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Implementation of AHP and TOPSIS In Web-Based Decision Support System For Best Serie A Player 2022/2023

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ABSTRACT

Football is immensely popular worldwide, and Serie A is a top European league that receives significant attention. However, the award for the best player often leads to dissatisfaction due to perceived subjectivity. Increasing competition in Serie A underscores the importance of research on selecting the best player, as such awards are critical for evaluating player performance and team success, which depends on both tactics and individual abilities. The widespread disagreement with announced results highlights the need for a more objective and transparent approach in assessing the best players. This study aims to implement the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) in a web-based decision support system to evaluate the best football player in Serie A for the 2022/2023 season. By considering various relevant criteria, this system provides more measurable and fair results. The analysis determined that Victor Osimhen is the best player with the highest alternative score of 0.55. The study concludes that systematic and objective approaches like AHP and TOPSIS can help determine the best player more fairly and accurately.

KEYWORDS
Football
Serie A Italy
Decision Support System
Analytic Hierarchy Process
Technique for Order of Preferences by Similarity to Ideal Solution

1. Introduction

Football is one of the most popular sports among Indonesians (Asrianda et al., 2019). Fans have diverse views on how a football team plays, influenced by the roles of players, coaches, and strategies during matches. Coaches use specific standards to select players for the starting eleven (Asrianda et al., 2019). Serie A, featuring top clubs like Juventus, AC Milan, and Inter Milan, is one of Europe's most prestigious leagues. It attracts global attention and provides a platform for players to showcase their excellence. Organizers award the best player to those who consistently maintain top performance (Iskandar et al., 2020). Due to intense competition, research on selecting the best players in Serie A is crucial. Best player awards serve as a benchmark for evaluating player performance. Team success depends not only on tactics but also on individual player abilities. Disagreement over announced results highlights the need for a more objective and transparent approach in evaluating the best football players. This research aims to develop a fair and accurate decision support system (DSS) for selecting the best players [1]. The evaluation criteria include goals, assists, yellow cards, key passes, accurate passes, won contests, saves, and goals conceded, based on data from legaseriea.it.

To enhance objectivity in player selection, this study employs the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), proven effective in evaluation and selection contexts. TOPSIS aims to select the best alternative by comparing it to an ideal one, considering all factors [2]. AHP provides consistent evaluation steps and helps determine the importance of criteria [3]. The Waterfall method is used in system development for its linear and sequential process, ensuring clarity and good project management. This method addresses subjectivity in evaluating the best players, offering an analytical and objective foundation for Serie A managers. Implementing a DSS using AHP to weight criteria and TOPSIS to evaluate players based on these criteria offers a novel approach compared to previous studies focused on other leagues or using a single method.

2. Method

2.1. Observation Method

The observation method was used to gain direct insights into the phenomena being studied. This research involved direct observation of Serie A matches during the 2022/2023 season. Observers examined player behavior, playing patterns, and other factors relevant to determining the best player. This observation included aspects such as goals, assists, yellow cards, key passes, accurate passes, won contests, saves, and goals conceded by players during matches.

2.2. Literature Review

The literature review was conducted to gain a deep understanding of theories, conceptual frameworks, and related research findings. Relevant literature includes studies on the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods in decision-making contexts. These sources provide the theoretical foundation for the analysis in this research. Additionally, literature on football player decision-making strategies and influencing factors was analyzed to support the interpretation of observation results.

2.3. System Development Life Cycle

The System Development Life Cycle (SDLC) is a systematic approach to designing, developing, implementing, and maintaining information systems. SDLC ensures that system development is conducted in a structured and efficient manner, minimizing risks and ensuring alignment with user needs. In this context, the Waterfall method is used because it allows for a linear and sequential process, where each phase must be completed before the next one begins. This provides high clarity and structure, facilitating project management and good documentation. The Waterfall method also simplifies supervision and quality control at each stage of development. SDLC serves as a framework to detail the steps of developing the decision support system for selecting the best Serie A football players, as depicted in Figure 1.

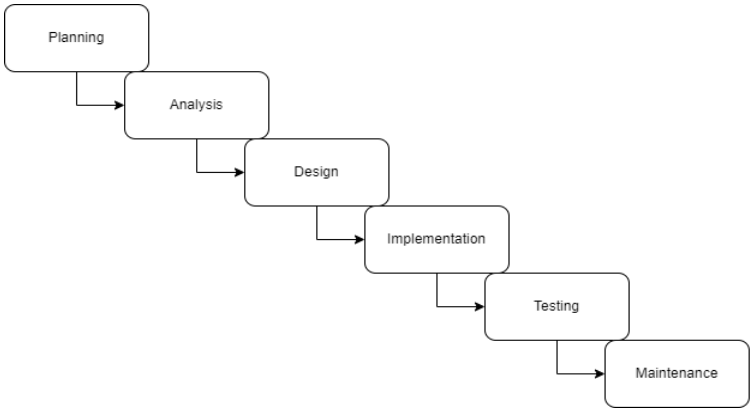

Fig. 1. System Development Life Cycle

- Planning Phase
  - Specify specific requirements of the Decision Support System (DSS) to evaluate the best Serie A football players.
  - Analyze potential risks and constraints that may arise during system development.
- Analysis Phase
  - Determine relevant variables to assess player performance, including techniques, tactics, attitude, and team contributions.
  - Develop the database structure to store and manage Serie A player and match data.
- Design Phase
  - Design an intuitive and responsive user interface for data input and viewing assessment results.
  - Design how the AHP and TOPSIS methods will be integrated into the system.
- Implementation Phase
  - Translate the design into programming code using HTML, CSS, and PHP as the primary languages.
  - Program the implementation of the AHP and TOPSIS methods into the system to determine importance levels and rank players.
- Testing Phase
  - Conduct functional testing to ensure all system features run according to requirements.
  - Test the integration between the AHP and TOPSIS methods to ensure consistency and accuracy of results.
- Maintenance Phase
  - Monitor system performance post-testing and respond to potential issues or required improvements.
  - Update the system according to regulatory changes and fix bugs or identified issues.

