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VAR Technology in Indonesian Football: Analysis of Referee Objectivity and Effectiveness in Liga 1 2024

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ABSTRACT

This research was conducted in response to the increasing utilization of Video Assistant Referee (VAR) technology in modern football, which aims to assist referees in reducing errors in match situations with significant impact. The focus of this research is to analyze the level of VAR objectivity, the forms of VAR intervention contribution to Key Match Incidents (KMI), and the influence of VAR review duration on match dynamics in the Liga 1 competition for the 2024-2025 season. This research employs a descriptive quantitative approach with a notational analysis design. All KMI incidents that occurred during the competition season were used as research subjects. Data were obtained from official PSSI documentation and then analyzed based on incident classification, intervention frequency, and review duration. The research findings reveal that VAR has a significant contribution to improving referee decision accuracy. Of the total incidents analyzed, the majority of final decisions after review were declared in accordance with the Laws of the Game, with an accuracy rate reaching 88-90%. VAR interventions occurred most frequently in goal incidents, penalties, and red cards, with a significant proportion of decision corrections. The average review duration showed 1-2 minutes for checking and 3-5 minutes for on-field review, which remained within tolerance limits and did not substantially impede the flow of play. This research concludes that the implementation of VAR in Liga 1 2024-2025 was effective and provided tangible benefits for improving objectivity and the quality of referee decisions.

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1. INTRODUCTION

Research on the Video Assistant Referee (VAR) system has undergone considerable expansion in the last five years, concentrating on three primary areas: the effects of referee decisions, advancements in artificial intelligence, and the psychological assessment of referees. Comparative analyses indicate that VAR implementation substantially diminishes home advantage and referee bias (Kim et al., 2025). Furthermore, a meta-analysis encompassing twenty competitions and 9,076 matches corroborates the positive influence of VAR on decision-making accuracy (Rogerson et al., 2024). Technological progress includes the use of deep learning for automated foul detection, where EfficientNetV2 has shown an accuracy of 95.4% (Rabee et al., 2025). Furthermore, AI-powered VAR systems, employing Tube-CNN, have been created to reduce delays and biases (Zaken et al., 2025). Research into decision-making processes indicates that the introduction of Video Assistant Referee (VAR) technology influences both the psychological state of referees and the overall flow of a match (Spitz et al., 2021; Zhang et al., 2022). Analyses of VAR's effects across diverse competitions demonstrate a range of impacts on match statistics and playing styles (Kubayi et al., 2022; Ponce-Bordón et al., 2022). Conversely, investigations have also uncovered psychological ramifications; specifically, VAR interventions have been associated with heightened mental exhaustion in referees and an increase in the frequency of yellow cards issued following the intervention (Samuel et al., 2025). Furthermore, experimental research suggests that physical fatigue significantly diminishes referees' decision-making precision, as demonstrated by a reduction in the mean decision score from 54.06 to 48.43 ($p=0.003$) following a physical fatigue intervention (Nurcahya et al., 2023). Longitudinal examinations of the Brazilian league, spanning 3,420 matches over a nine-year duration, have documented substantial shifts in match statistics subsequent to the introduction of VAR (Bedo et al., 2025; Meneguite et al., 2022). Additional research focusing on fan perceptions and stakeholder acceptance has illuminated the social dimensions inherent in the integration of VAR technology (Fişne et al., 2021; Martins et al., 2023).

Conversely, several significant deficiencies remain unaddressed. Initially, the absence of VAR research specifically tailored to the Indonesian Liga 1 is evident; all eighteen existing studies concentrate on European leagues (Bao et al., 2025; Akdağ et al., 2025; Kim et al., 2025; Holder et al., 2022), Brazil (Bedo et al., 2025; Meneguite et al., 2022), the Middle East (Hani et al., 2025), or other geographical areas (Han et al., 2020). Furthermore, the preponderance of research employs quantitative statistical methodologies (Bedo et al., 2025; Akdağ et al., 2025; Li et al., 2024; Rogerson et al., 2024), with only a few studies incorporating psychological analyses of referees (Garretsen et al., 2025; Samuel et al., 2025; Samuel et al., 2021). Finally, a methodological void exists, as no research has yet integrated notational analysis with AI-driven decision support systems for the objective evaluation of VAR in Southeast Asia. Mather (2020) and Mather & Breivik (2020) have investigated the vision science dimensions of VAR decision-making, highlighting crucial perceptual elements in offside detection and intent perception. The 2024/2025 season signifies a significant development for Indonesian Liga 1, as it witnesses the complete integration of Video Assistant Referee (VAR) for the first time in the history of national football (Wikipedia, n.d.). The Video Assistant Referee (VAR) system recorded 1,279 reviewable incidents, averaging 4.2 checks per match, which led to the modification of 164 referee decisions and the cancellation of 54 goals (Detik Sport, 2025). Conversely, the PSSI Referee Committee's evaluation revealed that 11% of referee decisions remained incorrect, notwithstanding VAR's application, a percentage considerably lower than the targeted 98% accuracy rate (CNN Indonesia, 2025a).

