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## **WHEN IS A GOAL A GOAL? ADDRESSING EQUIVOCALITY WITH TECHNOLOGY**

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# WHEN IS A GOAL A GOAL? ADDRESSING EQUIVOCALITY WITH TECHNOLOGY

*Research in Progress*

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## Abstract

*Video assistant Referee (VAR) was introduced in football (soccer) to minimize errors directly affecting the match result. As a socio-technical intervention in the sport of football to support decision-making, there is tension between real-world contexts that lack objectivity and the application of information systems to make sense of them. In this research, we set out to offer new insights for information systems research by demonstrating this fundamental but hitherto neglected tension arising from the use of technology to reason about events and execute tasks. Using an initial sample of 27 VAR errors, we demonstrate the challenge of using information systems to faithfully represent subjective events. Our initial analysis outlines emergent concepts that help to explain the incidents analyzed, which serves as the orienting framework for our findings. Our findings suggest that information systems may not necessarily offer answers to messy, complex and subjective matters.*

*Keywords: information systems, sport, subjectivity, video assistant referee.*

## 1 Introduction

Information systems research is at its heart concerned with questions around how information systems support and augment human activities. In recent years, much of this interest has tilted toward digital transformation and the transformative role of AI and machine learning (Fügener et al., 2021; Hu et al., 2021; Jain et al., 2021; Mann et al., 2022; Teodorescu et al., 2021). However, in practice, most information systems still require heavy interaction with human actors who may more, or less, rely on the technology for decision making, augmenting their work, and delivering improved organizational outcomes (Mennecke et al., 2000; Trieu et al., 2022). Despite the role of human actors, most information systems research treats the interaction between human actors and systems as frictionless. This may not be problematic in more objective contexts, such as those related to medicine and economics, however, most organizational contexts are imbued with subjectivity rather than only facts and thus, may not be frictionless.

We offer new insights by demonstrating a fundamental, but hitherto neglected tension: between real-world contexts that lack objectivity and the application of information systems to make sense of them. Such contexts mean there is an inherent tension in the application of information systems to faithfully represent an incident. To emphasize this tension, we study the introduction of the Video Assistant Referee (VAR) in the sport of football (soccer) and how it is applied by actors to make decisions, represent and revisit incidents and how it influences the dynamics of outcomes. This setting represents the digitalization of a core activity in many sports (Xiao et al., 2017), or “digitally supported sport” (Goebeler et al., 2021). We are particularly driven not by the overall success (or failure) of the introduction of such technology in football, which is difficult to conclude, but rather by the tensions it has raised and the nature of ongoing incorrect and controversial decisions it often leads to, as well as what the application of technology to subjective contexts reveals, and the insights relevant for information systems research.

The application of information systems to subjective contexts raises the question of who is correct, what is the truth and how to interpret information that represents the context? For instance, when a referee makes a decision and then is recommended to review their decision with support from VAR, it may lead to the referee seeing something they missed and should have considered – exactly how the system was designed to work. However, it may also lead the referee to doubt their decision as they may be influenced by the VAR intervention. Because the interpretation of many incidents is subjective this may sway decision making. VAR may only offer a snippet of footage (usually of a few seconds) which is slowed down and therefore, may miss a big picture context and lack the nuance of the incident at hand. This means that the context of the event is altered upon replay rather than faithfully represented. As such, our study brings us into the deep waters of how information systems influence decision making and reasoning about events and help execute tasks.

Like other organizational settings, human-technology interaction (between actors and VAR) does not take place in a vacuum. The local and situated application of information systems, the reasoning about incidents and the construction of decisions happen collectively. There is an intense interplay between the unfolding of the game, players, and coaches (who are often angry), passionate spectators cheering and protesting, team dynamics between the referees on the field and the VAR team, repercussions for wrong decisions, and the materiality of the stadium and field of play.

While our research is clearly linked to recent interest in the application of technology in sports (e.g., Goebeler et al., 2021; Mazurova, 2022; Westmattmann et al., 2021; Xiao et al., 2017), we argue that our focus is not distinct from organizational settings where information systems are applied to deal with subjective but complex problems. Indeed, recent arguments have been made that the classical view of an information system as representing and reflecting physical reality is challenged by digital technologies increasingly, creating and shaping physical reality and that this ontological reversal challenges us to think more deeply about the role of humans and technology in the society (Baskerville et al., 2020).