This system development follows the SDLC to ensure each phase is meticulously executed and meets user needs. This enables the system to provide added value in evaluating the best Serie A players.

3. Results and Discussion

The Serie A League in Italy is renowned as one of the most prestigious football leagues in Europe, attracting global attention and providing a platform for players to showcase their excellence. Organizers recognize the best players who consistently maintain top performance [4]. With the increasing competitiveness in Serie A football, research on selecting the best players becomes crucial. Individual player abilities are key to a team's success, and the current voting-based player selection system often raises concerns about its objectivity among fans. The issues arising from this system lay the groundwork for the need to implement a new system through the application of the Analytic Hierarchy Process (AHP) as the initial step in criteria weighting.

AHP calculations are used to determine the relative weights of each criterion applied in selecting the best players for the Serie A League's 2022/2023 season. Subsequently, the results from AHP are combined with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method to produce the final ranking of football players. Additionally, this section elaborates on the implementation of the Unified Modeling Language (UML) for system development, which is used to visually design the system's structure and facilitate understanding of the relationships between objects within the system.

3.1. System Design

System design is a crucial stage that ensures the efficient and effective implementation of research methodologies, providing a robust framework for the entire project. The primary focus of designing the best Serie A football player decision support system (DSS) is to seamlessly integrate the Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods into a suitable software platform or environment. This integration involves both the technical aspects of coding and algorithm development, as well as user interface and experience design, ensuring the system is user-friendly, reliable, and capable of processing complex datasets accurately. By carefully crafting the system architecture, we facilitate a more objective and transparent evaluation process, enhancing the credibility and acceptance of the DSS results.

3.1.1. Use Case Diagram

The use case diagram for the decision support system (DSS) for selecting the best players involves users, who could be football coaches or team managers, utilizing the application to evaluate and choose the best players based on predefined criteria. Users input player data, such as individual statistics and team contributions, into the application. The system then performs analysis using the AHP and TOPSIS methods to rank players. This DSS allows users to quickly and efficiently select the best players. The author presents the use case diagram as depicted in Figure 2:

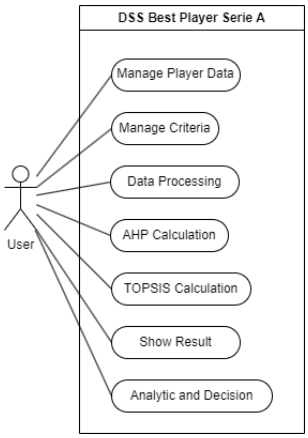

Fig. 2. Use Case Diagram

3.1.2. Sequence Diagram

A sequence diagram is a type of interaction diagram in the Unified Modeling Language (UML) that depicts interactions between objects in a specific scenario of a system. In the system for selecting the best Serie A players, the sequence diagram illustrates how the system interacts with the user:

- The user initiates interaction with the system by entering their ID and password in the Login form. The system responds by sending a request to the Database to validate user data.
- Upon receiving validation, the Website displays. The user sends a request to the database to retrieve Serie A data. Upon receiving the request, the system sends Serie A data display to the user.
- The user sends a request to the website to retrieve criteria data. Upon receiving the request, the system sends the criteria data display.

With the sequence diagram depicted in Figure 3, we can understand how the interaction between the user and the system occurs and how the process of selecting the best players is conducted.

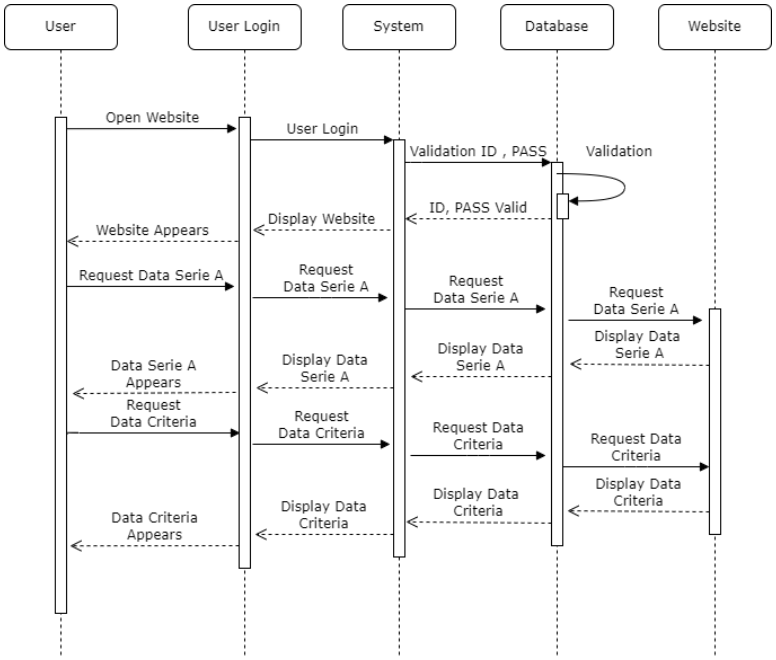

Fig. 3. Squences Diagram

3.1.3. Activity Diagram

This activity diagram illustrates a series of steps performed by the user in utilizing the decision support system to determine the best Serie A player. Figure 4 details the workflow of the system, starting from the user login process, adding player data, to determining the criteria weights required for AHP and TOPSIS analysis.

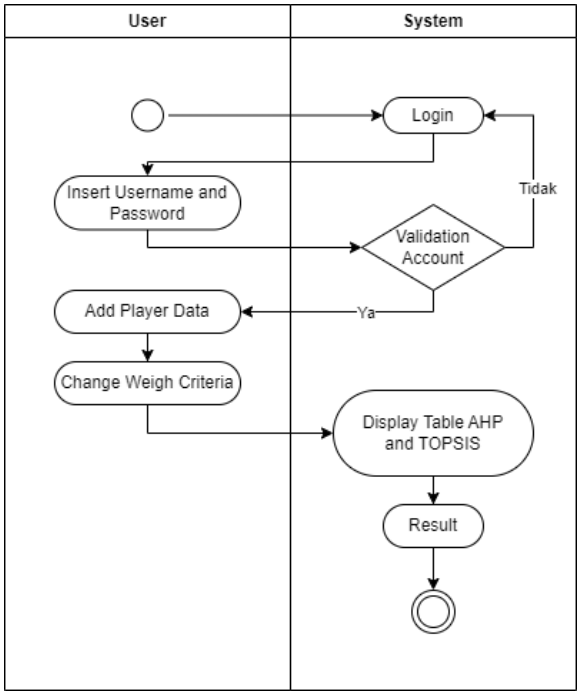

Fig. 4. Activity Diagram

3.2. Implementation

The implementation of the AHP and TOPSIS methods is a crucial step in building the decision support system for selecting the best Serie A football player for the 2022/2023 season. In this implementation phase, the AHP calculation steps are carried out, starting from creating the criteria

comparison matrix to calculating consistency values. After determining the relative weights of each criterion, the TOPSIS method is applied to rank players based on the weighted criteria.

