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An AHP–TOPSIS-Based Decision Support System for Objective Pencak Silat Athlete Selection at KONI Lamongan

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Abstract – Sports achievement development requires an objective and measurable athlete selection mechanism, particularly in regional sports organizations preparing for competitive events. However, the athlete selection process conducted by Komite Olahraga Nasional Indonesia (KONI) Kabupaten Lamongan for the Pencak Silat branch in preparation for PORPROV Jawa Timur IX 2025 still relied on subjective weighting, namely 40% physical test and 60% achievement certificate assessment, potentially causing decision bias. Therefore, this study developed a Decision Support System (DSS) integrating Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The combination was chosen because AHP determines consistent criterion weights from expert judgments, while TOPSIS effectively ranks alternatives based on their proximity to ideal solutions. The study involved 26 athlete candidates, nine physical performance criteria, and seven expert respondents. The results showed that Sprint 30m, Illinois Agility, Stork Stand, Standing Broad Jump, and Beep Test obtained the highest priority weights (14.94%). The Consistency Ratio (CR) was 0.0018, indicating reliable judgments. TOPSIS identified Sastro Hadi Saputro as the top-ranked athlete (Ci = 0.8954). System rankings also showed strong agreement with coach evaluations (Spearman = 0.9945; Pearson = 0.9863). These findings demonstrate that the AHP–TOPSIS framework improves transparency and reduces subjectivity in athlete selection.

Keywords – Decision Support System, AHP, TOPSIS, Athlete Selection, Pencak Silat, Multi-Criteria Decision Making.

I. INTRODUCTION

Sports achievement has become an important indicator in regional development, not only in relation to institutional prestige but also as part of long-term human resource development through structured athlete coaching [1];[2]. In this context, Komite Olahraga Nasional Indonesia (KONI) Kabupaten Lamongan carries a strategic responsibility in preparing competitive contingents for the East Java Provincial Sports Week (PORPROV) IX 2025. Among the prioritized sports, pencak silat occupies a significant position due to its strong athlete regeneration system and considerable medal potential [3]. The success of competitive sports development is closely associated with the quality of athlete selection, since the selection stage determines the composition of athletes who will represent the region in high-level competitions [4];[5].

Despite its strategic role, the athlete selection process conducted by KONI Kabupaten Lamongan still encounters several issues related to assessment objectivity and consistency. The current mechanism relies on two primary assessment components, namely physical performance tests weighted at 40% and achievement certificates weighted at 60%. However, the determination of these proportions remains largely based on managerial assumptions rather than on scientifically validated weighting procedures. This condition becomes increasingly problematic considering the diversity of athlete profiles involved in the selection process. The candidate pool consists of 25 athletes with varying levels of physical capability, competition experience, and achievement records, creating a complex decision-making environment that cannot be adequately addressed through conventional judgment alone.

Preliminary findings obtained through interviews with the Vice Secretary II of KONI Kabupaten Lamongan on 12 November 2025 revealed a fundamental weakness within the current selection mechanism. The dominance of achievement certificates in the assessment structure tends to disadvantage newcomer athletes who demonstrate outstanding physical performance but possess limited competitive experience [6]. Consequently, athletes with declining physical conditions may still receive higher evaluations solely because of previously accumulated certificates [7];[8]. Such conditions indicate that the existing weighting mechanism has not fully represented the actual performance potential required for current competitive demands. The issue of weighting imbalance therefore becomes an urgent concern, particularly in ensuring that the selection process remains adaptive, fair, and performance-oriented.

From an academic perspective, determining criterion weights within athlete selection is not merely a technical issue but also a substantial problem in decision-making and sports management studies [9];[10]. In multi-criteria decision environments, inappropriate weighting structures may generate biased recommendations and reduce the validity of final decisions [11]; [12]. This issue becomes increasingly critical in sports selection systems where assessment outcomes directly influence athlete opportunities and organizational strategies. Previous studies have also emphasized that subjectivity frequently emerges in athlete evaluations due to the large number of participants and the complexity of performance indicators, thereby requiring decision support mechanisms capable of improving consistency and transparency in the assessment process [13]; [14].

Several previous studies have explored the implementation of Decision Support Systems (DSS) using Multi-Criteria Decision Making (MCDM) approaches for athlete selection [15];[16]. Research demonstrated that the integration of Analytic Hierarchy Process (AHP) and

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Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was capable of improving objectivity in pencak silat athlete selection [17];[18]. Similar findings were also reported in studies utilizing TOPSIS for ranking athlete candidates in competitive sports environments [4]. Nevertheless, most previous studies were conducted in broader competition settings and did not specifically address the weighting imbalance between physical performance and achievement certificates within regional athlete development systems. In addition, earlier studies generally focused on technical ranking procedures without sufficiently accommodating the practical needs of local sports organizations facing disparities between experienced athletes and physically superior newcomers [10];[19] These limitations indicate that further investigation is still required to develop a more adaptive and context-relevant weighting model for athlete selection at the regional level.

