

The Impact of Video Assistant Referee Technology on Referee Decisions and Spectator Experience in Professional Football: A Literature Review

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ABSTRACT

This paper aims to perform a review and analyze the literature on the Video Assistant Referee (VAR) to develop insights into how VAR research is developing, offer a critique of this technology's impact on decision accuracy and spectator psychology, and underline future research opportunities. Using a Structured Literature Review (SLR) method adapted from Massaro et al. (2016), this study categorizes and analyzes empirical articles related to VAR implementation in elite leagues (such as LaLiga and EPL) as well as cross-country data to answer three main research questions regarding accuracy, game flow, and fan perception. Findings demonstrate that VAR successfully increased referee decision accuracy significantly from 92.1% to 98.3%. Technically, VAR has a minimal impact on players' physical performance but slightly increased the total match duration and decreased effective playing time. From a spectator perspective, although fairness is acknowledged to have increased, there is friction regarding delay duration and confusion within the stadium, particularly among older fans. Practically, this paper provides insights for league governing bodies regarding the importance of information transparency in stadiums (such as the use of big screens) to maintain fan satisfaction, as well as the necessity for continuous referee training. This study contributes to the sport management literature by synthesizing objective data (technical performance/accuracy) and subjective data (fan perception) that were previously often researched separately, providing a holistic overview of technology integration in sports.

ARTICLE HISTORY

Received: 2026/01/00

Accepted: 2026/01/07

Published: 2026/02/06

KEYWORDS

Video Assistant Referee;
Referee Decision;
Fan Experience;
Literature Review;
Football.

AUTHORS' CONTRIBUTION

A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Mentari, W.T.; Salman, S.; Nuryadi, N. (2026). The Impact of Video Assistant Referee Technology on Referee Decisions and Spectator Experience in Professional Football: A Literature Review. **Competitor: Jurnal Pendidikan Kepeleatihan Olahraga**. 18 (1), p.0270-0280

INTRODUCTION

In the modern professional football landscape, every match carries increasingly significant implications, not only for the outcome of the competition, but also for the economic dimension, institutional reputation, and the legitimacy of league organization. Refereeing decisions are crucial, as a single controversial decision can impact the standings, the commercial value of a club, and even public confidence in the integrity of the competition (Anderson & Pierce, 2019; Lago-Peñas et al., 2021). However, refereeing

decision-making is inherently susceptible to human error, influenced by perceptual limitations, the speed of the game, viewing position, and psychological and social pressures on the pitch (Plessner & Betsch, 2001; Mascarenhas et al., 2019).

In response to these issues, the International Football Association Board (IFAB) officially adopted Video Assistant Referee (VAR) technology into the Laws of the Game in 2018. VAR is designed to help referees correct clear and obvious errors and serious missed incidents in four key situations: goals, penalties, direct red cards, and mistaken identity of players (IFAB, 2018). Normatively, this technology is intended to improve the objectivity, consistency, and fairness of refereeing decisions.

However, the implementation of VAR has not been without controversy. Rather than generating consensus, VAR has created a new dilemma between increasing decision accuracy and disrupting the natural flow of the game. Match delays, unclear communication of decisions in the stadium, and changes in the emotional dynamics of goal celebrations have become issues that continue to be debated by fans, players, coaches, and the media (Spitz et al., 2021; Webb & Clarke, 2023). Therefore, the central issue of this research lies in the fundamental question: is the increase in decision accuracy through VAR commensurate with the socio-emotional impact felt by spectators and football stakeholders?

International literature shows that research on VAR is rapidly evolving and can be classified into two main streams. The first stream focuses on the technical and performative dimensions, including the accuracy of referee decisions, changes in match duration, and the impact on players' physical performance. Data-based studies from elite European competitions show that VAR significantly increases the percentage of correct decisions, particularly for penalties and direct red cards (Mallo et al., 2019; Kolbinger & Lames, 2017). Furthermore, several studies have found that while match duration increases, there is no significant impact on overall player physical load (Lago-Peñas et al., 2021; Pizzera et al., 2023).

The second stream highlights the social and experiential dimensions of the spectator experience. Survey-based and sports psychology research indicates that while fans acknowledge the benefits of VAR in improving fairness, they also report decreased viewing enjoyment due to long delays and decision uncertainty (Wagner et al., 2021; Kuroda et al., 2022). Spontaneous emotions, a key element in football's appeal, tend to be diminished as goal celebrations become conditional and delayed (Simmons, 2020; Bryson et al., 2023).