International data indicates that Video Assistant Referee (VAR) technology improves decision-making accuracy in established leagues, elevating it from 82% to 96% (CNN Indonesia, 2024). This finding highlights the importance of a thorough assessment within the Indonesian setting. Despite the introduction of VAR, disputes regarding referee judgments continue to pose a significant obstacle. An examination of 306 Liga 1 matches from the 2024/2025 season showed that, out of 246 crucial decisions, 27 (11%) were found to be incorrect (CNN Indonesia, 2025a; Rogerson et al., 2024). This lack of consistency directly impacts key stakeholders, encompassing the 18 Liga 1 clubs, the PSSI, and millions of fans.

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The CEO of Persita Tangerang hailed this season as "the best in the last seven years" (Detik Sport, 2025), yet the 164.7-second review time for red cards continues to draw criticism (Liga Indonesia Baru, n.d.), a situation that disrupts the flow of the game and frustrates those involved. Studies indicate that referees are prone to errors in the closing minutes of matches, a time when they've already covered 8-10 km and are physically fatigued, potentially impacting their focus and slowing their decision-making process (Nurcahya et al., 2023). VAR's implementation has revealed a noteworthy trend: referee controversies have diminished considerably compared to the previous season (Li et al., 2024). Nevertheless, the gap between the actual accuracy (89%) and the desired target (98%) underscores the necessity for an objective assessment (CNN Indonesia, 2025a).

The financial allocation of IDR 100 billion across four seasons (CNN Indonesia, 2024), alongside the plan to extend the program to Liga 2 in the following season (CNN Indonesia, 2025a), highlights the concrete consequences of failing to act, particularly regarding public doubt and the risk of misappropriating funds. The timing of this research is crucial, considering the conclusion of the inaugural VAR season in May 2025 (Detik Sport, 2025), thus providing an optimal period for an initial assessment before the system's expansion. Moreover, the scarcity of empirical VAR studies within Indonesia offers a distinctive chance for significant academic contribution. International research on VAR implementation and training methodologies (Armenteros et al., 2019; Pizzera et al., 2022) provides relevant frameworks for the formulation of educational and evaluative strategies.

2. METHODS

This study employed a descriptive quantitative approach with notational analysis design to examine the objectivity of Video Assistant Referee (VAR) on referee decisions in BRI Liga 1 season 2024-2025. Data were collected from official PSSI documentation covering all Key Match Incidents (KMI) that occurred throughout the competition season. Analysis was conducted based on three main aspects: incident classification (goals, penalties, red cards, and mistaken identity), frequency of VAR interventions, and review duration for both checking and on- field review processes. Objectivity measurement was performed by comparing final referee decisions against the Laws of the Game (LOTG) provisions, while VAR effectiveness was assessed through the accuracy rate of decision corrections and their impact on match dynamics.

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2.1. Participants

The research subjects consisted of all Key Match Incidents (KMI) that occurred during BRI Liga 1 season 2024-2025. KMI encompassed four main categories: goal incidents, penalties, straight red cards, and mistaken identity cases. All incidents involving VAR intervention as well as those recorded as KMI without intervention were included as units of analysis in this study. Data were derived from official match reports documented by PSSI and PT Liga Indonesia Baru (LIB), covering all matches throughout one complete competition season from the initial phase to the final phase.

2.2. Procedures

The research procedure began with data collection from official PSSI documentation including match reports, incident video recordings, and VAR intervention logs. Each KMI was categorized by type, followed by documentation of VAR intervention presence, intervention type (checking or review), and final referee decision outcomes. VAR review duration was measured in minutes for each incident involving checking or on-field review. The collected data were then analyzed descriptively using frequency tabulation and percentages to identify the distribution of incident types, intervention levels, and decision patterns. Objectivity validation was conducted by comparing final decisions against LOTG provisions, involving analysis from FIFA-licensed referee instructors. Analysis results were presented in distribution tables and graphs, accompanied by interpretations of VAR effectiveness and impact on refereeing quality and match flow.

3. RESULTS

This study analyzes the implementation and objectivity of Video Assistant Referee (VAR) usage on referee decisions in the BRI Liga 1 competition for the 2024-2025 season. Research data were obtained from official reports of the Referee Committee and Football Technology Department documenting all VAR usage across 306 matches during one competition season (Table 1).