To address these issues, this study proposes the implementation of a Decision Support System based on the Multi-Criteria Decision Making (MCDM) approach through the integration of Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). AHP was selected due to its capability in decomposing complex decision problems into hierarchical structures and transforming expert judgments into measurable criterion weights. Previous studies have shown that AHP contributes to more controlled managerial processes and improves the quality of decision-making compared with conventional approaches [20]. Furthermore, TOPSIS was employed to rank athlete candidates based on their relative distances from positive and negative ideal solutions. The method is particularly suitable for competitive selection environments because it identifies alternatives with the closest proximity to ideal conditions while simultaneously maximizing their distance from undesirable conditions [17].

Accordingly, this study aims to develop a Decision Support System for pencak silat athlete selection in the preparation of PORPROV Jawa Timur IX 2025 by integrating AHP and TOPSIS methods. The AHP method is utilized to determine criterion weights systematically based on expert evaluations, while TOPSIS is employed to rank athlete candidates according to their performance proximity to ideal solutions. Through this approach, the study is expected to provide a more objective, transparent, and measurable athlete selection mechanism that can support strategic decision-making within KONI Kabupaten Lamongan.

II. RESEARCH METHODOLOGY

This study employed a mixed-methods approach using an exploratory sequential design to integrate qualitative expert judgment with quantitative computational analysis [21];[22]. The qualitative phase was conducted to identify relevant selection criteria and understand practical considerations within the athlete selection process at Komite Olahraga Nasional Indonesia (KONI) Kabupaten Lamongan. Subsequently, the quantitative phase was performed to calculate criterion weights and rank athlete candidates using the integration of Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). This approach was selected to ensure that the resulting decision model was not only mathematically measurable but also empirically aligned with real conditions in regional athlete development.

The object of this study focused on the selection process of pencak silat athletes prepared for PORPROV Jawa Timur IX 2025. The alternatives evaluated in the system consisted of 25 athlete candidates from IPSI KONI Kabupaten Lamongan. In addition, seven experts were purposively selected as respondents in the weighting process, comprising representatives from KONI management, senior coaches, and the Monitoring and Evaluation (MONEV) team. The involvement of multiple expert groups was intended to obtain balanced judgments reflecting managerial, technical, and performance evaluation perspectives.

Data collection involved both primary and secondary data sources. Primary data were obtained through semi-structured interviews and pairwise comparison questionnaires based on the Saaty scale [23];[24]. Interviews were conducted to identify relevant selection criteria and to examine weaknesses in the existing selection mechanism [25];[26]. Meanwhile, the pairwise comparison questionnaires were distributed to experts to assess the relative importance among criteria and sub-criteria [27]. Secondary data consisted of athlete performance records, including physical test results and achievement certificate documents obtained from IPSI KONI Kabupaten Lamongan. The physical assessment criteria included strength, speed, power, endurance, agility, coordination, balance, and aerobic capacity, which were considered essential indicators in pencak silat performance evaluation. The criteria and sub-criteria used in the athlete selection process were determined based on expert discussions and physical assessment standards applied by IPSI KONI Kabupaten Lamongan. The details of the evaluation criteria are presented in Table 1 [28].

Table 1. Criteria and Attributes Used in Athlete Selection

Criteria	Sub-Criteria	Attribute	Measurement Scale	Data Source
Physical Test	Strength	Benefit	Strength score	Physical test results
Physical Test	Speed	Benefit	Time (seconds)	Physical test results
Physical Test	Power	Benefit	Power score	Physical test results
Physical Test	Endurance	Benefit	Endurance score	Physical test results
Achievement	Competition Certificate	Benefit	Competition level	IPSI/KONI documents

The identified criteria were subsequently processed using the AHP method to determine criterion weights before the TOPSIS ranking stage. The overall research procedure implemented in this study is illustrated in Figure 1.

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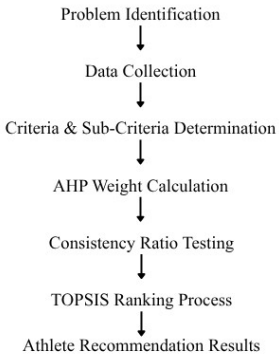

Figure. 1 Research Framework of AHP–TOPSIS Athlete Selection System

Based on the research framework shown in Figure 1, the study began with problem identification and data collection, followed by the determination of criteria and sub-criteria for athlete evaluation. The AHP method was subsequently applied to obtain criterion weights, while TOPSIS was employed to generate athlete rankings and recommendation results.

