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Implementation of SAW and TOPSIS in Decision Support System to Decide The Best Midfielder in A Football League

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ABSTRACT

Football has been one of the most popular sport in the world. In the world of football, there are often debates on determining who the best player of a position is, this debate would be a controversial topic in Football Awards like Ballon d'Or or FIFPro World XI because often, subjective opinions of human are used during the determining process of the best players. The purpose of this journal is to determine the best midfielder in a foot-ball league using a decision support system. The decision support system method used in this research are Simple Additive Weighting (SAW) to normalize and find the weighted sum of each criteria and Technique Order Preference by Similarity to Ideal Solution (TOPSIS) to determine the best alternative from the set of alternatives.The result of this journal will decide the best alterna-tive from a few midfielders that are chosen using a set criteria.

Keywords: Football Midfielder; Decision Support System; SAW; TOPSIS;

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1. INTRODUCTION

Football is the most popular sport in the world[1], along with the development of technology, there are many implementations of information technology in football such as the use of Virtual Assistant Referee (VAR) and Goal Line Technology as the use of information technology in football matches as well as computerized player analysis systems to determine the quality of players during matches as a form of using information technology post a football matches. However, there are still many aspects of football that are still done manually or require subjective human decisions. One example of a part of football that still uses human decision-making is selecting the best player in one playing position. In general, the decision of selecting the best player of a football position are made based on observation and subjective judgment from humans, so the decisions taken may not be the best choice. One of the most difficult player positions to determine is the position of the midfielder, because there is ambiguity in the purpose of the position, where there are midfielders who are aimed at blocking the ball, attacking the opponent's goal, and creating goal opportunities for attacking players. However, the function of a midfielder in general is to maintain possession of the ball, maintain the structure of the team formation, and regulate the tempo of the game. Midfielders are also required to have strong stamina because they are one of the most active players running in a soccer match [2]. Because of those many functions, it is difficult to determine the best midfielder in a football team, so a decision making system is needed that can help determine the best midfielder in a football club. The use of information system in this research is only to assist club or player management in making decisions related to semi-structural issues and does not replace major decisions making[3].

Decision support systems are computer-based systems and can be used to help humans find solutions in making decisions based on certain judgments [4]. In this research, the decision support system method used is SAW (Simple Additive Weighting) and TOPSIS (Technique Order Preference by Similarity to Ideal Solution) where these two methods will be used to determine the best midfielder according to the existing criteria. These criteria include: the percentage of passing accuracy, the number of successful tackles, the number of goal scoring opportunities created and the number of goals scored. The values in these criteria will later be normalized into a scale form using the SAW method and followed by the TOPSIS method to determine the best alternative [5]. Prior research that had used SAW and TOPSIS as it's method of decision support system for example are the research done by Laela Isna and Imam Husni titled "Implementasi Metode SAW Dan TOPSIS Dalam Pemilihan Rumah Hunian Di Wilayah Semarang Barat"[6] in which the researchers used SAW and TOPSIS as a method of determining the best housing complex in an area. Other similar researches for example the research done Sunarti in "Comparison Between Topsis And SAW Method In The Selection Of Tourist Destinations In West Java"[7] in which the researcher had also used SAW and TOPSIS as a method of determining the best output, which in this case is the best tourist destination in West Java. On a larger scale, some research on decision support system for example are to make better decision in an organization [8], to handle financial problems[9], to predict future demand in business market[10], and to perform a continous audit[11].

2. RESEARCH METHOD

2.1. Data Collection Method

The data collection method for this research is by browsing for online information and datas. The data used is Premier League midfielder player data for the 2020-2021 season where the Premier League is the main league of English football. The data are collected from the website https://fotmob.com which uses Opta Data asit's tool for data collection. Opta Data is a data collecting company specializing in the sport's industry and has worked with the Premier League to collect it's players data.

2.2. Decision Support System

A decision support system is a system that is able to help its users make decisions in structured and semi-structured situations, with conditions where the decision is not yet known[12].

2.3. Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) is a decision support system method where the main function is to find the weighted sum of the performance evaluation of each alternative on all existing attributes [9]. The SAW method is widely used for decision making where there are several attributes or Multiple Attribute Decision Making (MADM). Multiple Attribute Decision Making (MADM) is a process of determining the best alternative based on a set of criteria where MADM will look for the best alternative out of a number of alternatives. The SAW method has been used in a variety of complicated problems that require decision making such as determining the eligibility of promotions [10] and accepting new students [11]. In the SAW method, there is a process of normalizing the decision matrix into a scale to find the best alternative, the overall value/final value for the alternative can be obtained by adding up all the multiplication results between the rating and the weight of each attribute [12]. The formula for normalizing is as follow:

$$r_{ij} = \begin{cases} \dfrac{x_{ij}}{Max\ x_{ij}}, if\ j\ is\ a\ profit\ attribute \\ \dfrac{Min\ x_{ij}}{x_{ij}}, if\ j\ is\ a\ cost\ attribute \end{cases}$$

Where r_{ij} is the performance value after normalization, x_{ij} is the attribute value that each criterion has, Max x_{ij} is the attribute value that each criterion has, Min x_{ij} is the attribute value that each criterion has, profit is if the largest value is the best, and cost is if the lowest value is the best.