To build our theoretical argument in this research in progress paper we analyze twenty-seven documented incorrect VAR decisions, acknowledged officially, across five major European national football leagues. We provide our initial analysis which outlines ten concepts that help to explain the incidents analyzed and which serve as the orienting framework for our findings. Our findings suggest that information systems may not offer answers to inherently complex and subjective matters.

## 2 Theoretical Background

Our research began with a broad focus on the application of information systems to subjective contexts. We did not begin with theory a priori because we could not locate a theory that could help explain the tension between real-world contexts that lack objectivity and the application of information systems to make sense of them. Nonetheless, as we collected and analyzed data and examined the literature, we began to observe connections with existing theories and concepts, but also how our research departs from these. What follows is a brief discussion of three main theories from the information systems literature, which helps to illuminate where a new theory of technology enactment and subjectivity may be positioned. We present the main theoretical insights in Table 1 — limited space prevents us from going into more details.

<b>Theory / example references</b>	<b>Level of focus</b>	<b>Application</b>	<b>Application to subjective contexts</b>
Representation theory (Burton-Jones et al., 2017; Recker et al., 2019)	Organizations, users, system level	Information systems: (i) convey meaning; (ii) have been built to model a representation of (a human’s) perception of the real-world system; (iii) will be more useful to users if it provides an	Studies deal largely with scripts built into the systems. Subjective contexts offer multiple representations and interpretations.

		accurate and complete representation of their perceptions of the meaning of the focal real-world phenomena.	
Mindfulness (Dernbecher & Beck, 2017; Langer, 1989; Langer, 1992; Weick et al., 1999b)	Individuals/ users, collective	Mindfulness is when individuals are reluctant to simplify interpretation when making sense of information and events. Mindlessness is when individuals rely heavily on information based on previous categories and distinctions and are ignorant of alternative interpretations.	In contexts such as live sports, it is arguable that the actors will (should) be mindful. Both the on-field and VAR referee may be mindful.
Sensemaking (Maitlis & Christianson, 2014; Weick, 1988; Weick et al., 1999a; Weick et al., 2005)	Organizations, individuals	Sensemaking describes the negotiation and creation of meaning, or understanding, or the construction of a coherent account of the world. It is a process whereby people work to understand uncertain events.	Deals with equivocality. Sensemaking involves continuously redrafting an emerging story so that it becomes more comprehensive, incorporates more of the observed data, and is more resilient in the face of criticism. Has not been applied in hybrid digital-physical contexts.

Table 1. Theoretical insights

### 3 VAR Background

Video Assistant Referee (VAR) is a complex socio-technical system involving both humans and technology working to correct the most “obvious and clear” incorrect decisions on the incidents that can change the course of the match (Spitz et al., 2021). VAR is not a fully automated system (like an AI), rather it is a socio-technical system and includes a team of referees supported by the use of broadcast footage, using as many angles as possible, real-time replays are used to check for intensity, slow-motion replays are used to identify the point of contact and Hawk-Eye imaging technology (3D cross-hair system) is used to judge offside by the part of a player's body furthest forward (excluding arms). The existing technology, such as Goal-line technology and Hawk-Eye imaging is also used to judge if a ball has crossed the line and is also a part of the VAR system. In the English Premier League (EPL), for example, VAR has a lead official, who will make judgements on all reviews, an assistant official, who continues to watch the live game, while the lead handles a review, and a third person is the Hawk-Eye operative, who controls the technology and is independent of the decision-making process. While the peculiarities of implementation change from league to league, and continue to evolve, VAR is typically used to review (i) decisions around a goal/no goal; (ii) decisions around a penalty/no penalty; (iii) decisions around a direct red card (not second yellow card/caution); or, (iv) mistaken identity (when the referee cautions or sends off the wrong player) (IFAB, 2022; Spitz et al., 2021). Reviewing these incidents can involve multiple events such as checking for the ball out of play, handball, offside, and fouls during the goal-scoring and potential penalty situations.

In its current state, there are two modes in which VAR influences the game. First, in each match-changing incident, the VAR referee, based on the available video footage decides whether the original decision is correct or requires a review from the main referee. This is a silent check that takes place while the game continues. Most checks are completed so quickly that players and observers are not aware of these checks taking place behind the scenes—when the VAR referee deems the original decision is correct, and review is not necessary. If the original decision is incorrect, VAR intervenes, and the game is delayed. A “review” takes place where a referee might delay the restart of play—

signaled by the referee placing a finger to their ear—while the VAR is investigating a possible offence. For the obvious decisions, such as a clear offside, the VAR referee can give these decisions and the play will be stopped if the ball is in a neutral area, or the play will continue until the ball is dead or the referee halts the play. When the incidents are complex and require subjective decisions, VAR recommends the main referee review the incident in the side monitor next to the football pitch to confirm that he/she may change their decision.