The Analytical Hierarchy Process (AHP) method was applied to determine criterion weights systematically. The process began with the construction of pairwise comparison matrices based on expert judgments using the Saaty scale ranging from 1 to 9[29];[30]. Since multiple experts were involved, the judgments were aggregated using the geometric mean method to obtain a collective assessment. The matrices were subsequently normalized to calculate the priority weights of each criterion and sub-criterion [31]. To ensure logical consistency in expert judgments, consistency testing was conducted using the Consistency Index (CI) and Consistency Ratio (CR)[32]. The comparison matrix was considered acceptable when the CR value was less than or equal to 0.10, indicating that the judgments were sufficiently consistent for decision-making purposes [33]; [34]; [35].

After obtaining the criterion weights from AHP, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was implemented to rank athlete candidates. The TOPSIS procedure began with the construction of a decision matrix representing athlete performance scores across all evaluation criteria. The matrix was then normalized to eliminate scale differences among criteria before being multiplied by the corresponding AHP weights to produce a weighted normalized matrix. Based on this matrix, positive ideal solutions and negative ideal solutions were identified to represent the best and worst possible conditions for each criterion [36]; [37]. Euclidean distance calculations were subsequently performed to measure the relative proximity of each athlete candidate to both ideal solutions. The final preference value was calculated to determine athlete rankings, where higher preference values indicated greater eligibility for recommendation in the PORPROV Jawa Timur IX 2025 preparation process.

The integrated AHP–TOPSIS framework was implemented within a web-based Decision Support System to facilitate data processing and recommendation generation. System evaluation was conducted by comparing the recommendation results produced by the proposed model with the conventional selection mechanism previously applied by KONI Kabupaten Lamongan. This evaluation aimed to assess the extent to which the proposed system improved objectivity and consistency in athlete selection.

III. RESULTS AND DISCUSSION

This study implemented an integrated Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) framework to support the athlete selection process conducted by Komite Olahraga Nasional Indonesia (KONI) Kabupaten Lamongan in preparation for PORPROV Jawa Timur IX 2025. The proposed system was developed to overcome the limitations of the conventional athlete selection mechanism, which predominantly relied on subjective assessment and static weighting assumptions. Through the integration of Multi-Criteria Decision Making (MCDM) methods, qualitative expert judgment was transformed into a measurable and systematic computational model capable of generating more transparent and accountable selection recommendations.

A total of 26 athlete candidates consisting of 13 male athletes and 13 female athletes participated in the evaluation process. Athlete performance data were obtained from standardized physical tests conducted by KONI Lamongan, covering nine primary criteria, namely Push up (PU), Sit up (SU), Sprint 30m (S30), Illinois Agility (IA), Core Stability (CS), Stork Stand (SS), Standing Board Jump (SBJ), Handwall Toss (HT), and Beep Test (BT) [38]. These criteria were selected because they represent the dominant physical components required in pencak silat competitions, including muscular endurance, agility, balance, explosive power, coordination, speed, and aerobic endurance.

The first stage of analysis involved determining criterion weights using the AHP method. Seven expert respondents consisting of KONI management representatives, senior coaches, and Monitoring and Evaluation (MONEV) personnel participated in the pairwise comparison assessment process. The resulting judgments were aggregated using the geometric mean approach to obtain a collective organizational perspective regarding the strategic importance of each physical criterion. The pairwise comparison matrix generated from expert assessments is presented in Table 2 [38].

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Table 2. Criteria and Attributes Used in Athlete Selection

Criteria	PU	SU	S30	IA	CS	SS	SBJ	HT	BT
Push up (PU)	1	1	0,33	0,33	0,5	0,33	0,33	0,5	0,33
Sit up (SU)	1	1	0,33	0,33	0,5	0,33	0,33	0,5	0,33
Sprint 30m (S30)	3	3	1	1	2	1	1	2	1
Illinois Agility (IA)	3	3	1	1	2	1	1	2	1
Core Stability (CS)	2	2	0,5	0,5	1	0,5	0,5	1	0,5
Stork Stand (SS)	3	3	1	1	2	1	1	2	1
Stand Board Jump (SBJ)	3	3	1	1	2	1	1	2	1
Handwall Toss (HT)	2	2	0,5	0,5	1	0,5	0,5	1	0,5
Beep Test (BT)	3	3	1	1	2	1	1	2	1

The matrix analysis demonstrates a strong tendency among experts to prioritize dynamic physical performance indicators over static muscular endurance variables. Criteria associated with speed, agility, balance, explosive power, and aerobic endurance consistently received higher relative importance values compared with Pushup and Situp. This finding indicates that pencak silat athlete performance is perceived to depend primarily on explosive movement capability, rapid directional transitions, cardiovascular endurance, and body stability rather than isolated upper-body strength alone.

