**Original Article** 





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Football and the video assistant

referee: A grounded theory approach

#### Abstract

Few studies have examined the impact of technological officiating aids on football. The purpose of this study is to design a comprehensive model examining the use of video assistant referee (VAR) technology in football. Based on interviews with eminent sports experts, this study explores the use of VAR technology in football and provides a paradigm model. Data analysis was based on the continuous comparison method during three stages of open, axial and selective coding. The findings point to the ability of a referee to make an informed decision regarding an incident during a match and trends suggest continuing adoption of new technologies in decision support systems. In the model, causal conditions (e.g. rules and regulations, innovation in football) attract attention to the axial phenomenon (i.e. application of VAR technology to football) and strategies for its use (e.g. Total Quality Management, justice, increasing referee supervision) given the interfering factors (e.g. fair play, competition) and existing contexts (e.g. control of anti-football behaviours, referee performance, information technology, IT, control of violence and aggression), which create consequences (i.e. process weakness, slowing down the game, passion killing, increasing the quality of the referee's decision, increasing referee confidence, economical, increasing decision-making accuracy). Therefore, given the contextual conditions and the intervening factors, implementing VAR technology should improve the quality of football competitions. The research concludes that VAR has the potential to enhance the quality of football competitions but also acknowledges the need to address its negative impacts and ensure sustainable development.

#### **Keywords**

Video assistant referee, technological officiating aids, soccer, decision support technologies, sport officials, total quality management

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## Introduction

Sports and technology both have the ability to connect people.1 While there are many technological and/or digital innovations in sports,<sup>2,3</sup> there are negative consequences resulting from such innovations.<sup>4</sup> To enhance the quality of officiating, various sports have introduced Technological Officiating Aids (TOA).<sup>5</sup> One of the most well-known aspects of football is the Video Assistant Referee (VAR).<sup>6</sup> VAR was officially introduced in 2018, after many years in which referee errors were justified as being 'part of the game'. VAR seeks to improve the quality of officiating, protect the integrity of the game and consequently enhance the fan experience.<sup>7</sup> VAR was introduced with the express purpose of correcting major refereeing errors. Pressure from club owners and the media to improve the performance of referees, and thus create justice and fairness, prompted the reform of the VAR system.<sup>8</sup>

Yet, there are still concerns and much criticism that VAR is ineffective and otherwise problematic.<sup>9</sup> If poor refereeing decisions frustrate fans, players and coaches

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alike, then the same logic can also apply to VAR, the purported solution to poor refereeing decisions. The English Premier League (EPL) noted that VAR will not achieve 100% accuracy, but it will have a positive impact on decision-making and lead to more accurate and fair judgment calls.<sup>10,11</sup> However, this statement is characterised by an interesting paradox: whilst VAR was intended to provide a fairer competition, VAR also created its own controversies. Nevertheless, VAR is here to stay.

In this study, we position the VAR as a Decision Support System (DSS)<sup>12</sup> that is underpinned by Decision Support Technologies (DST). DSS reduce the time needed to make critical decisions about task and resource allocation. DSS can also be used to guide long-term resource acquisition decisions as well as to train and evaluate command and control capabilities.<sup>13</sup> An advanced DSS can assist two or more decisionmakers to process a variety of decision problems.<sup>14,15</sup> DST refer to any electronic device or set of devices used to assist referees and other officials during a competition.<sup>16</sup>

A paradigm model developed by Strauss and Corbin provides the theoretical foundation for this study.<sup>17</sup> This grounded theory paradigm considers the ecology of participants and the meanings that participants attach to their realities.<sup>18</sup> In an attempt to answer the aforementioned questions, an empirical study of sports experts was conducted to ascertain their perceptions of VAR technology in football. Based on these considerations, the following research questions were formulated: (1) What are the causal conditions of VAR? (2) What are the strategies applied to manage VAR? (3) What are the contextual and intervening conditions that influence, facilitate or constrain VAR strategies? (4) What are the positive and negative consequences of VAR?

This qualitative study assesses the obstacles and opportunities associated with VAR. The proposed paradigm model has the potential to act as a guideline for coaches, referees, sports practitioners and policy makers to ameliorate the negative impacts of VAR in football and pursue the sustainable development of this technology. The remainder of this paper comprises literature review, research methods, findings and concluding remarks.