This process begins with normalizing the decision matrix, followed by calculating the positive and negative ideal solutions, and then ranking players based on the Euclidean distance from the ideal solution. By integrating these two methods, the system can provide recommendations for the best players that align with the predefined evaluation criteria, making a significant contribution to the decision-making process of Serie A football teams.

3.2.1. Implementation Of AHP Method

The calculation process using the Analytical Hierarchy Process (AHP) begins with determining the problem hierarchy, where each element and relevant criteria in evaluating the best football players in the Serie A League are identified and prioritized.

- Player Data
  - Player data represents a sample from the entire population of Serie A football players for the 2022/2023 season.
  - The data in Table 1 below can be obtained from the official legaseriea.it website, which includes individual statistics such as goals, assists, appearances, and other relevant factors.

Table 1. Player Data

Name	*Goals*	*Assist*	*Yellow cards*	*Key pass*	*Accurate pass*	*Won contras*	*Saves*	*Conceded*
Oshimen	26	4	4	30	0,71	6	0	0
Provedel	0	0	1	1	0,78	0	100	30
Lukaku	10	6	1	26	0,73	1	0	0
Tomori	1	1	5	8	0,89	34	0	0
Ederson	1	1	4	20	0,82	34	0	0
Smalling	3	1	7	5	0,87	15	0	0
Bremer	4	1	6	8	0,90	20	0	0
Giacomo	5	1	4	33	0,86	23	0	0
Osolini	11	4	6	4 0	0,68	19	0	0
Vanja	0	0	4	1	0,75	0	97	41
Izzo	1	0	10	15	0,88	50	0	0
Wallace	0	1	6	16	0,85	39	0	0
Berardi	12	7	7	38	0,71	14	0	0
Luperto	2	0	4	3	0,87	18	0	0
Dia	16	6	4	29	0,77	5	0	0
Gallo	0	1	3	37	0,69	36	0	0
Montipo	0	0	2	0	0,58	0	126	59
Bourabia	1	3	3	35	0,8	21	0	0
Carnesecchi	0	1	0	1	0,53	0	107	47
Audero	0	0	1	0	0,64	0	84	39

Sources : legaseria.it

- Pairwise Comparison Fundamental Scale

The fundamental scale used to assign comparison values between pairs of criteria is the Saaty scale, consisting of values from 1 to 9 with increasing levels of importance as shown in Table 2.

Table 2. Pairwise Comparison Fundamental Scale

Intensity of Importance	Description
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other
7	One element is significantly more important than the other
9	One element is absolutely more important than the other
2,4,6,8	Values between two adjacent consideration values

Sources : Nirwanto , 2019

- List of Random Index (RI)
  - The Random Index (RI) list is used as a reference to evaluate the consistency of the comparison matrix.
  - RI is a pre-defined value by Saaty based on the size of the comparison matrix, as shown in Table 3.

Table 3. Random Index

No. of Criteria	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49	1,51

Source : Buono & Latif, 2020

- Criteria Comparison Matrix

In this decision-making system for selecting the best players, the weighting is directly performed by the decision-maker, i.e., the system user, by comparing the importance levels between evaluation criteria. The total weight of all criteria in this system is 100%. A higher weight value indicates a higher level of importance of the criteria in decision-making.

The user assigns relative comparison values between pairs of criteria based on the fundamental scale. For example, the author compares the importance of criteria obtained from the values frequently appearing in previous research, as shown in Table 4:

- Recommendation for Selecting the Best Football Players in League X Using TOPSIS Method" by Oki Iskandar, 2020 (Yellow Card, Saves, Assist, Passes, Conceded)
- The Idealposition System: A Decision Support Solution for Determining Ideal Football Players Based on Player Position" by Faisal F. Taran et al., 2020 (Discipline / Yellow Card)
- Decision Support System for Selecting the Football Team Captain Using TOPSIS Method" by Hari Ramdani et al., 2020 (Yellow Card)
- Implementation of Profile Matching Method for Football Player Selection" by Muhammad Seftriyan Rezeki, 2021 (Goal, Saves, Yellow Card, Assist)

Table 4. Criteria Comparison Matrix

Criteria	Goal	Assist	Yellow Card	Keypass	Pass Accurate	Won Contras	Saves	Conceded
Goal	1	2	4	1	1	0,5	2	1
Assist	0,5	1,0	2,0	0,5	0,5	0,25	1,0	0,5
Yellow Card	0,25	0,5	1,0	1,0	1,0	0,5	2,0	1,0
KeyPass	1	2	1	1	1	0,5	2	1
Pass	1	2	1	1	1	0,5	2	1

Accurate								
Won Contras	2	4	2	2	2	1	4	2
Saves	0,5	1,0	0,5	0,5	0,5	0,25	1	0,5
Conceded	1	2	1	1	1	0,5	2	1
Jumlah	7,25	14,50	12,50	8,00	8,00	4,00	16,00	8,00

- Calculation of Eigenvalues and Sum of Eigenvalues
  - a. After the comparison matrix is constructed, the eigenvalues (eigenvector) for that matrix are computed.
  - b. Eigenvalues are vectors that depict the relative weights of each criterion.
  - c. Subsequently, the eigenvalues, sum, and average of the comparison matrix are calculated to normalize the eigenvalues, as shown in Table 5.

