The Impact of Video Assistant Referee (VAR)

Decisions On Teams Performance in Modern Football

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Abstract:

Football is a contest between two teams, each with eleven players, competing for 90 minutes to find a winner, with referees whose rulings are definitive. Nevertheless, a single referee often finds it challenging to make precise judgments due to obstructions or close plays that are tough to gauge, resulting in significant mistakes. The Video Assistant Referee (VAR) was implemented to minimize critical refereeing blunders and enhance the decision-making process by allowing review of specific game events. While VAR was designed to elevate the quality of officiating and refine decision-making, some VAR decisions remain debated among supporters. Some fans perceive VAR decisions as biased, whereas others argue that it has barely improved refereeing standards. This study will examine how VAR decisions influence team performance in football, utilizing metrics like overturned goals, subjective calls, and net score impacts. By analyzing a dataset of 20 teams, we aim to uncover the benefits and drawbacks that teams experience concerning various VAR decisions, addressing questions such as whether VAR demonstrates bias towards particular teams, if home teams receive a greater advantage than away teams, and what effects VAR decisions have on teams and players overall.

Key words: Video assistant referee(VAR), teams, working, decision-making

Introduction:

In October 2016, Premier League clubs voted to test Video Assistant Referee (VAR). After the introduction of VAR in the 2017-18 EFL Cup and FA Cup tournaments, discussions began among football's top leagues over negative public perception of the system. Due to the International Football Association Board's (IFAB) exploration of how laws of game can be applied via VAR, it's rapidly in widespread use on the international scene and used down into leagues governed by FIFA's confederation. Nevertheless, the introduction was resisted owing to the negative impact VAR had on the domestic competitions. VAR opponents complain that the system is opaque and match officials cannot re-examine decisions on pitch-side monitors. By the 2019-20 season, it was becoming apparent that players, coaches and clubs in Europe's major leagues were unhappy with VAR, leading to UEFA President Aleksander Ceferin calling talks about its use 'errors' and 'issues'. Video Assistant Referee (VAR) was meant to improve the standard of refereeing and minimize errors in football with the focus on four main types of incidents: validating or denying goals, inspections, red assessments, and overturning previous decisions; To make these calls, a three-person team collaborates

to reconsider decisions made by the primary referee. They achieve this by watching video footage of every incidental event in the match from multiple angles. This team consists of the head Video Assistant Referee, an assistant, Replay Operator, working from a video operation room containing several monitors showing various camera angles. Determining the review: The VAR team may propose a review, but also a decision may be made forward and the head referee requests one after. These decisions can influence whether a team goes on to win and often leads to allegations around particular calls and if certain teams were favoured more outcomes than others.

Literature:

Third parties commentators, coaches tend to have access to technologies that replay events in slow motion or from various angles, enabling criticism of referees' decisions. This technology is not even necessarily accessible to the referees themselves. Various other technologies are well adopted to aid our officials, athletes and media which may contribute enhancing scoring mechanisms within the game. The fundamental principles of the Video Assistant Referee (VAR) system are

1.VAR is an official who can help the referee only in cases of a clear and obvious mistake or serious missed incident concerning goals, penalties, direct red cards.
2.referee always has to make the original decision and cannot just throw it over to the VAR.
3.Even if VAR is used to review the on-field referee decision is final.
4. VAR review process does not have any time limit because it aims for accuracy rather than speed
5. Players and team officials may not challenge a referee's decision to review, the review process or the final decision.
6 The on-field referee alone is authorized to start a review, although all other officials are permitted to recommend a review to the main man.
7.As the VAR officials are presumably checking every incident, there cannot be request to review from coaches or players.

Strategic Adaptations:

Teams are adjusting their strategies to account for VAR. Defenders, for instance, have become more wary of making contact in the penalty area: any challenge, however minimal, on a attacking player is at high risk of being deemed worthy of review by VAR and punishment in the form of a penalty. It has altered the landscape of defensive tactics particularly within key zones like the penalty area.