The formula for calculating the choice of each alternative (Vi) is as follow:

$$V_i = \sum_{j=1}^{n} w_j r_j$$

Where V_i is the rank for each alternative, w_j is the weight for each criterion, and r_{ij} is the normalized performance rank value.

2.4. Technique Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is a Multi Criteria Decision Making (MCDM) method that can be used to find solutions from a set of alternatives by minimizing the simultaneous distance from the ideal point and maximizing the distance from the lowest point. TOPSIS can also combine the relative weights of important criteria [17][18]. The steps and method of TOPSIS are as follow [19][20]:

2.4.1. Creating a normalized decision matrix from each alternative for each criterion.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, (\mathrm{i} = 1,2, \dots, \mathrm{n};\ \mathrm{j} = 1,2, \dots, \mathrm{m})$$

Where x_{ij} is the assessment of the performance of the i-th alternative to the j-th attribute and r_{ij} is the element of the normalized decision matrix.

2.4.2. Creating a decision matrix using weighted normalization.

$$y_{ij} = w_j \times r_{ij}$$

Where y_{ij} is the elements of the decision matrix are weighted normalized and w_j is the weight of the j-th criterion.

2.4.3. Determining the positive ideal solution (y_j^+) and negative ideal matrix (y_j^-).

$$A^+ = y_1^+, y_2^+, \dots, y_n^+$$
$$A^- = y_1^-, y_2^-, \dots, y_n^-$$

2.4.4. Determining the differentiation of alternative values from the positive ideal solution matrix (d_i^+) and the negative ideal solution matrix (d_i^-), the distance of the positive ideal solution (d_i^+).

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (y_j^+ - y_{ij})^2}$$
$$d_i^- = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_j^-)^2}$$

Where y_j^+ is the element of the positive ideal solution matrix and y_j^- is the element of the negative ideal solution matrix.

2.4.5. Calculating the final assessment for each alternative (Vi)

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

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Where V_i is the relative closeness value.

The research method used can be shown in the flowchart diagram below :

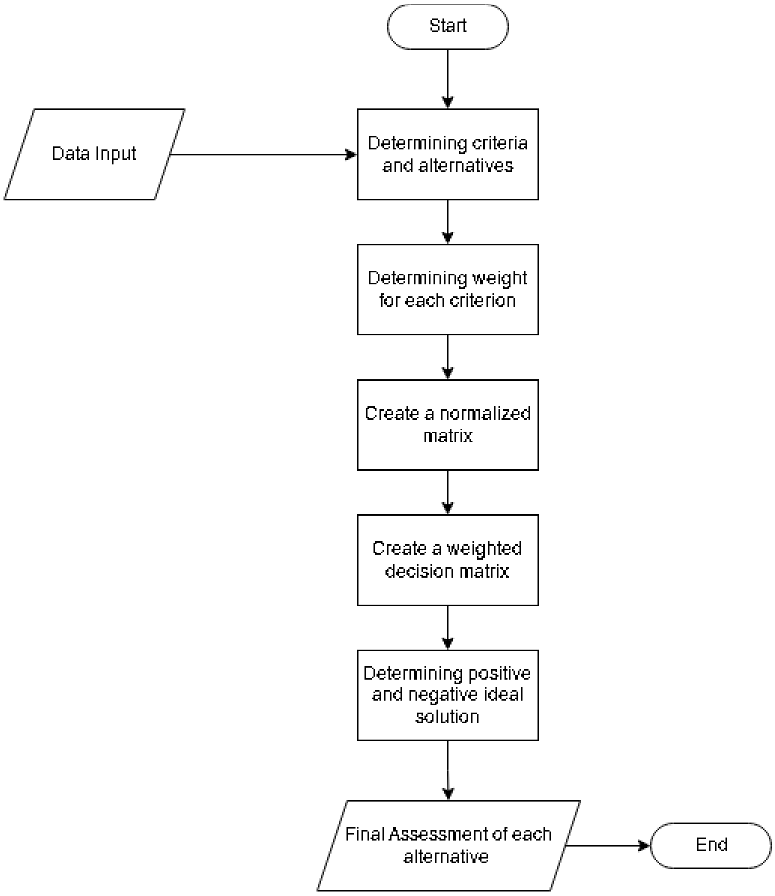

Figure 1. SAW and TOPSIS method flowchart

3. RESULTS AND DISCUSSION

In this study, 5 assessment criteria will be used for the case study, which can be shown in table 1.