# **Background literature**

## Accuracy of sport officiating

Referees make judgements about what is fairness and unfairness.<sup>6</sup> Sport officials, synonymous with umpires or referees, are, to some extent, unfairly expected to perform their obligations without committing any error. However, referees and umpires make mistakes. For example, in the EPL, referees commit five refereeing errors per game. Accuracy on contact fouls range from 93% to 95% in the National Basketball Association (NBA).<sup>11</sup> In Major League Baseball (MLB), umpires were incorrect more than 12% of the time between 2008 and 2018.<sup>19</sup> Based on Carboch et al.'s<sup>20</sup> calculation, 27% of challenges in elite tennis were successful, but the average error size was a mere 33.2 millimeters. It is these smaller margins for error that can be better evaluated with the help of technology. Although most referees are not professionals, it is evident that amateur officials have a similar standard of refereeing accuracy.<sup>21</sup>

On average, international football referees make 137 visible decisions per match.<sup>22,23</sup> Any mistake made by the referee can affect the outcome of the game. However, referees' decision-making process is complex, because it necessitates instant judgment in fast-paced, multi-player situations with limited visibility.<sup>24</sup> In addition, several other factors may also affect referees' decisions. These include perceptual limitations,<sup>25</sup> crowd noise,<sup>26</sup> fan influence,<sup>27</sup> match location,<sup>28</sup> and differences between teams' levels of play.<sup>29</sup> Concomitantly, judgement mistakes and bias in referees' decisions are almost inevitable. To remedy mistakes and eliminate bias in refereeing decisions, various technical officiating aids have been gradually deployed in a variety of sports.<sup>5,30,31</sup>

## Technological officiating aids

The world of sports is constantly changing, and over the years many of these changes are technological in nature. Many sport governing bodies have invested heavily in DST.<sup>32</sup> The primary purpose of officiating technologies is to facilitate referees' ability to make more accurate decisions.<sup>5</sup>

Most professional sports leagues and non-profit sports organisations use a variety of technologies to minimise errors that might otherwise affect game results.<sup>33</sup> Elite volleyball referees can access an instant replay that enables the careful detection of typical volleyball violations and balls in/out, recorded in high resolution by up to 19 high speed cameras positioned around the court. In a similar sense, in wrestling, when a coach considers a refereeing mistake blatantly against his wrestler, the Jury of Appeal reviews the video evidence. Boxing (and other combat sports) are pursuing unbiased scoring via automated systems. Hawk-Eye is a computer vision system used in a variety of sports. Hawk-Eye visually tracks the ball's movement and displays an animated prediction of its trajectory.<sup>34</sup>

#### Perceptions of VAR in football

VAR technology has not been universally acclaimed. Scanlon et al.<sup>35</sup> studied the Premier League football fans perception of VAR. Fan concerns centred on accuracy, loss of flow or continuity, ruining the moment and a lack of transparency. EPL team managers are more likely to publicly agree with VAR when decisions favour their club and question the utility of VAR when decisions are unfavourable.<sup>11</sup> At the 2018 FIFA Men's World Cup, fans believed that VAR decisions favoured teams from the Global North.<sup>36</sup> A person's attitudes towards the VAR are impacted by transparency, procedural justice, and social influence,<sup>23</sup> and the impact of these factors varies between in-stadium and at-home experiences of VAR. Most tweets (short statements made on the social media platform Twitter) that relate to VAR present a negative sentiment.<sup>37</sup> Aycan and Onag<sup>38</sup> concluded that Turkish football stakeholders perceived the impact of VAR on referees positively, citing more correct decisions, and preventing the unfair loss of points. However, the impact on match performance was evaluated negatively, when there is a potential goal or penalty, the referee has to pause the match and review the footage on a screen. Sometimes, this process takes several minutes, which disrupts the flow of the match and means players stand around waiting, which can impair their performance, and this reduces the natural excitement of football due to long breaks, reducing attractiveness and away from the main philosophy of football. Winand and Fergusson<sup>39</sup> established that Scottish football fans trust goal-line technology but perceive that the technology detracts from the fan experience because it reduces the fan's ability to debate contentious decisions. The majority of fans would prefer that technical assistance is not applied to VAR. Other studies report that the majority of German and English football fans were quite satisfied with and favoured the continued use of VAR.<sup>40</sup> During the 2018 FIFA World Cup, there were conspiracy theories shared on Twitter alleging that the VAR was used with malevolent motives.<sup>41</sup> These conspiracy tweets were also intertwined with tweets expressing scepticism and defiance towards the VAR.

