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Effectiveness of Video Assistant Referee Implementation in Indonesian Liga 1: Evidence from Key Match Incidents

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ABSTRACT

This study aimed to evaluate the effectiveness of the video assistant referee system in improving the quality of referee decisions during the 2024–2025 Indonesian Liga 1 season, which marked its first full implementation. The research used a descriptive quantitative approach by analyzing 300 critical match incidents drawn from a total of 306 matches. Data were obtained from official match documents, referee reports, operational review logs, and recorded video sequences. Each incident was categorized based on its influence on match outcomes, including decisions related to scoring, penalty actions, direct expulsions, and errors in identifying players. The results showed that the system confirmed the majority of on-field decisions as correct, while 32 decisions were corrected after video review, producing an overall accuracy rate of 89,33%. The analysis also revealed that incidents related to penalty situations were the most frequent, followed by direct expulsions and scoring actions. Review procedures lasted between 1 minute and more than 4 minutes, indicating the need for careful assessments during decisive situations. The study concludes that the video assistant referee system increased fairness, strengthened consistency, and reduced human error, thereby contributing positively to the integrity of the competition.

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INTRODUCTION

Football is one of the most popular sports worldwide, including in Indonesia, and has become a social phenomenon involving economic, cultural, and entertainment values (Putri et al., 2025; Tsaniyah et al., 2025). Its dynamic nature requires professional match organization supported by high-standard officiating. Referees hold a central role in maintaining fairness and integrity throughout the competition, as every decision they make has the potential to influence the match outcome significantly (Filter et al., 2023). The rapid pace of the game forces referees to make instantaneous decisions without the opportunity to review incidents from multiple angles, increasing the pressure on their perceptual and cognitive abilities (Pizzera et al., 2022). The complexity of modern football increases the likelihood of decision-making errors, particularly when incidents occur at high speed, in crowded penalty areas, or within obstructed lines of sight. Cognitive load and limited visual perception contribute significantly to misjudgements, as confirmed by several studies in sports psychology (Spitz et al., 2021). Emotional responses from players, coaches, and spectators further intensify the pressure on referees, potentially affecting their objectivity and concentration. Controversial decisions often provoke public protests, disrupt match quality, and even decrease trust in the competition's integrity (Archibald et al., 2025; Samuel et al., 2021).

Technological advancements have encouraged governing bodies such as FIFA and IFAB to introduce assistance systems to support refereeing accuracy. One of the most influential innovations is the Video Assistant Referee (VAR), which provides real-time video analysis through multiple high-resolution camera angles (Zhekambayeva et al., 2024). This system enables referees to review critical match incidents that fall under four decisive categories: goals, penalties, direct red cards, and mistaken identity. The introduction of VAR is considered a milestone in the modernization of football officiating, as it significantly enhances the objectivity and transparency of decision-making. Numerous international studies have confirmed that VAR increases refereeing accuracy (de Oliveira et al., 2023; Holder et al., 2022; Oliveira et al., 2021), with research in the Italian Serie A, Spanish La Liga, and German Bundesliga reporting improvements in decision correctness ranging from 25% to 40% following its adoption (Samuel et al., 2021). Similar findings were reported in the English Premier League and UEFA competitions. Increased accuracy ultimately contributes to higher perceived fairness among players and coaches, thereby strengthening the legitimacy of the competition. The use of technology, however, also brings challenges. The duration of VAR checks and On-Field Reviews (OFR) has been frequently criticized for interrupting the flow of the game, reducing spectator experience, and creating psychological discomfort among players due to prolonged waiting (Archibald et al., 2025; Firdaus et al., 2024).