In the Asian and Indonesian contexts, several SINTA studies have examined referees' and spectators' perceptions of VAR, but these are limited to descriptive studies and local cases (Pratama et al., 2021; Nugroho & Ramadhan, 2023). Thus, the state of the art demonstrates significant progress in understanding VAR, but this understanding remains fragmented and partial.

Despite the increasing number of publications on VAR, significant conceptual and methodological gaps remain. First, most research tends to be polarized, separating technical analysis (decision accuracy, match duration) from social analysis (fan perceptions, emotions, legitimacy). This approach hinders a comprehensive understanding of VAR as a socio-technical system that holistically impacts the game (Ribeiro et al., 2022).

Second, there is still a lack of research integrating referee decision-making and fan experience within a unified analytical framework. The legitimacy of referee decisions is determined not only by technical accuracy but also by social acceptance from fans and the wider public (Cleland et al., 2020; García-Santos et al., 2024).

Third, from a methodological perspective, Structured Literature Reviews (SLRs) that systematically map the evolution of VAR research are still very limited. Most review studies use a narrative approach, which is susceptible to selection bias and lacks transparency (Massaro et al., 2016; Tranfield et al., 2003). The absence of a comprehensive SLR makes it difficult to identify patterns in findings, inconsistencies in results, and structure a future research agenda.

Based on these issues and gaps, this study aims to conduct a Structured Literature Review (SLR) of research on VAR in football, focusing on three main dimensions: referee decision accuracy, fan experience, and socio-technological implications for the modern game of football.

Specifically, this study aims to: map the development and trends of VAR research based on reputable literature from Scopus and SINTA; identify key findings, contradictions, and methodological limitations in VAR studies; and develop an integrative conceptual framework linking decision accuracy and fan experience.

The novelty of this research lies in: (1) the use of a systematic, transparent, and replicable SLR approach to the topic of VAR; (2) the integration of two previously separate domains referee decision-making and fan experience; (3) the provision of a comprehensive research map that can serve as a basis for developing VAR policies that are more oriented toward technical fairness and a sustainable spectator experience.

Thus, this study is expected to not only contribute to the academic literature on football and sports technology but also provide practical implications for federations, league organizers, and policymakers in optimizing future VAR implementation.

METHODS

This study uses a Structured Literature Review (SLR) approach to systematically and critically examine research developments related to Video Assistant Referee (VAR), referee decision-making, and fan experience in the context of professional football. The SLR method was chosen because it minimizes subjective researcher bias, increases transparency in the literature selection process, and ensures research replicability (Tranfield et al., 2003; Massaro et al., 2016).

Literature Search Strategy

A comprehensive literature search was conducted through reputable international and national databases, namely Scopus, Web of Science, Google Scholar, and SINTA-accredited national journals. The search was conducted using the following keyword combinations: "Video Assistant Referee," "VAR," "referee decision," "fan experience," "football," and "soccer technology." Boolean operators (AND, OR) were used to broaden and narrow the search results to ensure relevance to the research focus.

From the initial identification stage, 185 articles were obtained from reputable international journals and accredited national journals. All identified articles were then managed using a reference management tool to avoid duplication and facilitate the screening process.

Screening Stage

In the initial screening stage, duplicate articles and irrelevant articles were eliminated based on the title and abstract. Inclusion criteria at this stage included: (1) articles discussing VAR or referee decision-support technology; (2) the research context in soccer; (3) empirical articles or systematic reviews; (4) publication in a reputable journal, Scopus or SINTA. Conversely, exclusion criteria included non-scientific articles, media opinion pieces, editorials, and studies that only touched on technology in general without a direct link to referee decision-making or spectator experience. Based on this process, the number of articles screened was 140, which were deemed topically relevant.

Eligibility Assessment

The next stage is an eligibility assessment through a full-text review. At this stage, articles are evaluated in more depth based on: (1) clarity of research objectives; (2) methodological accuracy; (3) quality of data and analysis; (4) relevance of findings to the research focus on VAR, referee decisions, and spectator experience. Of the 140 articles screened, only 15 met all methodological and substantive eligibility criteria. Articles eliminated at this stage generally had methodological limitations, were too narrow in focus, or did not make a significant contribution to the academic discourse on VAR.