### VAR process

The VAR process is well defined.<sup>10</sup> The VAR is a qualified human referee who watches the match on monitors. The on-field referee and VAR can communicate with each other via a microphone and an in-ear speaker. The referee review area (RRA) is adjacent to the field of play. Here, the on-field referee can watch an incident on a video monitor. The replay is facilitated by the Video Operation Room (VOR), which can be located either onsite or offsite. No player or coach may intervene in the review process. VAR is used only for 'clear and obvious errors' or 'serious missed incidents' in four match-changing circumstances: goals; penalty decisions; direct red-card incidents; and mistaken identity. Factual decisions such as offsides, and the issue of whether a player is inside or outside the penalty area, are not subject to the 'clear and obvious' test. For subjective decisions, either the referee informs the VAR that a decision should be reviewed or the VAR identifies a 'clear and obvious error' in one of the four match-changing situations. At the next stoppage in match play, the referee will review the video, before restarting play. If the VAR does not agree with the onfield referee, the VAR can recommend a change or even revocation of decision. If the VAR's advice falls within the referee's range of responsibilities, the onfield referee can make a final decision based on that information, without using the VAR. To summarise, the system provides the on-field referee with the opportunity to review a video of on-field incidents, and receive advice from the VAR in the event of a 'clear and obvious error' or 'a serious missed incident'. The on-field referee is always considered to be responsible for the final decision.

### Methods

Premised on the differences and innate subjectivity associated with qualitative research methods, it is important for researchers to explain the process of how a theory is developed.<sup>42,43</sup> Grounded theory (GT) is an inductive and exploratory method characterised by wide and recent application in sports management and related fields.44,45 This method allows the researcher to formulate a theory and related propositions without reliance on existing and pre-formulated theories.<sup>46</sup> In brief, GT propositions are systematically formulated using real data.<sup>47</sup> According to Strauss and Corbin,<sup>48</sup> the data-based nature of GT provides insight, understanding and meaningful guidance for action. In view of the aforementioned justifications, GT answers the questions of who, when, why, how and with what implications.<sup>48</sup> The GT for this study was in accordance with the most important rule of thumb quoted in the academic literature.

#### Participants

This study uses a purposive sampling approach. The interviewees were selected because of their ability to understand the research problem and central phenomenon (i.e. VAR).49 The study also relied upon snowball referrals.<sup>48</sup> There were 13 experts included in the study. All participants voluntarily agreed to participate in the study and recorded their consent. In addition, participants were guaranteed the confidentiality of their data and personal information. In the first stage of recruiting respondents, a database of contacts was created from websites, articles and books. The key selection criterion was a high level of familiarity with the issues surrounding the use of VAR in Iranian football. Ten participants were sports management academic staff and they all possessed either a football coaching or referee certificate. The remaining three interviewees were coaches and they are either recipients of Asian A-Level coaching certificate or national team coach(es). Participants were from Iran, Turkey, Australia, Italy and the USA. All participants had more than 10 years of experience in their respective professions and all considered themselves familiar with VAR technology. The participants in the study varied considerably in age. Approximately 31% were aged between 30 and 40 years, 46% were aged between 41 and 50 years old and the remaining 23% were aged over 51 years. The majority of interviewees were male (92%).

## Data collection

Semi-structured interviews were conducted in person or over the phone. Semi-structured interviews were selected because they are more conversational and allow new ideas to be explored as a result of the interviewee's statements.<sup>17,43</sup> The critical questions in the interview guide were as follows: (1) 'What is your opinion about VAR in Iranian football?' (2) 'What makes VAR useful?' and (3) 'What makes VAR problematic?' Follow-up prompts probed catalysts, context, key covariances, contingencies and consequences. These prompts included, 'What else contributes to the success or failure of VAR?' and 'What are the consequences of VAR?'

Three interviews were conducted by telephone and three others conducted face-to-face. Interview times ranged from 20 to 60 min. On seven occasions, the researchers relied on email correspondence, which were all completed within 3 days of the initial email.

