessment of criteria and alternatives that will be used as references in decision
making, As Figure 1. The second step is determining priority criteria and calculating data consistency if the value of the consistency ratio is less than 0.1, then the ratio of the consistency of these calculations so that the main vector and CR eigenvalues are obtained at each level. The average value of the criteria for each player's position can be seen in Table 2. The third step is the decision making process by using the TOPSIS method to make a normalized decision matrix of the AHP process to rank alternatives based on the order of Ci and the best alternative solution is the shortest alternative to the ideal solution and the farthest distance from the negative ideal solution. The implementation of the best player selection calculation process with both methods in this survey is shown in Figure 2 and an example of the implementation of one player selection can be seen in Figure 3. Whereas testing the accuracy of the AHP and TOPSIS methods in matching with the actual data and the results of the system, can be seen in the distribution chart shown in Figure 4.

Table 2. Criteria Value of Each Position

| No | Player Position | Criteria Value |
|----|-----------------|----------------|
| 1  | Forward players | 76.31          |
| 2  | Midfielder      | 73.36          |
| 3  | Defender        | 71.09          |
| 4  | Goalkeeper      | 62.43          |
4. Conclusion

This research has been able to assist the coaches in making decisions to determine the position of a suitable soccer player in a team objectively from the best alternative. Besides, the ideal position selection system for a player can also increase the effectiveness and efficiency of working hours in the selection process by using both methods. In this research, the AHP method is used for weighting with a relative priority scale based on 12 existing criteria. On the other hand, the TOPSIS method is used to provide a more precise assessment based on the criteria and weight values that have been determined so that it will get more accurate results. The success of the suitability of the position of soccer players in this study using 112 data samples of soccer players based on 12 criteria, then obtained 14 data correct data on the position of the front and goalkeeper, 32 midfielders, and 34 defenders. So that the accuracy of the suitability level of the system reaches 83.9% from 4 positions both forward, midfielder, defender, and goalkeeper.

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