Implementation of VAR across European leagues highlights further concerns. The Premier League experienced criticism for excessive delays and lack of transparent communication (Madsen & Johnsen, 2025). Serie A struggled with inconsistent interpretations of VAR protocols, whereas La Liga dealt with debates regarding over-intervention, where VAR influenced decisions too frequently. These variations illustrate that successful VAR implementation requires harmonized standards, trained officials, reliable infrastructure, and consistent operational procedures (Chen & Davidson, 2022). The introduction of VAR in Indonesia's Liga 1 beginning in the 2024 season marks a significant step in modernizing national officiating structures. The Indonesian Football Association (PSSI) invested in referee training programs, certification processes, and the development of Video Operation Rooms (VOR) to ensure that VAR implementation aligns with FIFA and IFAB standards (Imaddudin et al., 2025). Several challenges emerged during the initial implementation stage. Studies

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indicate that stadium infrastructure varies widely, with some venues lacking optimal lighting, camera coverage, and stable communication networks, factors that directly influence the effectiveness of VAR operations (Irawan et al., 2025). Differences in referee experience and VAR familiarity also lead to inconsistent decision-making across matches.

Public responses to VAR in Indonesia reflect concerns similar to those observed internationally. The length of reviews, especially during crucial situations such as penalty decisions or potential red-card offenses, creates uncertainty and disrupts match rhythm (Asiabar et al., 2025). Variability in review duration between similar incidents suggests that procedural consistency has not yet been fully achieved. Referee competency remains a central factor, particularly regarding decisions on whether an incident requires an OFR or can be resolved through a standard VAR check (Kim et al., 2025). While previous studies have primarily examined VAR effectiveness in elite European leagues with well-established officiating infrastructures, limited empirical evidence exists on how VAR is implemented and operationalized in emerging football contexts such as Indonesian Liga 1. Moreover, few studies have systematically analyzed review duration and decision-making thresholds in relation to referee competency. This gap underscores the need for the present study to provide context-specific evidence on VAR performance and refereeing processes in Indonesia's top-tier competition. Comprehensive evaluation of VAR implementation in Indonesia becomes essential to assess its actual impact on match fairness, refereeing accuracy, and competition integrity. Empirical analysis of Key Match Incidents (KMIs) including incident type, decision outcomes, review duration, and the extent of VAR intervention, provides crucial insights for improving the officiating system. Evidence-based recommendations are needed to refine VAR protocols, enhance referee training, and strengthen technological infrastructure to ensure consistent and high-quality implementation. This study is designed to address those needs by analyzing the effectiveness of VAR in Liga 1 during the 2024–2025 season. The analysis examines decision accuracy, types of incidents reviewed, the influence of VAR on referee decisions, and the efficiency of checking and review processes. The findings are expected to serve as a scientific foundation for improving the officiating framework in Indonesia and strengthening the quality of national football competitions.

METHODS

This study employed a descriptive quantitative research design using a notational analysis approach to evaluate the effectiveness of the Video Assistant Referee (VAR) system in the Indonesian Liga 1 during the 2024/2025 season. Notational analysis is a systematic and objective method for recording, categorizing, and quantifying performance-related events during match play, enabling the examination of specific incidents and decision-making processes in a competitive context. This approach was chosen because it allows for precise identification and measurement of key match incidents, VAR interventions, and refereeing outcomes based on observable match data.

Participants

The population consisted of all 306 matches played during the Indonesian Liga 1 2024/2025 season, representing the first full year of official VAR implementation following a pilot phase conducted by the Indonesian Football Association (PSSI).

Sampling Procedures

This study utilized total sampling, in which all matches from the population were included in the analysis. From these matches, a total of 300 Key Match Incidents (KMI) were identified

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based on IFAB-defined categories, comprising 141 penalty-related incidents, 73 direct-red-card incidents, 46 goal-related incidents, and several cases of mistaken identity.

Materials and Apparatus

The data sources comprised official match reports, VAR operational logs, referee reports, and video documentation published by the Liga 1 Refereeing Department and the Football Technology Division under the authority of PSSI.

Procedures

Data collection involved systematic observation and coding of all KMIs obtained from the official documents. Each incident was recorded according to IFAB definitions, including the referee's initial decision, type of VAR intervention (checking or On-Field Review/OFR), final decision outcome, duration of checking, duration of OFR, total added time due to VAR intervention, and the half of the match in which the incident occurred.