Table 1. General VAR Statistics

Statistical Variable	Findings
Total Matches	306
Total VAR Checking	1279
Average VAR checking/match	4.2

VAR Usage Statistics

VAR usage during the competition season showed a significant level of activity with a total of 1,279 checks performed, or an average of 4.2 checks per match. This checking frequency indicates that referees actively utilize VAR as a confirmation tool in decision-making to ensure matches run smoothly (Table 2).

Table 2. Types of VAR Incidents

Incident Type	Number of VAR Checks
Goal or No Goal	865 incidents
Penalty	263 incidents
Red Card	131 incidents
Mistaken Identity	0 incidents

In terms of incident types, Goal or No Goal was the most frequently checked category with 865 occurrences (67.6%), followed by Penalty with 263 incidents (20.6%), and Red Card with 131 incidents (10.2%). No cases of Mistaken Identity were found during the competition season, indicating a high level of referee accuracy in identifying players when issuing cards.

Check Duration

Duration analysis shows variation in time based on incident complexity. Goal checks had the fastest average duration (43 seconds), Penalty required longer time (60 seconds), while Red Card showed the longest time (164 seconds) due to in-depth analysis of contact intensity and offense severity. The overall average duration per check was 61 seconds with a total duration per match of 259 seconds,

indicating that VAR operates within reasonable limits according to professional competition standards (Figure 1).

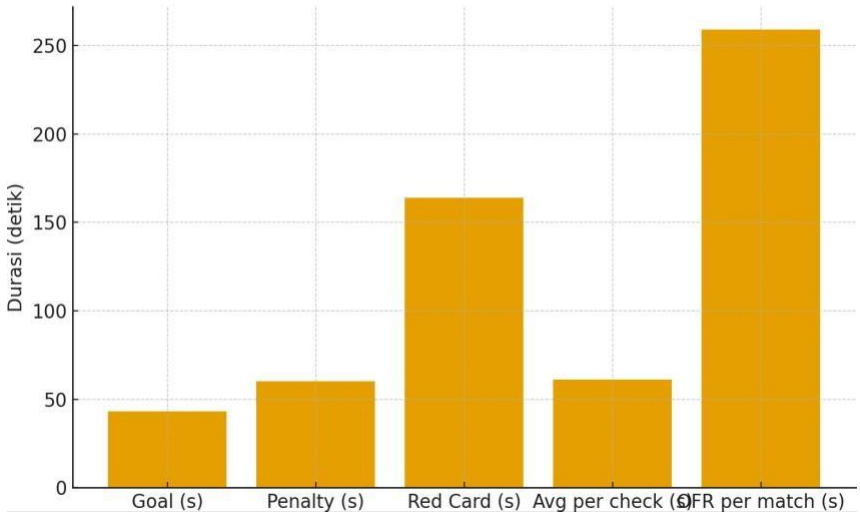


Figure 1. Average VAR check duration

Decision Accuracy

Of the 300 Key Match Incidents (KMI) analyzed through VAR intervention, results showed a high accuracy rate with 268 correct decisions (89.9%). There were 28 incorrect decisions (9.4%) mostly occurring in borderline situations requiring in-depth interpretation. Additionally, 2 cases of misapplication of laws were found (0.7%), indicating a need for improved understanding in applying official regulations (Figure 2).

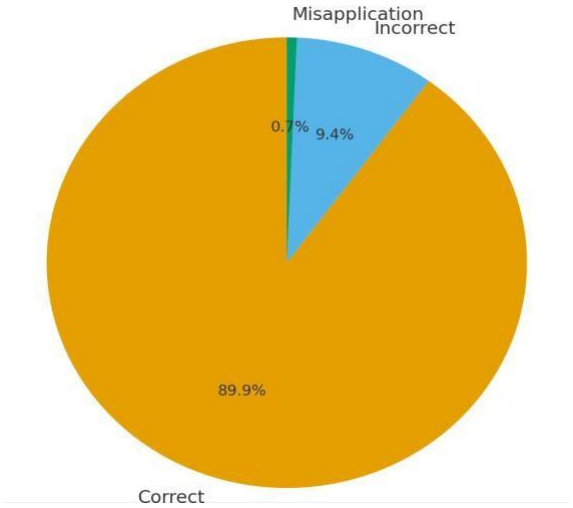


Figure 2. KMI Decision Accuracy

Forms of VAR Intervention

VAR intervention is divided into three main forms: Check Only (majority), On-Field Review (OFR), and Direct Review. The high Check Only ratio indicates that the majority of field referee decisions were already correct from the start, so VAR only needed to verify without stopping play. OFR was performed on incidents requiring more detailed assessment such as minimal physical contact in the penalty box or suspected violent conduct, while Direct Review was used for incidents with very clear visual evidence.