An on-field review is only instigated by the VAR if they believe the original decision is wrong. If this is the case the referee is recommended to review the decision. An important part of this process is that while the VAR will advise the referee of a possible wrong decision, the final call is made by the referee. While the VAR supports decision-making, it is important to note a referee cannot give a “no decision” or indicate that they will check and then use the VAR to make the decision. To put it differently, they must make a decision (e.g., foul or no foul). For offside decisions, assistants raise their flag if the offside is clear and obvious, else a silent check takes place. However, referees indeed make decisions to award penalty, goals, and red-card which is reviewed by the VAR referees.

The exact mode of VAR operation differs from the leagues and is still evolving. For instance, in the first season of VAR implementation, the EPL 2019/2020 had a silent check where the VAR officials could review and overturn the decision without involving the main referee. As a result, some correct on-field decisions were controversially overturned by the VAR referees forcing the EPL body to revise the VAR protocol (BBC, 2020; Kennerley, 2020). As a result of the revised VAR protocol, to be consistent with other leagues, starting from 2020/21 the main referees started reviewing the decision on the referral of VAR referees (BBC, 2020). In addition to the changes in protocol, the rules of the games have also been adapted to suit the use of technology. For instance, the 2020/2021 season saw a significant spike in the number of penalties awarded for accidental handballs, from that point all types of contact with the hand inside the penalty area was deemed handball (Brand, 2022; PremierLeague, 2020). The VAR implementation meant a strict and rigid interpretation of the handball rule during the review process. After several well-publicized infamous decisions, IFAB revised the handball rules and limited them to intentional handball. Despite such changes in protocol and rule adaptation, the VAR is far from perfect as it is aimed to reduce, not eliminate, the clear and obvious errors.

## **4 Method**

### **4.1 Research Design**

The research design is both qualitative and inductive (Brinkmann, 2014). The study is concerned with building a theory of how information systems are enacted in subjective contexts. In line with this, the setting of the use of VAR in football is important for our theorizing in several ways. First, it is a quintessential setting for subjective decision making. Second, VAR is a relatively new introduction, meaning that we are able to see how the technology and processes are adapted and improved. Third, the enactment of a system in such a setting is similar to other time critical, pressurized contexts where individuals need to interact with a system to complete a task or make a judgement. Fourth, the impact of the system is distributed between actors on the field (field referees) and the VAR team (the actors in front of the computer). This is similar to other work contexts where actors may be faced with more subjective contexts, or where actors may be more or less removed from the context.

### **4.2 Data Collection**

Our study draws on real-world data on the use of VAR. We built our corpus of data by searching Google for examples of VAR errors and controversies. This search returned thousands of news reports, analyses, videos and so on related to these events. To provide some boundaries to our search we limited the football leagues to the English Premier League, French Ligue Un, Spanish La Liga, German Bundesliga and the Italian Serie A. As Europe’s top five leagues this meant that news reports and other media were

readily accessible. Because the implementation of VAR is relatively recent, we considered events from 2018 to 2022. A critical factor in our search was that we specifically sought instances where VAR produced an incorrect outcome. By incorrect we mean for instance where a referee association (e.g., in England the Professional Game Match Officials Board) or a referee makes a statement that the decision was made in error or make an apology. In total, at this phase of the research, we analyzed twenty-seven incidents.

### **4.3 Analysis Procedures**

Data collection and analysis were conducted simultaneously allowing understanding to emerge from the theoretical concepts and the empirical content. We started our analysis by creating a template for each event that captured key details and evidence such as the initial decision, nature of the VAR intervention, the final decision and the admittance of error. We did this in MS Excel which was fundamental for creating and maintaining a repository of the data that facilitated our analysis.

Two researchers co-coded each event. We decided to adopt this approach because of the novelty of the data analysis and to iteratively develop our analysis and continuously challenge each other's ideas and underlying assumptions (Gioia et al., 2010; Volkoff et al., 2007). This means that rather than using an inter-coder reliability value, we used our debriefings to identify inconsistencies and discrepancies and build shared understanding. During this process, we undertook multiple rounds of analysis. At the time of writing this paper, we have undergone three rounds of analysis, we stayed very close to the data whilst moving back and forth between the data and theory in each round (Suddaby, 2006). During this process, we also ensured that the findings are not biased by the different leagues or incidents we analyzed. To reduce researchers' biases, we asked a third researcher to take part in the analysis of some of the data. Although the colleague was experienced in information systems and familiar with the context, they were not involved in the analysis. The purpose of their involvement was to identify concepts that may have been missed, offer an alternative perspective, and detect possible bias in data analysis. Having completed these steps, we settled on an initial set of analytical concepts (Table 2) that we believed captured the richness of the data analyzed and which serves as the orienting framework for our findings.