Psychological Effects:

The psychology of VAR As with any piece of technology, the introduction of VAR has a psychological aspect to it. Some are under more pressure with their every move monitored, while for others the temptation to seek decisions by diving or otherwise may increase in the knowledge that VAR will intervene.

Changes in Match Variables:

<u>Match Duration:</u>

VAR reviews have also increased the average match length; but from 15 to 62 seconds, depending on screen time spent. That leads to long stoppage times, in which crucial, game-changing goals might be scored.

<u>Spot Kicks awarded by VAR</u>

The incidence of penalties has soared since the introduction of VAR, with evidence from the 2018 World Cup. This increase in the

penalties has a huge effect on the outcome of matches.

Decisions on Offside taken by VAR:

VAR has also minimized incorrect offside decisions, which can rectify mistakes that may influence the outcome of matches.

Impact of Disallowed Goals:

On the other hand disallowed goals through the help of VAR can completely ruin a team form. So, think back, for example, to the last-minute City goal against Tottenham in 2019 that was disallowed for a handball in the buildup which effectively denied City a win and two points.

A series of VAR overturns can also pile up to prove detrimental to a team's season. Leicester City's experience during the 2020-21 season, in which it had several goals disallowed that might have earned it precious points, led to a near miss of a Champions League place as it finished fifth.

Research methodology:

We are using a dataset of 20 premier league teams, the dataset is from Kaggle which consists of variables related to VAR decisions, each of which is crucial for understanding the influence of VAR of the match outcomes.

The analysis utilized a dataset from Kaggle compiled by S. Joshi [1].

[1] S. Joshi, "FIFA Video Assistant Referees (VAR)" Kaggle, 2023. [Online]. Available: https://www.kaggle.com/datasets/sauravjoshi23/fifa-video-assistant-referees-var

1.overturns: the number of VAR decisions overturned

2.leading to goals: These are the cases where var decision leads to a goal where: For: Goals given to a team and Against: Goal scored by opposition team

3. Disallowed Goals (For and Against): These are goals that VAR disallowed where For: Goals that were taken away from a team and Against: Goals that were scored by the team but was cancelled

4.Net Goal Score: This is the total impact of VAR on Goals for a team, calculated as (Goals Allowed for - Goals Allowed Against)

5.subjective Decisions: These decisions are based on judgement like handballs or fouls which can go either way For: calls given in a team's favour. Against: calls given against a team

6.Net subjective score: this is the balance of subjective decisions for each team, calculated as (subjective for – subjective decision against)

We will be doing descriptive analysis, impact analysis and home and away analysis to determine the decisions made by VAR

Results:

1.Discriptive analysis:

It is a way of looking at data to understand its basic features. Here we summarize and describe the main parts of the dataset to find patterns and trends of VAR so that we can understand VAR decisions

from the descriptive analysis we found out that

For Teams who benefitted Vs teams Disadvantaged By VAR

NET GOAL SCORE: Teams with high positive values in net goal score are those that benefited the most from VAR decisions leading to goals for them or disallowed goals for their opponents and teams with low or

negative net goal score may have faced more VAR decisions that lead to goals against them or disallowed their goals

Moreover we can conclude from descriptive analysis that the mean we found of the average number of overturn decisions across all the teams is 11, this means on an average each team has about 11 decisions overturned by VAR and the median is also close to the mean which is 11.5 which means overturns are fairly consistently distributed across teams, with no extreme outliers

On an average teams had 1-2 VAR overturn decisions that lead to goals in their favour and 3 goals disallowed due to VAR (mean:2.8), which is more than those awarded by VAR overturns (1.4).

From table 1, we can see that teams that positively impacted by VAR had like Brighton & Hove Albion had the highest positive net goal score of +7.We can also see that negatively impacted teams with net goal score of -5.

And in figure2, we can see that it contains "leading goals to" and ''goals leading against'' where "leading goals to" were goals awarded by VAR to teams gaining a goal showed by green bars and "leading goals against" for teams losing a goal opportunity or having a goal awarded to opposition represented by red bars.