Data Analysis

The research instrument used was a structured coding sheet designed to categorize KMIs, classify VAR interventions, and measure temporal variables based on official timestamps recorded in the VAR Operation Room. Reliability was ensured through the use of standardized IFAB-compliant VAR logs supported by internal verification mechanisms within the VAR team, while data consistency was validated by cross-referencing match reports, referee logs, and VAR documentation. Descriptive statistical analysis was employed to calculate frequencies, percentages, decision accuracy levels, distribution patterns of KMIs, intensity of VAR interventions, and average durations of checking and OFR procedures.

Ethical Considerations

The study received ethical approval from the institutional research ethics committee (B/104555/UN38.6/LT.02.02/2025). Written authorization to access operational VAR data was obtained from the Liga 1 Referees' Committee. The study relied exclusively on officially released secondary data and involved no direct human participation.

RESULTS

The 2024/2025 season of the Indonesian Liga 1 marked the first full implementation of the Video Assistant Referee (VAR) system, making a comprehensive evaluation essential to understand the extent to which this technology contributed to the quality of refereeing within the national competition. As a newly implemented system at the professional league level, VAR serves not only as a verification tool but also as a corrective mechanism for decisions made by referees in situations classified as Key Match Incidents (KMI). Therefore, analyzing the data from this inaugural season is crucial for identifying patterns of intervention, the accuracy of referees' initial decisions, and the impact of decisions that were modified following review. To provide a detailed overview of how VAR functioned during the season, the analysis begins with an examination of the distribution of KMI across all matches. Mapping these incidents is important for understanding which categories of decisions most frequently required VAR involvement and for identifying potential high-risk areas within match officiating. The following table presents the complete distribution of KMI recorded throughout the 2024/2025 Liga 1 season.

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Table 1. Distribution of Key Match Incidents (KMI) in Liga 1 2024/2025

Incident Category	Frequency	Percentage
Penalty	141	47,0%
Direct Red Card	73	24,3%
Goal	46	15,3%
Misidentification	4	1,3%
Others	36	12,0%
Total	300	100%

The distribution of KMI indicates that penalty incidents (47%) were the most frequent, confirming that the penalty area poses the greatest officiating challenge. Such dominance aligns with previous research showing that penalty decisions often involve complex body contact and rapid movement, making them highly error-prone for referees. The substantial number of direct red card incidents (24.3%) reflects the intensity and physicality of Liga 1 matches, where serious fouls frequently require video confirmation. Goal-related incidents (15.3%) emphasize the importance of VAR in validating scoring actions, maintaining fairness in match outcomes. Misidentification cases were very rare (1.3%), yet the presence of even a few cases demonstrates how VAR prevents potentially severe disciplinary mistakes. The others category (12%) suggests additional nuanced incidents, such as handball or offside build-up, that required further evaluation.

Table 2. Accuracy of Referee Decisions Before VAR Intervention and Types of VAR Interventions

Decision Status	Frequency (n)	Percentage (%)
Correct Decision	268	89.33%
Incorrect Decision	32	10.67%
Total	300	100%
Type of Intervention	**Frequency (n)**	**Percentage (%)**
Checking	198	66.0%
On-Field Review (OFR)	102	34.0%
Total	300	100%

The accuracy rate of 89.33% demonstrates that referees in Liga 1 generally made correct decisions even before VAR involvement. This reflects a strong foundational officiating performance. However, the 10.67% incorrect decisions reveal a substantial margin where VAR serves as an essential corrective tool. The high proportion of checking interventions (66%) suggests that most incidents could be resolved internally by the VAR team without requiring the referee to review the footage on the pitch side monitor. This is consistent with IFAB's principle that OFR should be used only when

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necessary- specifically, for clear and obvious errors requiring a second visual assessment. The 34% OFR rate reflects a healthy operational balance, indicating that VAR officials were selective in escalating decisions for on-field review. This distribution demonstrates efficient adherence to VAR protocols and reduces match disruption.