Table 5. Eigenvalues

Criteria	Goal	Assist	Keypas	Pass Accurate	Won Contras	Saves	Conceded	Jumlah
Goal	0,138	0,138	0,125	0,125	0,125	0,125	0,125	1,221
Assist	0,069	0,069	0,063	0,063	0,063	0,063	0,063	0,610
Yellow Card	0,034	0,034	0,125	0,125	0,125	0,125	0,125	0,774
KeyPass	0,138	0,138	0,125	0,125	0,125	0,125	0,125	0,981
Pass Accurate	0,138	0,138	0,125	0,125	0,125	0,125	0,125	0,981
Won Contras	0,276	0,276	0,250	0,250	0,250	0,250	0,250	1,962
Saves	0,069	0,069	0,063	0,063	0,063	0,063	0,063	0,490
Conceded	0,138	0,138	0,125	0,125	0,125	0,125	0,125	0,981

- Percentage and Priority Ranking
  - The relative weights of criteria are converted into percentages to demonstrate the relative contribution of each criterion in decision-making.
  - Criteria are prioritized based on their relative weights, from most important to least important, as shown in Table 6.

Table 6. Percentage and Priority Ranking

Criteria	Priority	Percentage Priority	Rank
Won Contras	0,245	25%	1
Goal	0,153	15%	2
KeyPass	0,123	12%	3
Pass Accurate	0,123	12%	3
Conceded	0,123	12%	3
Yellow Card	0,097	10%	4
Assist	0,076	8%	5
Saves	0,061	6%	6
	1,000	100%	

- Calculation of Lambda Max (λMax), CI, and CR
  - Lambda Max (λMax) is calculated using the formula:

$$\sum_{i=1}^{n} (JKi \; x \; BRi)$$

    where:

    JKi is the sum of the columns for the i-th criterion from the comparison matrix table. BRi is the average weight for the i-th criterion, from the priority ranking table.
  - Consistency Index (CI) is calculated as the difference between λMax and the number of criteria, divided by the number of criteria minus one: CI = (8.326 – 8)(8 – 1) = 0.47
  - Consistency Ratio (CR) is the result of dividing the CI value by the RI value to evaluate the consistency of the comparison matrix: CR = 0.47 / 1.41 = 0.33
  - If CR is less than or close to 0.1, then the matrix is considered consistent.
  - The results of the calculations can be seen in Table 7.

Table 7. Consistency Ratio

Lamda *Max*	8,326
CI	0,047
CR	0,033

With these steps, the consistency of the comparison matrix can be evaluated, and the relative weights of each criterion can be objectively determined using the AHP method. The weights obtained from the AHP method can be seen in Table 8 below.

Table 8. Criteria Weight

Goal	***Assist***	***Yellow Card***	***Key pas***	***Pass Accurate***	***Won Contras***	***Saves***	***Conceded***
0,153	0,076	0,097	0,123	0,123	0,245	0,061	0,123

3.2.2. Implementation Of TOPSIS Method

After obtaining the criterion weights from the AHP calculation, the next step is to implement the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. TOPSIS is used to rank players based on their relative proximity to the ideal solution. This process involves data normalization, criterion weighting, and determining the distance of each player from the positive and negative ideal solutions, thereby generating the final rankings of the best players in the Serie A League.

- Creating Normalized Decision Matrix

After weighting the criteria using the AHP method, the first step is to create the normalized decision matrix by dividing each value in the decision matrix by the square root of the sum of squares of each value in the column, using the equation:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

This is done to normalize the data to have a uniform scale for comparison. Below are the results of the normalized decision matrix shown in Table 9.

Table 9. Normalized Decision Matrix Divisor

Goals	*Assist*	*Yellow Cards*	*Key Pass*	*Accurate Pass*	*Won Contras*	*Saves*	*Conceded*
36,810	13,038	21,260	100,946	3,455	100,832	231,927	98,955

The results of the division using the normalised decision matrix divider can be seen in Table 10.

Table 10. Normalized Decision Matrix

Name	Goals	Assist	Yellow Cards	Key Pass	Accurate Pass	Won Contras	Saves	Conceded
Victor Oshimen	0,706	0,307	0,188	0,297	0,206	0,060	0,000	0,000
Ivan Provedel	0,000	0,000	0,047	0,010	0,226	0,000	0,431	0,303
Romelu Lukaku	0,272	0,460	0,047	0,258	0,211	0,010	0,000	0,000
Fikayo Tomori	0,027	0,077	0,235	0,079	0,258	0,337	0,000	0,000
Ederson	0,027	0,077	0,188	0,198	0,237	0,337	0,000	0,000
Chris Smalling	0,081	0,077	0,329	0,050	0,252	0,149	0,000	0,000
Bremer	0,109	0,077	0,282	0,079	0,261	0,198	0,000	0,000
Giacomo Bonaventura	0,136	0,077	0,188	0,327	0,249	0,228	0,000	0,000
Riccardo Osolini	0,299	0,307	0,282	0,396	0,197	0,188	0,000	0,000
Vanja Milinkovic-Savic	0,000	0,000	0,188	0,010	0,217	0,000	0,418	0,414
Armando Izzo	0,027	0,000	0,470	0,149	0,255	0,496	0,000	0,000
Wallace	0,000	0,077	0,282	0,159	0,246	0,387	0,000	0,000
Domenico Berardi	0,326	0,537	0,329	0,376	0,206	0,139	0,000	0,000
Sebastiano Luperto	0,054	0,000	0,188	0,030	0,252	0,179	0,000	0,000
Boulaye Dia	0,435	0,460	0,188	0,287	0,223	0,050	0,000	0,000
Antonino Gallo	0,000	0,077	0,141	0,367	0,200	0,357	0,000	0,000
Lorenzo Montipo	0,000	0,000	0,094	0,000	0,168	0,000	0,543	0,596
Mehdi Bourabia	0,027	0,230	0,141	0,347	0,232	0,208	0,000	0,000
Marco Carnesecchi	0,000	0,077	0,000	0,010	0,153	0,000	0,461	0,475
Emil Audero	0,000	0,000	0,047	0,000	0,185	0,000	0,362	0,394

- Calculating Normalized and Weighted Decision Matrix

The next step is to multiply the normalized decision matrix by the criterion weight matrix using the equation:

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

This is done to assign appropriate weights to each criterion value in the decision matrix, resulting in the weighted normalized decision matrix shown in Table 11.