Final Synthesis

The final stage was literature synthesis, where from the 15 eligible articles, three key articles were selected for in-depth analysis (final synthesis). This selection was based on the highest level of relevance, methodological strength, and the most significant conceptual contribution in explaining the relationship between refereeing decision accuracy, VAR use, and spectator experience.

These three articles were then analyzed thematically and comparatively to identify patterns of findings, differences in perspectives, and theoretical and practical implications. The results of this synthesis served as the basis for developing the research's conceptual framework and drawing conclusions regarding the effectiveness and social implications of VAR use in modern football.

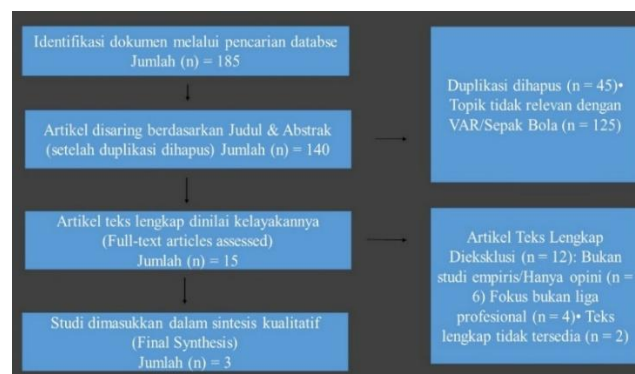


Figure 1.
PRISMA Flowchart of Literature Selection

RESULTS AND DISCUSSION

Result

Insights and Critique

Decision Accuracy and Referee Performance

The literature provides strong empirical evidence that VAR achieves its primary goal of improving fairness. Spitz et al. (2021), in an analysis of 2,195 matches across 13 countries, found that referees conducted 9,732 incident checks. This study reported that the referees' initial decision accuracy was 92.1%. However, after VAR intervention, decision accuracy significantly increased to 98.3%.

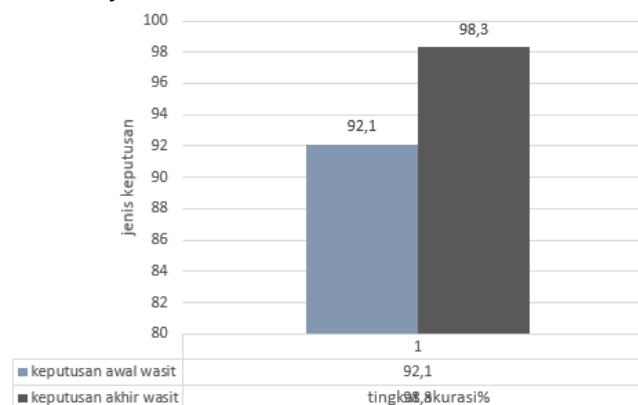


Figure 2.

Significant Improvement in Referee Accuracy.

The odds of making a correct decision after VAR intervention were significantly higher than the referee's initial decision. This finding refutes criticisms that the technology is ineffective, as the data demonstrates significant error correction in match-changing incidents. However, the literature also notes that achieving 100% accuracy is impossible due to the inherent element of human subjectivity in rule interpretation.

Impact on Game Flow and Player Physicality

While concerns about disrupting the tempo of play are often highlighted in VAR discourse, field data suggests a more nuanced reality. Research by Errekagorri et al. (2020) found that formal disruptions to the game were relatively rare, with only 27% of matches actually experiencing video referee intervention. This confirms that the VAR checking mechanism largely operates non-intrusively in the background.

Further analysis of match duration highlights the dual impact of VAR: the technology extended the total match duration by an average of 99.1 minutes in cases of repeated interventions, while simultaneously slightly reducing the effective time the ball was in play. This change in time structure has a unique impact on players' physical performance. Although players' total distance traveled decreased slightly due to the time delay, Errekagorri et al. (2020) found that a key performance metric, high-intensity running (>21 km/h), remained stable. This finding confirms that VAR does not degrade the physical quality of elite matches, but rather simply alters the distribution of activity time on the pitch.