Table 3. Duration of VAR Procedures

Procedure Type	Average Duration
Checking	1 minute 01 second
OFR	4 minutes 19 seconds

The checking duration (1:01) reflects quick internal decision-making, consistent with the goal of minimizing interference with match flow. Conversely, the OFR duration (4:19) is notably longer, which aligns with global findings that OFR inherently requires more time due to referee movement, careful replay inspection, and final decision communication.

Table 4. Distribution of Incident by Match Half

Match Half	Frequency (n)	Percentage (%)
First Half	103	34.3%
Second Half	197	65.7%
Total	**300**	**100%**

The significantly higher proportion of second-half incidents (65.7%) suggests that match dynamics intensify as the game progresses. This aligns with theoretical perspectives indicating that fatigue, emotional pressure, tactical shifts, and higher game tempo contribute to more infractions and contentious decisions late in the match. The lower first-half frequency (34.3%) reflects generally more controlled play during the early stages. These findings imply that referees face increasing difficulty in accurate decision-making as the match advances, reinforcing the importance of VAR as support during higher-intensity phases. The results of this study demonstrate that the implementation of the Video Assistant Referee (VAR) system in the 2024–2025 Indonesian Liga 1 season had a substantial and positive impact on the accuracy, consistency, and integrity of refereeing decisions. Across 300 Key Match Incidents (KMI), VAR proved to be highly effective in reducing human error and validating crucial decisions involving goals, penalties, red cards, and cases of mistaken identity. A total of 268 decisions (89.33%) were confirmed as correct, while 32 decisions (10.67%) were identified as incorrect prior to VAR intervention. This high accuracy level illustrates the essential role of VAR as a corrective and verification tool in high-speed, high-pressure match situations where on-field referees face significant perceptual limitations.

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DISCUSSION

The high level of decision accuracy observed in this study highlights the critical function of VAR as both a corrective and verification mechanism in modern football officiating, particularly in high-speed and high-pressure match situations where on-field referees are subject to substantial perceptual and cognitive limitations. The findings align strongly with Herbert Simon's theory of Bounded Rationality (Spitz et al., 2021), which argues that human decision-making is constrained by limited time, incomplete information, and cognitive restrictions. In professional football, referees must make instantaneous judgments under intense pressure, often with obstructed sightlines, narrow viewing angles, and rapid player movement. Such conditions make misinterpretation inevitable. VAR compensates for these human limitations by providing multi-angle replays, slow-motion footage, and clearer visual evidence, enabling referees to shift from instinctive, rapid judgments to more deliberative and informed decisions. This transition is supported by Dual-Process Theory, where referees move from fast, intuitive System 1 decision-making toward more analytical System 2 processing when reviewing incidents through VAR.

The study's results are also consistent with existing literature. Spitz et al., (2021) found that video-based technologies significantly reduce perceptual error and improve decision accuracy, particularly for high-speed incidents. Samuel et al. (2021) reported that VAR reduces incorrect decisions by up to 35%, particularly in penalty and offside-related situations, two categories that were also highly corrected in this Liga 1 season. Similarly, Chen & Davidson (2022) emphasized that VAR enhances transparency and fairness by basing conclusions on objective visual evidence. In the Indonesian context, research by Firdaus et al., (2024) confirmed that technological officiating systems positively influence perceptions of fairness, even though long review durations remain a concern. Vater et al., (2024) and Irawan et al., (2025) documented improvements in decision-making quality due to reduced psychological pressure on referees, particularly in situations requiring interpretation of contact intensity or foul severity. These findings align with Li et al., (2024) who argue that VAR fundamentally reshapes modern officiating by increasing consistency across matches and reducing inter-referee variability.