Table 11. Normalized and Weighted Decision Matrix

Name	Goals	Assist	Yellow Cards	Key Pass	Accurate Pass	Won Contras	Saves	Conceded
Victor Oshimen	0,108	0,023	0,018	0,036	0,025	0,015	0,000	0,000
Ivan Provedel	0,000	0,000	0,005	0,001	0,028	0,000	0,026	0,037
Romelu Lukaku	0,041	0,035	0,005	0,032	0,026	0,002	0,000	0,000
Fikayo Tomori	0,004	0,006	0,023	0,010	0,032	0,083	0,000	0,000
Ederson	0,004	0,006	0,018	0,024	0,029	0,083	0,000	0,000
Chris Smalling	0,012	0,006	0,032	0,006	0,031	0,036	0,000	0,000
Bremer	0,017	0,006	0,027	0,010	0,032	0,049	0,000	0,000
Giacomo Bonaventura	0,021	0,006	0,018	0,040	0,031	0,056	0,000	0,000
Riccardo Osolini	0,046	0,023	0,027	0,049	0,024	0,046	0,000	0,000
Vanja Milinkovic-Savic	0,000	0,000	0,018	0,001	0,027	0,000	0,026	0,051
Armando Izzo	0,004	0,000	0,046	0,018	0,031	0,122	0,000	0,000
Wallace	0,000	0,006	0,027	0,019	0,030	0,095	0,000	0,000
Domenico Berardi	0,050	0,041	0,032	0,046	0,025	0,034	0,000	0,000
Sebastiano Luperto	0,008	0,000	0,018	0,004	0,031	0,044	0,000	0,000
Boulaye Dia	0,066	0,035	0,018	0,035	0,027	0,012	0,000	0,000
Antonino Gallo	0,000	0,006	0,014	0,045	0,024	0,088	0,000	0,000
Lorenzo Montipo	0,000	0,000	0,009	0,000	0,021	0,000	0,033	0,073
Mehdi Bourabia	0,004	0,018	0,014	0,043	0,028	0,051	0,000	0,000
Marco Carnesecchi	0,000	0,006	0,000	0,001	0,019	0,000	0,028	0,058
Emil Audero	0,000	0,000	0,005	0,000	0,023	0,000	0,022	0,048

- Finding the Positive Ideal Solution (Maximum) and Negative Ideal Solution (Minimum)

The positive ideal solution (maximum) is obtained by taking the maximum value from each column in the weighted normalized decision matrix, while the negative ideal solution (minimum) is obtained by taking the minimum value from each column in the weighted normalized decision matrix using the formula:

$$A^*_{j+} = \max(R^*_{ij})$$
$$A^*_{j-} = \min(R^*_{ij})$$

The results of finding the maximum and minimum solutions can be seen in Table 12.

Table 12. Positive Ideal Solution (Maximum) and Negative Ideal Solution (Minimum)

	Goals	*Assist*	*Yellow Cards*	*Key Pass*	*Accurate Pass*	*Won Contras*	*Saves*	*Conceded*
MAX	0,108	0,041	0,000	0,049	0,032	0,122	0,033	0,000
MIN	0,000	0,000	0,046	0,000	0,019	0,000	0,000	0,073

- Calculating the Distance of Alternatives to the Positive and Negative Ideal Solutions

After obtaining the positive and negative ideal solutions, the next step is to calculate the distance of each alternative to the positive and negative ideal solutions. This distance can be calculated using the Euclidean distance metric:

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(A_{j^+}^* - X_{ij})^2}$$
$$D_i^- = \sqrt{\sum_{j=1}^{n}(A_{j^-}^* - X_{ij})^2}$$

The table below (Table 13) displays the results of calculating the Euclidean distance metric between each player and the ideal preferences.

Table 13. Distance of Alternatives

Player Name	D+	D-
Victor Oshimen	0,116	0,141
Ivan Provedel	0,178	0,061
Romelu Lukaku	0,142	0,105
Fikayo Tomori	0,129	0,114
Ederson	0,125	0,117
Chris Smalling	0,147	0,085
Bremer	0,135	0,093
Giacomo Bonaventura	0,121	0,107
Riccardo Osolini	0,109	0,113
Vanja Milinkovic-Savic	0,183	0,044
Armando Izzo	0,129	0,144
Wallace	0,128	0,123
Domenico Berardi	0,115	0,114
Sebastiano Luperto	0,145	0,091
Boulaye Dia	0,124	0,115
Antonino Gallo	0,124	0,127
Lorenzo Montipo	0,190	0,049
Mehdi Bourabia	0,133	0,106
Marco Carnesecchi	0,183	0,056
Emil Audero	0,182	0,053

- Arranging Alternatives Based on Preference Results

The preference results of each alternative can be used to arrange the alternatives from best to worst. The alternative with the highest preference score is considered the best solution. The table below (Table 14) displays the arrangement of alternatives based on preference results.

Table 14. Alternatives Based on Preference

Alternatives	Preference	Rank
Victor Oshimen	0,549	1
Armando Izzo	0,528	2
Riccardo Osolini	0,511	3
Antonino Gallo	0,506	4
Domenico Berardi	0,498	5
Wallace	0,492	6
Ederson	0,484	7
Boulaye Dia	0,481	8
Fikayo Tomori	0,469	9
Giacomo Bonaventura	0,469	10
Mehdi Bourabia	0,444	11
Romelu Lukaku	0,426	12
Bremer	0,407	13
Sebastiano Luperto	0,385	14
Chris Smalling	0,367	15
Ivan Provedel	0,256	16
Marco Carnesecchi	0,234	17
Emil Audero	0,226	18
Lorenzo Montipo	0,206	19
Vanja Milinkovic-Savic	0,195	20

With these steps, the author can implement the TOPSIS method to select the best football player based on the weighting of criteria from the AHP method.