#### Data analysis

Analysis was undertaken concurrently with the data collection process. After the interviews were transcribed by the lead author, each transcript was coded independently by two authors. Consistent with Strauss and Corbin's<sup>50</sup> systematic approach, three types of coding – open, axial and selective - enumerated the first and second level categories and their relationships. In open coding, categories were developed and then authors determined how the categories changed along the specified dimensions. In axial coding, the categories were systematically refined and linked with subcategories. In the selective coding stage, the research paradigm model was developed.<sup>17</sup> In this research, we also consider the direct, indirect and positive/negative effects amongst the different variables. The direct effect of one variable on another can be established and measured by holding constant all intermediate variables. Indirect effects present conceptual and practical difficulties, because they cannot be isolated by holding certain variables constant.<sup>51</sup>

Classifications were performed based on code refinement, duplicate code removal and comparison of embryonic codes with previously obtained codes.<sup>17</sup> Repetition of codes was observed from the ninth interview, however, the data collection process continued until the last interview to ensure complete theoretical saturation.<sup>52</sup> Finally, systematic analysis of Corbin and Strauss'<sup>53</sup> GT was performed using MAXQDA statistical software (Version 12) for data analysis and classification. EndNote 20 was used to create a bibliographic database. Finally, several initiatives were undertaken to ensure the rigour of the analysis. Members of the research squad discussed the data, themes and lead researcher's interpretations.<sup>48</sup> We calculated Cohen's kappa coefficient (k)<sup>17</sup> because it is a leading measure of inter-rater reliability for qualitative (categorical) items.<sup>54</sup> The total number of codes in a 30-day interval was 98, the agreements and nonagreements were 67 and 20 respectively. Hence, the retest reliability coding was 68%, comfortably above the 60%, threshold for establishing internal reliability.<sup>55</sup> The final model was also shared with participants and their feedback – mainly to do with wording – incorporated into the model.<sup>56</sup>

## Results

The most important element in the process of analysing the data obtained from semi-structured interviews is coding. Coding involves carefully reading the data and turning it into the smallest possible component. The codes are the result of microscopic analysis of the data. The grounded theory method is much more practical when all three coding processes are used simultaneously rather than sequentially.<sup>17</sup> In this study, all three coding processes have been used to analyse the data obtained from the interview.

## Open coding

Open Coding defines and labels concepts, and develops categories based on their properties and dimensions.<sup>57</sup> Categories are related and organised based on relationships, conditions and dimensions are developed, and finally a theory emerges.<sup>58–60</sup>

Open coding involves data shredding, comparison, conceptualisation and categorisation.<sup>17</sup> In the open coding stage, 132 codes extracted from 13 detailed interviews with experts and specialists in the field of research became 67 more abstract concepts (after removing duplicate and insignificant codes), and finally 18 categories were identified. The results of this step include the formation of basic concepts and the categories derived from them are shown in Table 1.

## **Operational definition**

The operational definition of the main concepts is provided in Table 2.

### Axial coding

Axial coding is the second stage of grounded theory. Axial coding links groups to their subgroups.<sup>17</sup> At this stage, the researcher selects one of the categories as the central category and explores it as the central phenomenon and determines the relationship of the other categories with it.<sup>53</sup> Charmaz<sup>61</sup> and other critics contend that axial coding may be considered an optional phase of the constant comparative method. At this point, the

Table I. S	econdary axial c	odes and indicators.		
Effect	Effect	Category	Frequency	Indicators/concepts
Direct	Positive	Competition	01	<ul> <li>Promotes fair competition</li> <li>Improves quality of match</li> </ul>
		Innovation	6	<ul> <li>Competitive advantage</li> <li>Modernises the game</li> </ul>
				<ul> <li>Creative solutions to enduring problems</li> <li>Provides new services</li> </ul>
				New technology
				Contribution technology     Changes service delivery process
			0	<ul> <li>New management systems</li> </ul>
		Information technology	17	<ul> <li>Applies new technologies</li> <li>Provides valid information</li> </ul>
		Referee performance	13	<ul> <li>Prevents the referees from making very bad mistakes</li> </ul>
				Reduces referee errors
				<ul> <li>Enhances official's ability to control the game</li> <li>Official's ability to make mistakes is arearly reduced</li> </ul>
		Fair play	13	Identifies more rule violations
		-		Improve results
				<ul> <li>Increase the capabilities and ability of teams</li> </ul>
				Eair play
		Justice	ω	<ul> <li>Reduces frequency of players protesting official's decisions</li> </ul>
		Referee confidence	6	<ul> <li>Iransparency in the judges audio files</li> <li>Enhanced referee and plaver confidence</li> </ul>
				Independence
				Strengthens the mind
				Calm the referee
				<ul> <li>Willingness of the officials to communicate</li> </ul>
		Quality of decision making	=	<ul> <li>Decision alignment</li> </ul>
				<ul> <li>Innovation in decision making</li> </ul>
				Ability to execute decisions
				Admity to evaluate decisions
				Contect decision making
		Decision making accuracy	=	Ose for making important, match-influencing decisions
		5		Software
				Hardware
				<ul> <li>Expertise and skill of the referee</li> </ul>
	Negative	Referee supervision	6	Fair monitoring
				<ul> <li>Monitoring and evaluation along with better performance of judges</li> <li>Boforces lass confidence and become avoid an uAB</li> </ul>
		Dession killing	7	<ul> <li>Nelet ees lose collingence and become overly renain on YAN</li> <li>Increase the stress of spectrators and reference</li> </ul>