## **5 Preliminary Findings**

Our findings show some patterns regarding the errors in the application of VAR. These are summarized in Table 2. Column 1 indicates the type of error (Human judgement, Application/use, Technology features). Column 2 shows our analytical concept. Column 3 delineates the initial decision made as well as the type of intervention. Column 4 provides our description of the concept. Column 5 provides a count of events, while column 6 provides an example from our data.

The most common type of error is the 'Incorrect application (Subjective judgement by the assistant referee)' – at its core a human issue of subjectivity. This occurs when the VAR assistant referee does not interpret a foul and therefore does not enact a review for the referee. That is, it is a non-use of technology. An example of this is a potential foul or handball situation where the referee does not spot it, but also where VAR should have intervened, but it failed to do so. As an example from our data, when Lo Celso (Tottenham) tackled Azpilicueta (Chelsea) the referee did not see the tackle, VAR also did not see it as an obvious red card offence, despite watching replays. This was later described as "human error by video officials" by PGMOL.

Some decisions are explained by two concepts. For example, 'Falsification bias' and 'Selective judgement by referee'. An example of this is when Newcastle's goal was overturned for a foul after a VAR review. The foul was a result of a push from Crystal Palace's player (not the other way around). By zooming in on the contact between the Newcastle player and the Crystal Palace goalkeeper the referee missed or ignores the wider context. In the presence of multiple incidents, the referee selectively picks falsifying evidence to overturn their own correct judgement when influenced by assistant referee's referral.

There are also technology-driven issues that are perhaps unexpected. One that we outline here is ‘Technology misguiding - partial picture’. In the match between Juventus and Salernitana, VAR intervenes for an offside, checks and rules out the goal. However, the VAR video footage does not spot a defending player near the corner flag playing the goal on-side. In other words, the referee was not presented with a faithful representation of the incident and made the right decision based on the evidence given, but the outcome was incorrect. In this incident, initially, the goal was given as the linesman had a clear and complete line of sight but was incorrectly overturned without consultation.

Another example from our data is ‘Technology breakdown’. In the match between Aston Villa and Sheffield United in 2020 the ball had crossed the line; however, the match officials did not receive a signal on their watch nor earpiece as per the Goal Decision System (GDS) protocol. The seven cameras located in the stands around the goal area were obstructed by the goalkeeper, defender, and goalpost. The goal was not given. Hawk-Eye later apologized for the shortcoming. The referees were not alert to the fact that the technology may not have been working during the incident.

Error Type	Analytical concept	Initial decision/ VAR role	Description	Event counts	Example
Human judgement	Selective judgement by referee	Incorrect / Intervention	In the presence of multiple evidence, the referee picks the one that confirms the decision made.	2	VAR checks for a <b>potential penalty</b> but since it is an <b>offside</b> , the VAR referee ignores a <b>red card situation</b> ; selectively reviews only one incident.
	Subjective judgement by the referee	Incorrect / Intervention	The technology provides correct information, but the referee incorrectly interprets it.	1	The on-field referee concludes <b>no handball</b> and confirms with VAR check, <b>lack of obvious evidence</b> to judge handball.
	Subjective judgement by assistant referee	Correct / Intervention	Only the assistant referees have access to the technology and incorrectly interpret the incident and make wrong decisions.	4	Initial decision <b>no penalty</b> , overturned incorrectly after VAR check.
	Subjective judgement error <i>and</i> Falsification bias	Incorrect / Intervention	A combination of subjective judgement and falsification bias.	1	Referee was close and had a clear view while making the original decision <b>no foul</b> but <b>reverses decision</b> after reviewing the same incident on a VAR screen. <b>The referee incorrectly questions/changes their own decision.</b>
	Falsification bias	Correct / Intervention	Anchored by the assistant referee’s referral to review, referee incorrectly overturns their own correct judgement based on falsifying evidence.	1	Referee was close and had a clear view while making the original decision to <b>award the goal</b> but <b>overturns</b> the original decision <b>for a foul</b> after reviewing it in VAR screen. <b>VAR nudges referee to interpret the same event as a foul.</b>
	Falsification bias <i>and</i> Selective	Correct / Intervention	In the presence of multiple evidence, referee selectively	1	A goal is <b>overturned for a foul</b> after VAR review; the foul was a result of a push from the