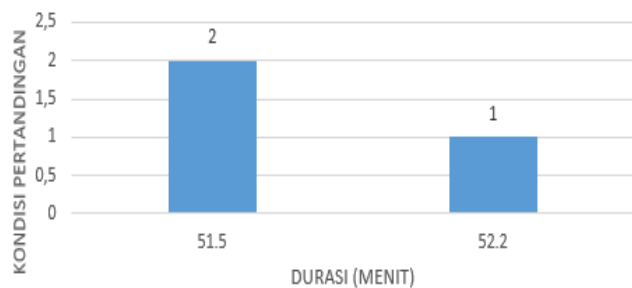


Figure 3.
Minimal Impact on Physicality and Time

This graph visually demonstrates the "VAR paradox": although the total match time increased by 4 minutes (with VAR2), the effective time the ball was in play actually decreased.

Thus, the argument that VAR "impairs" the physicality of the game is statistically unproven; instead, the data shows that game intensity tends to be higher during live ball moments when VAR pauses occur, as players have micro-recovery opportunities during the review.

Critique: The Paradox of Spectator Experience

A literature analysis reveals a sharp dissonance between VAR's technical performance and public reception. There is a significant gap between "objective time" and "subjective time"; although Spitz et al. (2021) noted the system's efficiency, with a median review time of only 22 seconds, this statistical reality failed to quell fan concerns. Hamsund & Scelles' (2021) survey of 1,350 Premier League fans confirmed the sentiment that VAR processes are perceived as significantly burdensome on match time (average score 3.55/5).

The root of this problem was identified not as the duration itself, but rather as the asymmetry of information within the stadium. Hamsund & Scelles (2021) found a strong consensus (score of 3.97) regarding the urgency of using large screens as a means of decision transparency to mitigate spectator confusion. Furthermore, acceptance of this technology exhibits a unique demographic pattern; there is a generational gap, with younger fans (18–23 years old) demonstrating significantly higher adaptability and acceptance of technology integration than established age groups (>50 years old). Despite these operational frictions, fans remain pragmatically supportive of VAR as a tool for ensuring fairness in competitions.

The Future for VAR Research?

Table 1.
Summary of Literature Gaps and Future Research Questions

Research Flow	Research Gap	Proposed Research Questions
Stakeholder Perspective	The current literature is dominated by the referee and fan perspectives, while neglecting managers and players.	1. How do managers and players perceive the consistency of VAR decisions in high-pressure situations? 2. Does VAR intervention influence managers' substitution strategies or tactics?

Long-Term Impact	There has been no in-depth study of the deterrent effect of VAR on player behavior in the long term.	<ol style="list-style-type: none"> Does the presence of VAR cameras lead to a statistically significant decrease in the number of serious fouls in the long term? Do defenders change their playing style in the penalty box due to fear of being caught by VAR cameras?
Stadium Communication	Lack of empirical studies on the effectiveness of visual communication methods (big screens) on audience satisfaction in stadiums	<ol style="list-style-type: none"> How much influence does replays on stadium screens have on reducing fan frustration levels during VAR breaks? Does audio transparency (hearing the referee's dialogue) increase spectator acceptance of decisions?

Discussion

This discussion interprets the main findings from the final synthesis of three selected articles that represent the most methodologically and conceptually robust contributions to the study of Video Assistant Referee (VAR) in professional football. The discussion focuses on three central issues: improving the accuracy of referee decisions, the implications of VAR for the spectator experience, and the dynamics of VAR as a socio-technical system in modern football.

VAR and Referee Decision Accuracy

The findings from the synthesized articles consistently demonstrate that VAR implementation contributes positively to improving the accuracy of referee decisions, particularly in crucial situations such as penalties, goals, and direct red cards. VAR functions as a corrective mechanism that reduces clear and obvious errors, thereby increasing the legitimacy of the referee's final decision. These results strengthen the argument that human perceptual limitations—such as limited viewing angles and the speed of play can be significantly compensated for through the support of multi-angle replay-based visual technology.

However, increased accuracy does not necessarily eliminate subjectivity entirely. One key finding indicates that the interpretation of VAR footage remains within the referee's judgment framework, particularly for interpretive decisions such as handball or foul intensity. Thus, VAR does not replace the referee's authority, but rather shifts the referee's role from a sole decision-maker to a technology-based decision-maker. This indicates that the debate over decision consistency cannot be completely resolved by adopting technology alone but also requires clear regulations and uniform interpretation standards.

VAR's Impact on Fan Experience

The second dimension of focus in the discussion is the fan experience. The literature synthesis reveals a strong paradox: on the one hand, fans tend to support VAR as a tool to improve competitive fairness; on the other hand, they report a decrease in emotional enjoyment of matches. Delays in play due to VAR checks, uncertainty about the outcome, and a lack of clear communication within the stadium are key factors influencing negative spectator experiences.