(continued)

Effect	Effect	Category	Frequency	Indicators/concepts
				<ul> <li>Increasing fan scepticism of referee</li> <li>Reduce the pleasure of watching football</li> </ul>
				<ul> <li>Decreased happiness after goal</li> </ul>
Indirect	Positive	Total quality management	8	Continuous improvement
		•		Referee training
				Quality
		Rules and regulations	6	<ul> <li>Internal and external relations</li> </ul>
				<ul> <li>Domestic and foreign policy</li> </ul>
				<ul> <li>Follow the rules of the game</li> </ul>
		Control – violence and aggression	0	<ul> <li>Reduced likelihood of crowd misbehaviour linked to referee decisions</li> </ul>
		}		<ul> <li>Reduced likelihood of player misbehaviour linked to referee decisions</li> </ul>
		Control –anti-football and racist behaviours	6	<ul> <li>Players focus as much as possible on the game and avoid paying attention to the margins</li> </ul>
				<ul> <li>Referee decisions have very little effect on the outcome of games</li> </ul>
				<ul> <li>FIFA's seriousness in dealing with racist behaviour in stadiums</li> </ul>
	Negative	Economic costs	8	<ul> <li>Transport cost</li> </ul>
				<ul> <li>Requires HD quality cameras</li> </ul>
				<ul> <li>Increased space requirements</li> </ul>
				<ul> <li>Production costs</li> </ul>
		Process weakness	7	<ul> <li>Lacks formal approach</li> </ul>
				<ul> <li>Lacks scientific perspective</li> </ul>
				IT underdevelopment
		Slower game	6	Complexity
		,		<ul> <li>Game rhythm interrupted</li> </ul>
				Play interrupted too often
				<ul> <li>VAR decisions too slow</li> </ul>
				<ul> <li>Annoying for spectators and players</li> </ul>

Table 1. (continued)

#### Table 2. Operational definitions.

Category		Operational definition		
•	Competition	•	VAR facilitates the organised and structured rivalry or contest between individuals, teams or entities with the aim of determining the best or most skilled participants.	
•	Innovation	•	VAR is a new and innovative product.	
•	Information Technology	•	VAR is an application of information technology.	
•	Referee performance	•	The quality and or accuracy of referee decision making is improved.	
•	Fair play	•	An established standard of decency, honesty and integrity.	
•	lustice	•	VAR has compromised football's unexpected and unfair spirit.	
•	Referee confidence	•	Referees confidence was increased.	
•	Quality of decision making	•	VAR reduces the number of refereeing mistakes.	
•	Decision making accuracy	•	The application of VAR ensures that the referee's decisions are fair and equitable.	
•	Referee supervision	•	The VAR uses provide on-field referees with recommendations	
•	Passion killing	•	VAR technology has removed the referee's human biases, and the game is slower and less emotional.	
•	Total Ouality Management	•	The application of VAR to manage the whole collection to get the best result.	
•	Rules and regulations	•	The application of VAR technology is only for decisive and effective incidents such as goals, penalties, dismissals and penalties for a player's mistake instead of a player making a mistake.	
•	Control – Violence and Aggression	•	VAR seeks to reduce violence and aggression amongst fans resulting from frustration with officiating.	
•	Control – Anti-Football and	•	VAR seeks to reduce anti-football and racist behaviours of fans resulting from	
	Racist Behaviour		violence and aggression amongst fans resulting from frustration with officiating.	
•	Economic costs	•	VAR technology is expensive which prevents its widespread use.	
•	Process Weakness	•	Messages sent to the referee are not transparent.	
•	Slower game	•	VAR decisions take time which has slowed the game and disrupts the natural rhythm.	