	judgement by referee		picks falsifying evidence to overturn their own correct judgement when anchored by assistant referee's referral.		defending player and <b>should be a penalty</b> . The referee <b>misses or ignores the context</b> .
Application / use	Incorrect application (Subjective judgement by assistant referee)	Incorrect / Non-Intervention	Incorrect subjective judgement of the assistant referee leading to the non-use of technology.	12	A <b>potential hand</b> ball situation where referees did not spot and call and <b>VAR misses</b> this and should have intervened but does not.
	Tunnel vision	Incorrect / Intervention	In the presence of multiple evidence, the assistant referee refers only to an incident but overlooks other sources of errors.	1	<b>Penalty</b> given for a hand ball, but the VAR referee <b>missed the foul in</b> the buildup.
Technology features	Technology misguiding - partial picture	Correct / Intervention	The technology provides partial information leading to incorrect decisions.	1	VAR intervenes for <b>offside</b> checks and <b>rules out the goal</b> , video footage missed the opponent player near flag and does not consult linesman who had a better view.
	Technology breakdown and Blind trust	Incorrect / Non-Intervention	Unaware of technological breakdowns, blind reliance on technology overrides human judgement.	1	A <b>potential goal is denied</b> as the referee did not spot the ball crossing and did not receive the digital notification. The <b>referee trusted</b> malfunctioning goal-line technology.
	Technology breakdown	Correct / Intervention	Breakdown in technology affects the decision-making process, leading to incorrect decisions.	1	VAR intervenes and incorrectly rules out the original <b>goal for an offside</b> due to the glitch in technology.
	Technology blind spot	Unknown / Non-Intervention	Technology does not cover or fails to provide necessary information to make decisions	1	A possible <b>offside</b> could not be reviewed by VAR as the camera <b>did not cover the incident</b> and there was no support for the potential review

Table 2. Findings summary

## 6 Discussion and Conclusion

In this research, we set out to offer new insights for information systems research by demonstrating a fundamental, but hitherto neglected tension: between real-world contexts that lack objectivity and the application of information systems to make sense of them. We focused on the introduction of VAR to support decision making, reason about events and execute tasks.

While this is a research in progress, we illuminated several concepts, derived from the data, that helps to explain the reasoning behind errors around the use of VAR. At the centre of these concepts is the tension between the application of information systems to faithfully represent a subjective situation and



the human actors that use it. At the same time, the findings show that even when technology fails to work as it should human actors continue to follow it.

Our research in progress, therefore, brings us to the crossroads of the application of information systems to help actors deal with subjectivity, as well as how to recognize when they are not working as they should. This reveals that, with the use of information systems in such contexts, reality is up for grabs: it is a complex sociomaterial construction that is in a constant state of flux. Hence, human actors face “*evolving disorder. There are truths of the moment that change, develop, and take shape through time. It is these changes through time that progressively reveal that a seemingly correct action “back then” is becoming an incorrect action “now”*” (Weick et al., 2005, pp. 412-413).

An important further consideration is that as our data spans four years we note that actors are continuously adapting the rules to support the use of VAR (Brand, 2022; PremierLeague, 2020); for example in an attempt to make the handball rule easier to interpret with VAR. In this way, the enactment of technology forces changes to long-standing institutions.

In our theoretical background, we foregrounded representation theory, mindfulness, and sensemaking. Each of these theories provides us with some foundation for further scaffolding theoretical development and inducing the beginning of a theory on subjectivity and technology enactment. For instance, representation theory helps understand accurate and complete representations which are lacking in some of our analyzed incidents. Mindfulness helps in part to explain why in some instances actors are not alert to the notion that things may be otherwise. Sensemaking deals with equivocality and may in part explain why actors create a story that relies on selective data to confirm a decision.

This paper presents our preliminary work. We are currently building on our sample of incidents. As we do so we discover that the rules are constantly being adapted to streamline the use of VAR, thus, we are also analyzing changes to rules to understand how the technology spurs changes in institutions. Our goal is not only to develop new theory around information systems and subjective contexts, but also to provide some explanation as to how such systems can be improved. At the same time, we argue that the context of digitalization of sports (e.g., Goebeler et al., 2021; Westmattelmann et al., 2021; Xiao et al., 2017) may offer lessons for organizational settings where information systems are applied to deal with subjective but complex problems.

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