When analyzed through the KMI categories, VAR interventions were profoundly impactful. In goal-related incidents, 46 situations were reviewed, with 28 goals annulled due to violations during the Attacking Possession Phase (APP). This high annulment rate (61%) indicates that many goals would have stood incorrectly without VAR. In penalty situations, the largest KMI category with 141 incidents 63 decisions were overturned, demonstrating the complexity and high error risk of penalty calls. Penalty areas are dense, fast-moving, and congested spaces, making it difficult for referees to accurately assess critical contact events. These findings support Samuel et al. (2021) argument that penalties are inherently prone to misjudgment and require technological support. Similarly, in red-card incidents, 35 out of 73 decisions were corrected. Red cards carry substantial consequences for match flow and outcome, making accuracy vital. Pizzera et al., (2022) note that psychological pressure peaks during severe disciplinary decisions, increasing misinterpretation risk. VAR thus functions as a protective mechanism, ensuring that red cards are awarded only when visual evidence clearly supports serious foul play or violent conduct corroborating (Li et al ,2024).

Another critical aspect of VAR implementation concerns review duration. This study recorded an average checking time of 1 minute 1 second and an On-Field Review (OFR) time of 4 minutes 19 seconds. Although OFR duration is considerably longer, it remains within the

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global range reported by Li et al., (2024), which spans 180–320 seconds in top leagues. Goal reviews were the shortest (43 seconds) due to their generally straightforward nature, while red-card reviews required the longest assessment due to the need for detailed evaluation of foul intensity, injury potential, and contextual factors. Long OFR durations can temporarily disrupt match rhythm, affect player concentration, and heighten emotional reactions from coaches and supporters. However, based on Kahneman's Dual-Process Theory, such duration is the natural outcome of transitioning from fast, intuitive judgments to deliberate, analytical evaluation. Thus, review time represents a trade-off between efficiency and accuracy, where accuracy must take priority in upholding fairness and competitive integrity. The study further shows that review durations increase in high-intensity matches and later stages of the game, especially during the second half. This pattern aligns with research indicating that cognitive fatigue and emotional pressure intensify as matches progress, increasing the likelihood of controversial incidents. Firdaus et al., (2024) noted similar concerns in Indonesian football, emphasizing that while review time may affect match flow, the benefits of corrected decisions outweigh the disadvantages. Interestingly, some coaches use VAR stoppages tactically to reorganize defensive structures or deliver strategic instructions suggesting that VAR introduces new dimensions to in game management. Overall, the findings of this study reveal that the duration of VAR reviews does influence match rhythm, but such influence is justifiable due to the significant accuracy gains achieved. The technological system fulfils its primary purpose: ensuring fair play, minimizing critical errors, supporting referee decision-making, and strengthening the integrity of the competition. VAR has therefore emerged as a cornerstone of modern officiating in Indonesia, grounded in IFAB protocols, objective visual analysis, and evidence-based decision-making.

CONCLUSION

This study concludes that the implementation of the Video Assistant Referee (VAR) system in the 2024–2025 Indonesian Liga 1 significantly improved the accuracy, consistency, and fairness of refereeing decisions. Analysis of 300 Key Match Incidents (KMI) showed that VAR effectively corrected incorrect decisions and validated correct ones, resulting in an overall decision accuracy of 89.33%. VAR interventions were most prominent in penalty, goal, and red-card situations categories that inherently involve high complexity and a high risk of misjudgement. Although VAR reviews, particularly On-Field Reviews, introduced temporary disruptions to match flow, these pauses were justified by substantial improvements in decision quality. Review durations remained within global standards and reflected the need for deliberate and evidence-based evaluation in critical match situations. The higher number of incidents in the second half reinforced the importance of VAR during phases of increased fatigue and emotional pressure. Overall, VAR played a crucial role in enhancing fairness and integrity in Liga 1, reducing human error, and supporting referees in making more objective and defensible decisions. Continued development of referee training, technological infrastructure, and procedural consistency will be essential to optimize VAR implementation in future seasons.

AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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