Figure 1. Paradigm examples in axial coding.

data that was divided in the open coding process is reassembled to provide a more accurate explanation of the phenomenon. For this purpose, categories and relationships between them are classified using the axial coding model in the form of axial phenomena or core category, causal conditions (i.e. categories that precede and influence the central phenomenon), strategies (i.e. actions or interactions that are applied to manage the central phenomenon), contextual and intervening conditions (i.e. general context that influences or facilitates or constrains strategies) and consequences (i.e. the result of these actions and interactions).<sup>50</sup> The relationship between these categories is shown in Figure 1.

## Selective coding

Selective coding is the third step of the grounded theory method. This stage of coding is the process of integrating and improving categories to form a theory.<sup>17</sup> Selective coding relates the categories and presents those relationships within the framework of a narrative and corrects those categories that need further improvement and development.<sup>53</sup> At this stage of the research, the researcher, depending on their understanding of the text of the phenomenon under study, either presents the framework of the paradigm model in the form of a narrative or breaks down the paradigm model and graphically presents the final theory.



Figure 2. VAR technology paradigm model.

A paradigm model design is one of the most important strategies of qualitative research method, especially data-based theorising.<sup>61,62</sup> Data integration is very important in fundamental theorising.<sup>53</sup> The paradigm model shows the flow of processes and activities. This model consists of five parts: causal conditions, background conditions, intervening conditions, strategies and consequences. At the centre of the model is the central phenomenon around which activities are formed. It shows the flow of processes and activities that happened in the context of this research. Figure 2 summarises the re-analysis of data based on the paradigm model.

When using the GT approach of Strauss and Corbin, sub-categories are linked to the main and central category under a series of relationships. The relationships between them and the main category are specified under the paradigm model. Establishing such a relationship is based on asking questions and making comparisons.<sup>18</sup> Through the paradigm model, the scope of research is narrowed to one of several main social processes or conditions evident in the data. The appearance of the central variable in the study (i.e. VAR) acts as a guide for collecting and analysing further data. In this way, the central category provides direction to the theoretical sampling. According to Figure 2, the emergence of technology, as well as stringent guidelines and rules, gave rise to VAR technology. The contextual conditions which supported this development included a desire to control anti-football and racist behaviour, control violence and aggression in wider society, an emphasis on maximising referee performance, and the acceptance of information technology. The intervening conditions were the desire to promote fair competition and fair play. The strategies, actions and interactions resulting from the use of VAR technology were total quality management, increased referee supervision and emphasis on justice. The positive consequences were improved accuracy and quality of referee decision-making, and increased referee confidence. The negative consequences were increased economic costs, the inevitable interruptions and not-so inevitable process weaknesses which slowed the game and reduced enthusiasm (i.e. passion killing).

# Discussion

VAR has been introduced progressively into football. In this study, VAR was positioned as a neo-colonial technological tool.<sup>36</sup> The findings highlight VAR outcomes beyond just classical agent monitoring.<sup>63</sup> The academic contribution of the present study resides in its specification (and integration) of the causal conditions, background conditions and conditions within a single model. Another feature of this research was the utilisation of four approaches (i.e. positive, negative, direct, and indirect) as well as both external and internal conditions.

VAR is a key component of professional football. Prior research has explored various game-related foci, but little was known about stakeholder reactions to its usage. The present study addresses the effects of VAR technology as a complementary refereeing system in modern football. The introduction and implementation of VAR in football reflected the technical-technological change of referees. This change had implications for referee education, performance, public status and professional development.<sup>64,65</sup>

The results of the present study showed that VAR technology is a function of causal conditions (i.e. innovation and creativity, rules and regulations), context conditions (i.e. control of anti-football behaviours, football and racism, control of violence and aggression and information technology) and intervening conditions (i.e. healthy competition and fair play). These factors provide the conditions for the implementation of strategies (i.e. total quality management, increasing the referee's observation and justice) that have positive and negative consequences such as increasing the accuracy and quality of the referee's decision, and increasing the referee's confidence (i.e. positive outcome). However, the process is costly, slows down the game, weakens the process and reduces enthusiasm.<sup>36</sup> Therefore, the VAR system improves the quality of events, develops refereeing and improves the image of the governing organisations by establishing justice and reducing errors, margins and protests in football. Reducing refereeing errors, increasing the job security of referees and providing psychological help to referees, bodes well for the absolute quality of play, revenue generation and profitability via television, sponsorship and fan engagement. The results of the research are consistent with many existing scholarly publications. 32,66-69