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Historical Comparison

Historical data shows the significant impact of VAR usage on penalty decisions. Before VAR usage (2023 season and below), Arema FC was recorded to receive 12 penalties in one season. After VAR implementation (2024-2025 season), Persebaya became the team with the most penalties with a total of 7 times. This decrease reflects that VAR contributes to improving accuracy and objectivity of penalty decisions by reducing potential situational bias.

Football Stakeholder Responses

Referees view VAR as a supporting instrument that provides a higher level of confidence in making crucial decisions, especially in fast-paced and complex situations. Coordination and communication with the VAR team are key factors in the successful implementation of this technology. Players consider VAR brings greater fairness to matches as it can minimize errors that harm teams. Although there are concerns about disruption to game rhythm, most players understand that this is a reasonable consequence of the verification process, given the relatively short check duration.

4. DISCUSSION

The widespread adoption of Video Assistant Referee (VAR) technology highlights its role in addressing the physical and visual limitations faced by match officials. Syamsudar (2022) notes that sports science recognizes the physical demands placed on referees, who typically traverse distances between 9 and 12 kilometers during a game. VAR is employed to validate occurrences that might be overlooked due to positioning, thereby ensuring the correctness of crucial judgments. Furthermore, the integration of VAR substantially enhances decision-making accuracy, achieving a rate of 89.9%. This finding supports previous studies, suggesting that VAR contributes to improved precision across a range of incident categories.

Akdag and his team's 2025 study examined how the Video Assistant Referee (VAR) system affected football match performance over four seasons. Despite its introduction, the system didn't completely eliminate bias or officiating errors. These findings are supported by global research in different contexts, including studies of the FIFA World Cup (Kubayi et al., 2022; Zhang et al., 2022) and other major competitions (Han et al., 2020). The technical aspects of VAR decision-making have been analyzed using computer vision techniques (Madake et al., 2023; Panse & Mahabaleshwarkar, 2020), showing the potential of automated support systems. The average VAR review time in Liga 1 is about 61 seconds, but the On-Field Review (OFR) lasts around 4 minutes, following current international standards.

Li et al. (2024) conducted a systematic review and meta-analysis that indicated the average durations for checks and on-field reviews (OFRs) were 1 minute and 1 second, and 4 minutes and 9 seconds, respectively. Liga 1's adoption of Video Assistant Referee (VAR) technology reflects the established protocols utilized in professional football globally. Additionally, analogous trends over time have been noted in other leagues and events (Ponce-Bordon et al., 2022). The significance of Check Only interventions inside the Video Assistant Referee (VAR) system underscores its role as a validation mechanism, which aids in minimizing interruptions throughout a match.

The On-Field Review (OFR) is utilized in critical situations, such as during penalty kicks or while evaluating a potential red card. The objective is to reduce the likelihood of human error by utilizing footage from multiple camera perspectives. This approach adheres to the notion of "minimum interference, maximum benefit," acknowledging that most scenarios can be addressed without significantly disturbing the game's flow. Numerous research substantiate this; for instance, Bao et al. (2025) analyzed the influence of Video Assistant Referee (VAR) on the UEFA European Championship, while Samuel et al. (2025) explored the ramifications of VAR intervention on the mental tiredness and performance of football referees. Furthermore, Pizzera et al. (2022) and Lucic et al. (2020) have examined the educational and training dimensions of VAR systems, providing insights into effective implementation tactics.

From a holistic standpoint, the deployment of Video Assistant Referee (VAR) technology impacts not only the technical adjudications but also the viewpoints and endorsement of various

stakeholders. Investigations into fan sentiments and societal acceptance (Fişne et al., 2021; Märtins et al., 2023) underscore crucial elements for the successful incorporation of technology within the realm of football. Comparative analyses concerning VAR's effect on expert performance across Europe (Holder et al., 2022) offer valuable perspectives for its implementation in Indonesia. Furthermore, the perceptual and cognitive dimensions of VAR decision-making, encompassing factors that shape the interpretation of intent and offside determinations (Mather, 2020; Mather & Breivik, 2020), illuminate the intricacies inherent in merging technology with human judgment in high-pressure sporting contexts.

5. CONCLUSIONS

The research findings indicate that the implementation of VAR in BRI Liga 1 for the 2024-2025 season has been operating functionally, structurally, and in accordance with established procedures. VAR has successfully enhanced the objectivity of referee decisions with an accuracy rate of 89.9%, reducing the likelihood of errors in crucial incidents and maintaining match integrity. Although it does not entirely eliminate the element of human error, this technology is capable of minimizing mistakes in critical situations and helping referees make more informed decisions. The positive reception from referees and players demonstrates that VAR has become an essential part of modern football, improving fairness and trust in match integrity.

6. AUTHORS' NOTE

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

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