3.3. Website Display

The display of this research website is described regarding the integration and management of images from the created web. This is important to ensure an attractive and optimal visual display for users.

- Login Page

The first page that appears when the website is launched is the Login page, as seen in Figure 5. This page serves as the gateway to the system, ensuring that only authorized users can access the various features and functionalities of the decision support system. Users are required to identify themselves by entering their username and password, which must have been previously registered in the system's database. This authentication process is crucial for maintaining the security and integrity of the system, preventing unauthorized access and protecting sensitive data. The design of the Login page typically includes fields for username and password input.

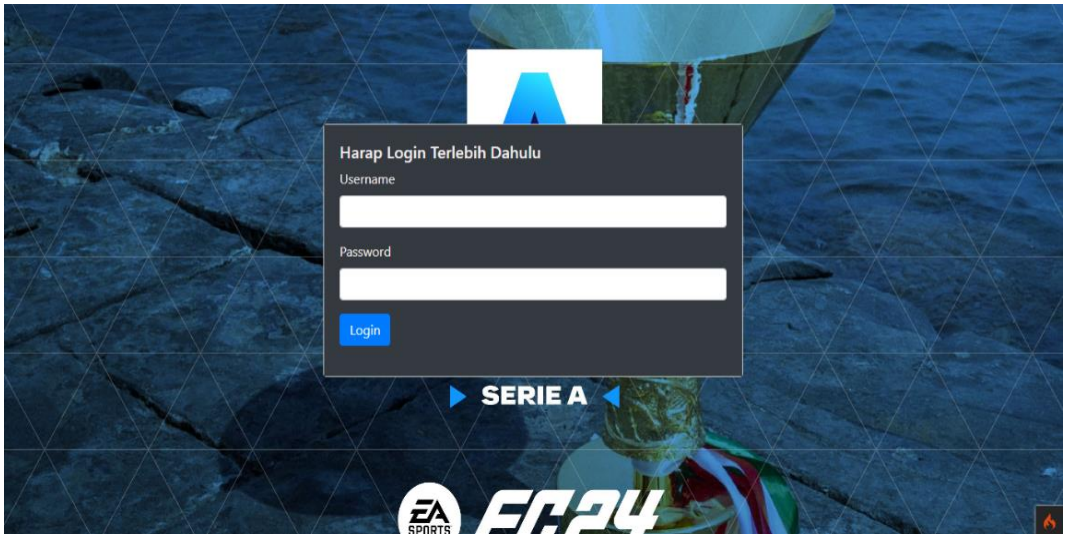

Fig 5. Login Page

- Home Page

  After successfully logging in, users are directed to the main page of the website. The main page of the best Serie A player decision support system application displays summary information about the system, providing users with an overview of its functionalities and purpose. This central hub serves as the starting point for users to navigate to other important sections, such as player rankings, evaluation criteria, and detailed analysis reports. The interface is designed to be intuitive and user-friendly, ensuring that users can easily find the information they need and perform necessary actions without confusion. The Home page display, as illustrated in Figure 6, includes essential navigation links, a welcome message, and an overview of the data of Serie A and player performance. This layout helps users to quickly orient themselves within the system and efficiently access its various features and tools.

Fig 6. Home Page

- Player List Page

  Through the Serie A Data navbar menu, which when clicked leads to the Serie A player data page. This page, as seen in figure 7, displays a complete list of players registered in the database, along with detailed statistical information for each player such as name, goals, assists, yellow

cards, and others. On this page, there is a button to add player data which displays a form for adding player data to the database.

Fig 7. Player List Page

- Add Player Data Page

By clicking the add player data button on the player list page, users are directed to the add player data page. Users can use this page to add new player data to the system by entering the required information, such as player name and statistics. The Add Player Data page display can be seen in figure 8.

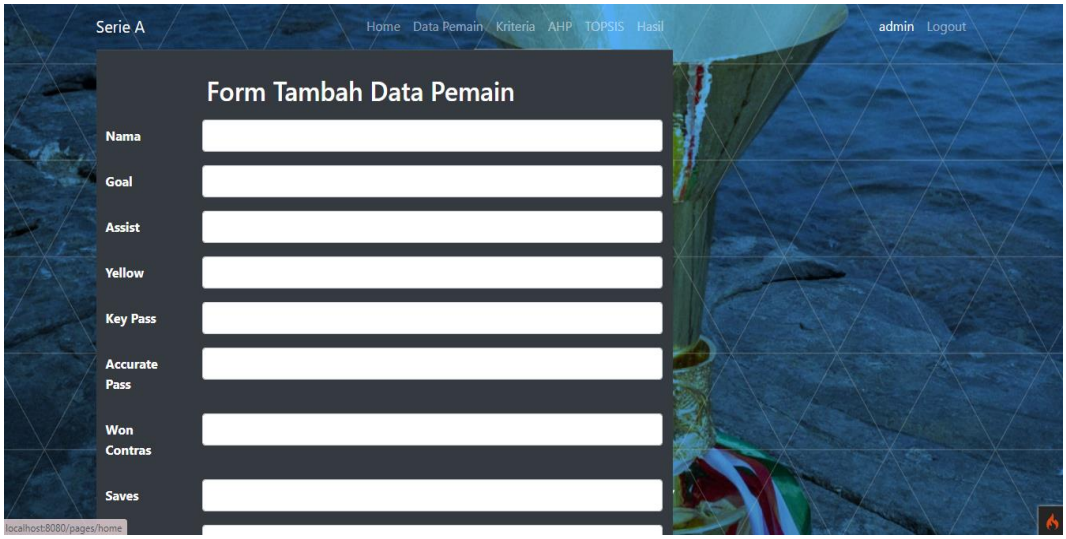

Fig 8. Add Player Data Page

- Criteria Page

This page contains a list of criteria or factors used in the player evaluation process, such as goals, assists, yellow cards, and others. Users may view and manage the criteria listed here. The Criteria page display can be seen as in figure 9 below.