From a sports science perspective, these findings are highly relevant to the characteristics of pencak silat competitions, which require athletes to maintain mobility, reaction speed, and endurance during continuous combat situations. Consequently, the weighting structure generated through expert judgment reflects the practical demands of competitive performance rather than merely emphasizing general physical fitness indicators [29];[39]. Based on the pairwise comparison matrix, normalization and eigenvector calculations were subsequently performed to determine the final priority weights of each criterion. The resulting criterion weights are presented in Table 3 [40].

Table 3. Priority Weights of Athlete Selection Criteria

Numb	Criteria	Weight (W)	Persentase (%)
1	Sprint 30m (/s)	0,1494	14,94%
2	Illinois Agility (/s)	0,1494	14,94%
3	Stork Stand	0,1494	14,94%
4	Standing Board Jump (cm)	0,1494	14,94%
5	Beep Test	0,1494	14,94%
6	Core Stability (/s)	0,0797	7,97%
7	Handwall Toss	0,0797	7,97%
8	Push up	0,0467	4,67%
9	Sit up	0,0467	4,67%
Total		**1**	**100%**

The results in Table 3 indicate that Sprint 30m, Illinois Agility, Stork Stand, Standing Board Jump, and Beep Test obtained the highest priority values, each contributing 14.94% to the overall evaluation model. The dominance of these criteria confirms that the experts considered speed, agility, balance, explosive power, and cardiovascular endurance as the primary determinants of athlete competitiveness within the KONI Lamongan pencak silat selection framework.

In contrast, Push up and Sit up received the lowest weights at 4.67%, suggesting that muscular endurance of the upper body and abdominal region was considered less decisive in comparison with dynamic movement-oriented variables. Scientifically, this weighting structure demonstrates that athlete evaluation in combat sports requires multidimensional physical analysis emphasizing movement efficiency and physiological sustainability rather than isolated muscular capacity alone.

The validity of the weighting process was further evaluated through consistency testing. The AHP computation produced a maximum eigenvalue (λmax) of 9.0205, a Consistency Index (CI) value of 0.0026, and a Consistency Ratio (CR) value of 0.0018. Since the resulting CR value was substantially lower than the acceptable threshold of 0.10, the expert judgments were considered logically consistent and mathematically reliable. This result is important because inconsistency in pairwise comparisons may reduce the stability and credibility of decision-support recommendations. Therefore, the low inconsistency value obtained in this study strengthens the validity of the proposed weighting model for athlete selection applications.

After obtaining the criterion weights, the TOPSIS method was applied to evaluate and rank all athlete candidates. TOPSIS was selected because of its capability to identify alternatives possessing the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution simultaneously. Within the context of athlete selection, this approach enables the system to identify athletes demonstrating balanced overall performance rather than athletes who excel only in isolated criteria. The TOPSIS ranking results for the ten highest-performing athlete candidates are presented in Table 4.

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Table 4. TOPSIS Ranking Results of Athlete Candidates

Numb	Athlete's Name	Gender	D+	D-	Preference Value Ci	Rank
1	Sastro Hadi Saputro	Male	0,002	0,0175	0,8954	1
2	Hegar Marga Birawa	Male	0,0022	0,0173	0,8886	2
3	Bagus Prayetno	Male	0,0024	0,017	0,8749	3
4	M. Shofar Habibur Rochman	Male	0,0041	0,0156	0,794	4
5	Famay Ahmad Al-Silmi	Male	0,0047	0,0148	0,7586	5
6	Mohammad Waliyullah	Male	0,0048	0,0147	0,7523	6
7	Ahmat Rendi Saputra	Male	0,0055	0,0139	0,7157	7
8	Mohammad Zidan Rizki	Male	0,0068	0,0129	0,655	8
9	Khulafaur Rosidin	Male	0,0074	0,0122	0,6209	9
10	Muktar Efendi	Male	0,008	0,0116	0,5933	10

The results presented in Table 4 indicate that Sastro Hadi Saputro achieved the highest preference value (Ci = 0.8954), indicating that this athlete possessed the closest proximity to the positive ideal solution and the greatest overall performance balance among all evaluated candidates. Similar performance patterns were also observed for Hegar Marga Birawa and Bagus Prayetno, who consistently demonstrated strong performance across dominant criteria such as speed, agility, explosive power, and endurance.