#### Limitations and future research

As for limitations, the paper acknowledges its qualitative nature and small sample size, which may limit the generalisability of the findings. Therefore, future studies should aim to address these limitations to provide a more robust understanding of the use of VAR technology in football. Additionally, it is worth noting that the vast majority of participants were male (92%), which invalidated an attempt to investigate gender effects. It is important to examine how VAR is understood and implemented in other countries and how it is perceived by other stakeholder groups. Future work for this paper could involve conducting more empirical research to further investigate the impact of VAR technology on football. This could include larger-scale studies with a more diverse sample of participants, including referees, players and fans, to gather a range of perspectives on the use of VAR. Additionally, future research could explore the implementation of VAR in different countries and leagues to examine any variations in its effectiveness and challenges. Furthermore, the paper could benefit from incorporating other research methods, such as observations and document analysis, to gather more comprehensive data on the impact of VAR.

# **Practical implications**

Referee unions and football associations should provide support to referees and ensure that proper training and selection processes are in place. It is important to also acknowledge the importance of the VAR and all efforts to ensure that VAR does not replace on-field officiating. Practitioners should recognise the key refereeing areas which are impacted by VAR,<sup>3</sup> and where possible promote VARs virtues. When a complex VAR decision is assessed, fans would ideally be provided with insight into the communication and decision-making processes. Such insights may increase fan acceptance of VAR decisions. The VAR increases the volume of information and therefore may increase acceptance. Another interesting result was that the VAR could be used all the time and entered whenever the assistant thought it was needed.

The findings have implications for the ongoing debate around the introduction of technology in association football and may make a contribution to the establishment of guidelines regarding the use of technology across other sports and professional domains.<sup>32</sup> The findings of this study have practical implications that may facilitate the improvement of VAR implementation guidelines in football competitions and enable a better understanding of fans' preferences towards technology in sports and of the importance of fandom identity-related debate.<sup>40</sup>

## Conclusion

In conclusion, the research on the impact of VAR technology in football has provided valuable insights into its effects, both positive and negative. The proposed model, based on interviews with sports experts, offers a comprehensive framework for understanding the use of VAR technology. It is evident from this research that despite considerable oppositions and criticism, the VAR represents an important evolution in modern professional football. This technology enables a sport to improve its professional and moral standards, as well as its image and reputation.9 The findings suggest that VAR technology enhances the accuracy and quality of referee decision-making, leading to improved fairness and justice in the game. However, there are also concerns regarding the economic costs, interruptions in the game and process weaknesses associated with VAR. Given VAR's entrenched position and the necessity to support referees with decision-making technologies,<sup>69</sup> we hope that the concerns of football stakeholders may gradually decrease.<sup>70</sup> Coaches, players and managers should seek to better understand the VAR system, so that they can help identify strategies to improve refereeing.<sup>71</sup> The most notable achievement of this system is the correct administration of justice and high decisionmaking accuracy. VAR permeates the pitch and game, which enables teams' efforts to pay off and to be translated into fairer outcomes. Furthermore, the impact of refereeing errors in each game is significantly reduced.

Innovation and creativity in the field of electronic devices and systems, such as the design of referees' whistles, referees' assistant flags, the environment of the playing field and the ball, can be useful for referees' performance.<sup>72</sup> Thus, equipping the refereeing team with modern and accurate technologies to minimise mistakes and increase the excitement of the game is one of the important requirements of football refereeing. However, the dynamic nature of football makes refereeing mistakes inevitable, despite efforts to the contrary. Equally notably, technology cannot replace the referee's ability. Technology should help the referee, but it cannot replace human decisions. Furthermore, according to the results of the research, new technologies are strongly espoused in sports competitions and prevent refereeing errors.

The findings highlight the wide-ranging and unequivocal added value of monitoring technology. However, this is not necessarily realised through increased efficiency of referee decisions. Rather, it underlines their existing training and selection efficiency.<sup>63</sup> These findings indicate that the introduction of VAR has substantially and irreversibly impacted football matches. Nonetheless, it is necessary to continue analysing the effects of this innovative refereeing aid on football to verify its effectiveness and assess its applicability. The present study identified several factors influencing VAR perceptions. The results of this study can help sports organisations better comprehend the positive and negative perceptions of the consequences of VAR. However, it is crucial to strike a balance between technology and the abilities of human referees to maintain the integrity and excitement of the sport.

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