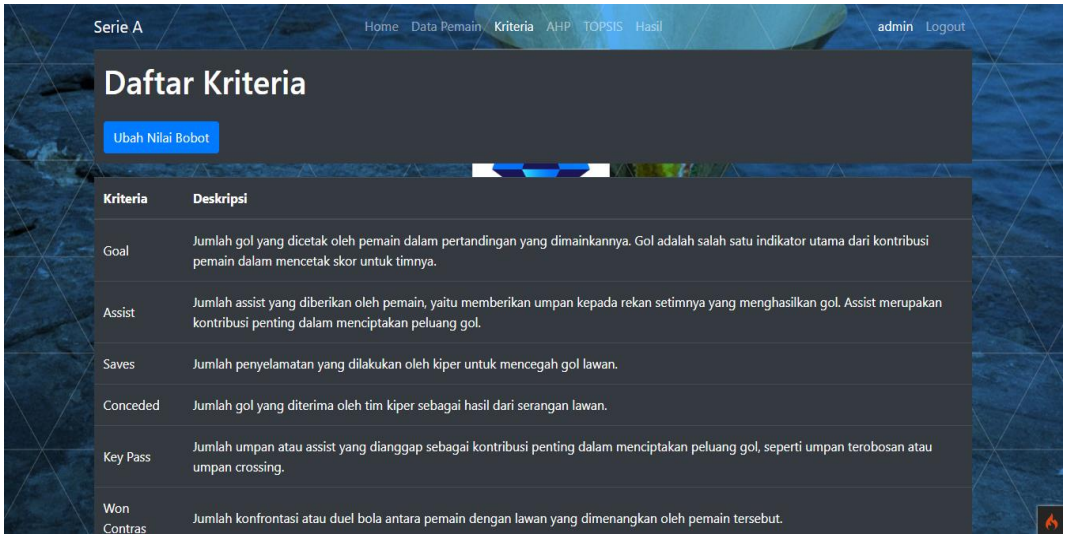

Fig 9. Criteria Page

- Modify Criteria Weight Page

  Users can access this page through the modify criteria weight button on the criteria page to adjust the relative weight of each criterion used in the system. This allows users to customize the importance of each criterion in the evaluation process. The Modify Criteria Weight page display can be seen as in figure 10.

Fig 10. Modify Criteria Weight Page

- AHP Page

  This page contains a calculation table that allows users to analyze the Analytic Hierarchy Process (AHP) method in determining the best player based on pre-defined criteria. The AHP page display can be seen in figure 11.

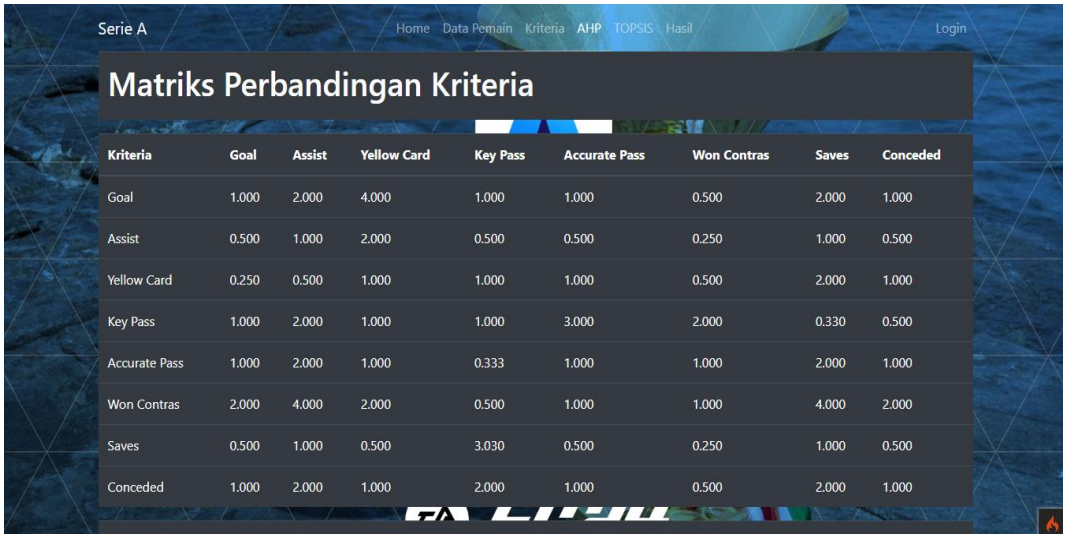

Fig 11. AHP Page

- Topsis Page

  This page contains a table that allows users to analyze the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method, a method for selecting the best alternative from a set of alternatives based on predefined criteria as shown in figure 12 below.

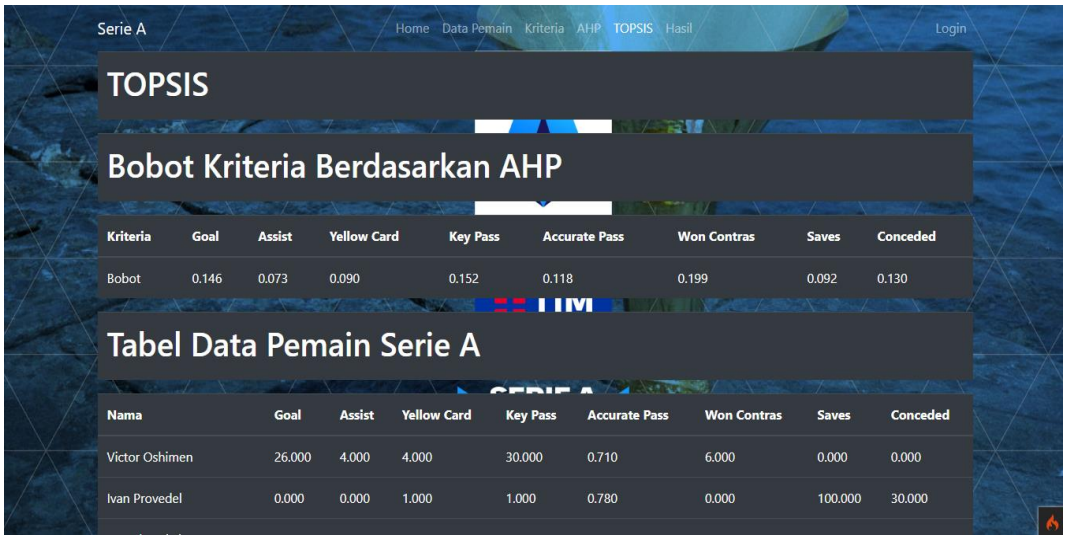

Fig 12. TOPSIS Page

- Results Page

  This page displays the final results of the evaluation process, including player rankings based on the analysis conducted using the AHP and TOPSIS methods. This provides an overview of the best players based on the established criteria. It can be seen in figure 13 below.