Table 1. Criteria Description

Criteria	Description
K1	Passing accuracy percentage
K2	Number of successful tackle(s)
K3	Chance(s) created
K4	Number of Goal(s)
K5	Number of Assist(s)

The alternatives that will be used are 5 midfielders from the English Premier League, namely: A1 = Kevin De Bruyne, A2 = Bruno Fernandes, A3 = Rodri, A4 = Jorginho, A5 = Jordan Henderson. The following is the suitability rating for alternatives on each criterion which is represented using a scale of 1-5, namely:

1 : Very Bad
2 : Bad
3 : Average
4 : Good
5 : Very Good

The following are assessment criteria table for K1 to K5:

Table 2. K1 Assessment Criteria

K1	
60-70	Bad
71-83	Average
84-90	Good
91-100	Very Good

Table 3. K2 Assessment Criteria

K2	
2-10	Bad
11-20	Average
21-31	Good
>=32	Very Good

Table 4. K3 Assessment Criteria

K3	
10-22	Bad
23-43	Average
44-60	Good
>=11	Very Good

Table 5. K4 Assessment Criteria

K4	
0-5	Bad
6-7	Average
8-10	Good
>=11	Very Good

Table 6. K5 Assessment Criteria

K5	
0-4	Bad
5-7	Average
8-10	Good
>=11	Very Good

The criterion data for each alternative are shown on the table below:

Table 7. Criterion Data for Each Alternative

Alternative	Criteria				
	K1	K2	K3	K4	K5
Kevin De Bruyne	81.7	21	80	6	12
Bruno Fernandes	78.3	30	95	18	12
Rodri	91.3	40	33	2	2
Jorginho	89.2	30	24	7	1
Jordan Henderson	87.3	15	14	1	1

The following are weighting table for each criterion:

Table 8. Weight for each criterion

Criteria	Weight
K1	20%
K2	10%
K3	30%
K4	30%
K5	10%

3.1. Normalization

The first step is to normalize the existing matrix using the SAW normalization formula , the results are as shown in the table below.

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Table 9. Normalization Result

Alternative	Criteria				
	K1	K2	K3	K4	K5
Kevin De Bruyne	0.895	0.525	0.842	0.333	1
Bruno Fernandes	0.858	0.75	1	1	1
Rodri	1	1	0.347	0.111	0.167
Jorginho	0.977	0.75	0.253	0.389	0.083
Jordan Henderson	0.956	0.375	0.147	0.056	0.083

3.2. Matrix Weighting

Furthermore, the weighting of the normalization results is carried out using the weight values of table 8. The results are as shown in table 10.

Table 10. Weighting Result

Alternative	Criteria				
	K1	K2	K3	K4	K5
Kevin De Bruyne	0.179	0.053	0.253	0.01	0.1
Bruno Fernandes	0.172	0.075	0.3	0.3	0.1
Rodri	0.2	0.1	0.104	0.033	0.017
Jorginho	0.195	0.075	0.076	0.117	0.008
Jordan Henderson	0.191	0.038	0.044	0.017	0.008

3.3. TOPSIS Method

The next step is to determine positive and negative ideal solutions. The results are as shown in table 11.

Table 11. Positive and Negative ideal solutions

Criteria	Positive Ideal Solution (A+)	Negative Ideal Solution (A-)
K1	0.2	0.172
K2	0.1	0.038
K3	0.3	0.044
K4	0.3	0.017
K5	0.1	0.008

The calculation of the differentiation of positive and negative ideal alternative solutions is then carried out. The results are as shown in table 12.

Table 12. Alternative Differentiation of Positive and Negative Ideal Solution

Alternative	Positive Ideal Solution (A+)	Negative Ideal Solution (A-)
F1	0.298	0.229
F2	0.038	0.394
F3	0.341	0.093
F4	0.305	0.114
F5	0.398	0.019

The final stage is to calculate the Relative Closeness for each alternative which will be the final assessment to determine the last alternative, then sorting/ranking are conducted to determine the best alternative order. The resulting table can be seen in table 13.

Table 13 Final Value and Best Alternative Rank

Alternative	Relative Closeness	Rank
F1	0.434	2
F2	0.913	1
F3	0.213	4
F4	0.272	3
F5	0.046	5

The results of this case study show that based on the criteria, alternatives and data used, as well as the use of SAW and TOPSIS decision support methods, Bruno Fernandes is the best midfielder of the 5 alternatives selected with a relative closeness value of 0.913.

4. CONCLUSION

From the research that has been carried out in this journal, it can be concluded that SAW and TOPSIS methods can be implemented to determine the best midfielder in a football league and the combination of the SAW and ranking normalization methods and the search for TOPSIS solutions is an effective combination in determining the right alternative to find the best midfielder in a football league. SAW and TOPSIS are able to decide on the best alternative by calculating the relative closeness of each alternative. SAW are responsible for normalizing and weighting each criteria and TOPSIS is responsible in determining positive and negative ideal solution using the weighted criteria from SAW method and calcuting the relative closeness based on the positive and negative ideal solution.

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