An important finding emerging from the ranking analysis is that the proposed AHP–TOPSIS framework generated noticeable ranking shifts compared with the conventional selection mechanism previously implemented by KONI Lamongan. Several athletes with strong physical performance but relatively limited achievement records experienced ranking improvements within the proposed framework. Conversely, athletes relying predominantly on historical achievements but demonstrating lower physical readiness tended to experience ranking declines.

This finding indicates that the reconstruction of criterion weighting significantly influences fairness within athlete selection systems. From a practical perspective, the proposed framework provides greater opportunities for newcomer athletes to compete objectively based on current performance quality rather than historical administrative advantages alone. Such findings are particularly relevant for regional sports development systems where athlete regeneration frequently becomes constrained by the dominance of senior athletes possessing accumulated competition certificates.

The validity of the proposed system was further examined by comparing computational ranking outcomes with manual evaluations performed by senior coaches. The comparison produced a Spearman correlation coefficient of 0.9945 and a Pearson correlation coefficient of 0.9863, indicating an extremely high level of agreement between the system-generated rankings and expert evaluation results. In addition, the ranking similarity accuracy reached 84.62%, demonstrating that the proposed system was capable of reproducing professional decision-making patterns while simultaneously minimizing subjective bias. Compared with previous studies, the present research contributes additional insight regarding the strategic importance of weighting reconstruction within MCDM-based athlete selection systems. Earlier studies involving AHP and TOPSIS integration generally focused on technical implementation and ranking optimization without specifically examining the imbalance between physical readiness and historical achievement indicators. In contrast, this study demonstrates that weighting structure itself represents a critical variable capable of influencing athlete opportunity distribution and organizational fairness.

From a managerial perspective, the implementation of the proposed Decision Support System contributes to more transparent and accountable athlete management practices. Coaches and management personnel are able to evaluate athlete performance using measurable indicators supported by mathematical computation rather than relying predominantly on intuition or personal preference. Furthermore, the flexibility of the AHP framework enables organizational priorities to be reconstructed dynamically according to evolving competition requirements and athlete conditions.

Despite these promising findings, several limitations remain within the present study. The evaluation framework primarily focused on physical performance variables and did not incorporate psychological readiness, tactical intelligence, injury history, or behavioral discipline factors, all of which may also influence athlete competitiveness. Additionally, the study was conducted within a single regional sports organization involving a relatively limited number of athlete candidates. Future studies may therefore expand the evaluation framework by integrating additional performance dimensions and comparing alternative Multi-Criteria Decision Making methods to further strengthen the robustness and generalizability of athlete selection systems in competitive sports environments.

IV. CONCLUSION

This study successfully implemented an integrated Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) framework to support the athlete selection process for PORPROV Jawa Timur IX 2025 within Komite Olahraga Nasional Indonesia (KONI) Kabupaten Lamongan. The proposed Decision Support System was capable of transforming subjective expert judgments into measurable computational recommendations, thereby improving transparency, consistency, and objectivity in athlete evaluation.

The AHP analysis demonstrated that speed, agility, balance, explosive power, and aerobic endurance constituted the most influential criteria in determining athlete competitiveness. The resulting weighting structure

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reflected the practical characteristics of pencak silat competition, which prioritizes dynamic physical readiness over isolated muscular endurance indicators. Furthermore, the consistency test produced a Consistency Ratio (CR) value of 0.0018, indicating that the expert judgments used in the weighting process were logically reliable and mathematically consistent.

The implementation of the TOPSIS method successfully generated athlete rankings based on proximity to ideal performance conditions. The ranking results revealed that athletes with balanced physical performance across multiple criteria obtained higher preference values compared with athletes relying predominantly on historical achievement records alone. In addition, the comparison between system-generated rankings and manual coach evaluations demonstrated a very high level of agreement, as indicated by Spearman and Pearson correlation values of 0.9945 and 0.9863, respectively. These findings confirm that the proposed framework is capable of supporting professional decision-making while simultaneously reducing subjective bias within the athlete selection process.

Overall, the integration of AHP and TOPSIS provides a more adaptive and scientifically grounded athlete selection mechanism for regional sports organizations. The proposed framework not only improves computational accuracy but also contributes to fairer athlete opportunity distribution by emphasizing current performance quality rather than static administrative achievements. Future studies are recommended to incorporate additional evaluation dimensions such as psychological readiness, tactical intelligence, and injury history to further strengthen the comprehensiveness of athlete selection systems in competitive sports environments.

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