Fig 13. Results Page

3.4. Funtionality Testing

The testing of this research system utilizes the Blackbox testing method, where the author's primary focus is to ensure that the system can effectively handle unforeseen situations or errors that may occur during usage. One aspect that the author scrutinizes is the system's ability to respond to errors correctly, including displaying informative error messages and directing users to appropriate actions to resolve the issue. In this testing phase, the author explores various error scenarios to ensure that the system behaves as expected in addressing less-than-ideal situations. The results of error handling testing can be seen in table 15.

Table 15. Functionality Testing

No	Testing	Tested system components	Test Scenarios	Expected Results	System Results	Test Result
1	Normal	Form Login	Input Registered Username and Password	Diplay Home Page	Display Home Page	Accepted
	Wrong	Form Login	Input Wrong Username and Password	An error message appears	An error message appears	Accepted
2	Normal	Navbar	- Klik link menu - Responsif display menu - Navigation dropdown	- Appropriate menu page appears - Responsive menu of various window sizes - The dropdown menu can be accessed properly	- Appropriate menu page appears - Responsive menu of various window sizes - The dropdown menu can be accessed properly	Accepted
	Wrong	Navbar	- Link problem - Unresponsive hidden menu - Dropdown navigation	- Displays a 404 error page - Menu can be accessed without CSS - Dropdown does not appear without being clicked	- Displays a 404 error page - Menu can be accessed without CSS - Dropdown does not appear without being clicked	Accepted
3	Normal	Button Add/Save Player Data	- Click the add new player data button - Enter valid information	- Add player data page appears - Data added/saved successfully	- Add player data page appears - Data added/saved successfully	Accepted

	Wrong	Button Add/Save Player Data	Click the button without filling in the data	An error message appears	An error message appears	Accepted
4	Normal	Delete Button in Player Page	Click the Delete button	- A confirmation message appears - Data in the database is deleted according to the ID if you select Yes - The message "Data deleted successfully."	- A confirmation message appears - Data in the database is deleted according to the ID if you select Yes - The message "Data deleted successfully."	Accepted
	Wrong	Delete Button in Player Page	Click the Delete button	- A confirmation message appears - Data in the database will not be deleted if you select no	- A confirmation message appears - Data in the database will not be deleted if you select no	Accepted
5	Normal	Logout Button in Navbar	Click the Logout button	- User is redirected to login page - Cannot access the page without logging in	- User is redirected to login page - Cannot access the page without logging in	Accepted
	Wrong	Logout Button in Navbar	Click the Logout button	- Users are not redirected to the login page - Can access the page without logging in	- Users are not redirected to the login page - Can access the page without logging in	Accepted

3.5. Validity Testing

The author conducted validity testing referring to the journal (Muqorobin et al., 2019) based on the comparison between manual calculations using Microsoft Excel and calculations performed by the implemented system using the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. This validity testing aims to ensure that the results produced by the system are consistent and comparable to manual calculations, thereby serving as a basis for decision-making in determining the best player in Serie A league. The results of the validity testing can be seen in table 16 below..

Table 16. Validity Testing

No	Name	Manual Preference	Manual Results	System Preferences	System Results	Validity
1	Victor Oshimen	0,549	1	0,550	1	Matching
2	Armando Izzo	0,528	2	0,527	2	Matching
3	Riccardo Osolini	0,511	3	0,512	3	Matching
4	Antonino Gallo	0,506	4	0,506	4	Matching
5	Domenico Berardi	0,498	5	0,499	5	Matching
6	Wallace	0,492	6	0,490	6	Matching
7	Ederson	0,484	7	0,483	7	Matching
8	Boulaye Dia	0,481	8	0,481	8	Matching
9	Fikayo Tomori	0,469	9	0,468	9	Matching
10	Giacomo Bonaventura	0,469	10	0,568	10	Matching
11	Mehdi Bourabia	0,444	11	0,443	11	Matching
12	Romelu Lukaku	0,426	12	0,426	12	Matching

13	Bremer	0,407	13	0,405	13	Matching
14	Sebastiano Luperto	0,385	14	0,383	14	Matching
15	Chris Smalling	0,367	15	0,365	15	Matching
16	Ivan Provedel	0,256	16	0,254	16	Matching
17	Marco Carnesecchi	0,234	17	0,235	17	Matching
18	Emil Audero	0,226	18	0,225	18	Matching
19	Lorenzo Montipo	0,206	19	0,206	19	Matching
20	Vanja Milinkovic-Savic	0,195	20	0,193	20	Matching

4. Conclusion

Based on the research conducted, it can be concluded that the implementation of the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) in a decision support system (DSS) to evaluate and rank the best Serie A players for the 2022/2023 season, based on the sample data collected, resulted in the following preferences: No.1 Victor Osimhen, No.2 Armando Izzo, and No.3 Ricardo Orsolini. The combination of these two methods provides a robust framework to address the complexities in evaluating relevant criteria and producing accurate player rankings.

This research makes a significant contribution to the development of player evaluation methods in the football industry. The results obtained offer valuable insights for club management, coaches, and fans in understanding the contributions and performance of players throughout the Serie A season. Additionally, the use of AHP and TOPSIS methods in this context can provide a new perspective on decision-making in the sports industry in general.

The validity testing results indicate that the system implemented using AHP and TOPSIS methods produced values identical to manual calculations performed using Microsoft Excel. Thus, it can be concluded that the system has provided accurate and valid results.

Despite the significant findings of this research, there are some limitations that need to be considered. One of the main limitations is the availability of comprehensive and consistent player performance data. Furthermore, the use of AHP and TOPSIS methods can also be influenced by the subjectivity in determining the criteria weights by experts.

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