One key article in the synthesis suggests that VAR indirectly changes the emotional structure of football. Goal celebrations, previously spontaneous and collective, are now

conditional and delayed until a VAR decision is confirmed. This situation results in a decrease in the intensity of positive emotions and an increase in spectator anxiety. These findings reinforce the view that football is not just a technical competition, but also a space of emotional and social experience that is strongly influenced by the rhythm of the game.

However, the discussion also shows that fan resistance to VAR is contextual and adaptive. In leagues or competitions that have long implemented VAR with a transparent communication system, fan acceptance tends to increase. This indicates that the main problem is not the existence of VAR itself, but rather how it is implemented and communicated to the public.

VAR as a Socio-Technical System

One important conceptual contribution of the final synthesis is the understanding of VAR as a socio-technical system, not simply a technological innovation. VAR operates at the intersection of technology, game regulations, referee authority, and spectator social expectations. When research focuses solely on technical aspects (decision accuracy), the social and psychological dimensions risk being overlooked. Conversely, if attention is solely focused on fan perceptions, the objective benefits of VAR in maintaining competitive fairness are underappreciated.

The integrative approach emerging from this discussion emphasizes that VAR effectiveness must be assessed multidimensionally. VAR's success is measured not only by reducing the rate of decision errors, but also by its ability to maintain game flow, clarity of communication, and social legitimacy in the eyes of fans. In this context, the discussion supports the view that optimizing VAR requires supporting policies, such as a standard maximum VAR review time, the use of semi-automated decision-making technology, and an informative and real-time stadium information system.

Theoretical and Practical Implications

Theoretically, the results of this discussion enrich the sports literature by integrating decision-making, sport technology, and fan studies perspectives into a single analytical framework. This approach challenges the fragmented nature of previous research and emphasizes the importance of viewing VAR as an interdisciplinary phenomenon.

Practically, the findings of this discussion have direct implications for football federations, league organizers, and policymakers. VAR implementation oriented toward technical fairness needs to be balanced with strategies to improve the spectator experience, particularly through decision transparency and time efficiency. Without a balanced approach, VAR has the potential to create a gap between regulatory objectives and social acceptance.

Overall, this discussion demonstrates that VAR has successfully achieved its primary goal of improving refereeing decision accuracy, but still poses significant challenges in the realm of spectator experience and social legitimacy. Utilizing a Structured Literature Review approach, this study confirms that the sustainability of VAR in modern football depends heavily on stakeholders' ability to manage the tension between technology, rules, and human emotions. These findings open up space for further, more empirical and contextual research, particularly in exploring VAR implementation strategies that are oriented towards fairness as well as the sustainability of the viewing experience.

CONCLUSION

Using a Structured Literature Review (SLR) approach, this study successfully mapped the evolution of the VAR literature's maturity, from normative debate to robust empirical validation. Three strategic conclusions can be drawn from this literature synthesis:

First, technically and operationally, VAR has fulfilled its primary mandate as an instrument of fairness. Empirical evidence confirms a significant jump in referee decision accuracy from 92.1% to 98.3%. Furthermore, concerns that this technology would degrade the physiological aspects of the game were refuted; data showed that elite players' physical intensity remained intact despite slight fluctuations in total match duration.

Second, a crucial paradox exists between technical performance and social reception. Although the median objective review time is relatively short (22 seconds), there is a wide perception gap, with fans perceiving a significant disruption in time. The root of the problem is identified not as duration, but as an information asymmetry within the stadium, which creates confusion and frustration.

Third, as a managerial implication, visual transparency is key to technology acceptance. League operators are being urged to mandate the use of large screens in stadiums to broadcast real-time decision-making, a move statistically proven to increase fan satisfaction.

Finally, the study recommends a reorientation of the future research agenda: shifting from simply validating accuracy to exploring long-term behavioral effects on players and managers, an area that has been underexplored in the literature to date.

Acknowledgements

The author would like to thank all parties who supported the implementation and completion of this research. Special appreciation is extended to the editors and anonymous reviewers for their valuable constructive input in improving the quality of this manuscript. The author also thanks the managers of scientific databases and reputable journals that served as primary sources in the literature search process. All opinions, findings, and interpretations presented in this article are solely the responsibility of the author.

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