We can observe from figure2 that Arsenal has highest number of goals favouring them while Wolves has significant number of goals against them

Based on the above analysis we can conclude that: VAR is

•The uneven impact of VAR on teams

The analysis reveals that some teams are more aided by VAR decisions than others. E.g Teams such as Brighton have more goals given to them than Wolves or West Ham who seem to have been hurt by VAR decisions more.

• Variability in VAR results:

The inefficiency of how leading goals for and against are distributed across teams indicates that VARs decision don't have an equal effect on all teams. This brings into question of whether one is more favoured than the other.

But the question is what makes VAR biased.

a. crowd effect: an interesting study suggest that referees watching a match back on the TV in silence make slower decisions away from home than when they watched matches and could hear the reaction of the home crowd (Castellano et al., 2014). This demonstrates that the atmosphere produced by the crowd can affect a referee's decisions. This bias becomes much more significant when crowds are closer to pitches. For instance, stadiums such as Old Trafford and Goodison Park can cause referees to be more affected by this effect compared to West ham's stadium.

b. Home advantage: Surprisingly, home teams get fewer yellow and red cards. Outside of football, in sports such as boxing or in events with the summer and winter Olympics where league judges decide for scope, home to loved ones advantage can be identified.

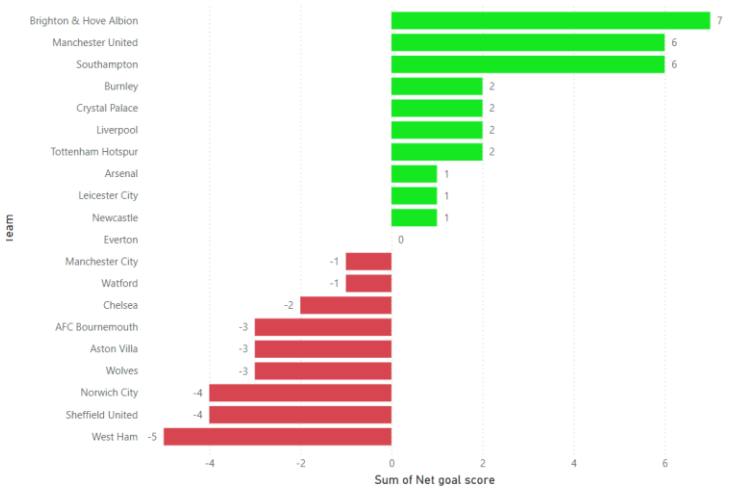

figure1:shows sum of net goals scored affected by VAR for each team

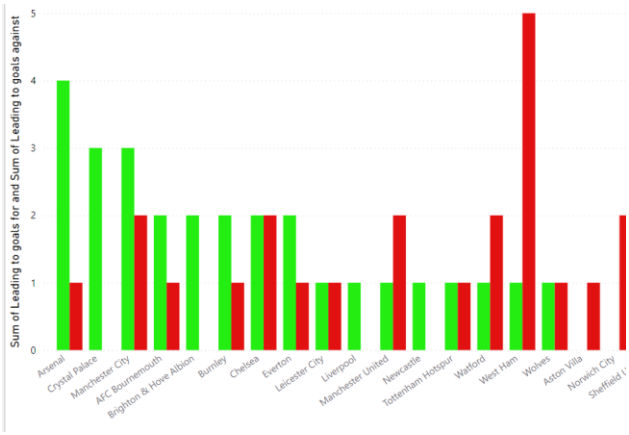

figure2 shows impact of VAR (Video Assistant Referee) decisions on goals "leading to" and "leading against" each team.

2)VAR Decision: Impact Analysis of VAR
This is an analysis of the impact of different types of VAR decisions on football match outcomes. This means categorizing VAR decisions according to their characteristics (objective VS subjective) and quantifying their specific impact on game measures such as goal scored, disallowed goal.

We created two decisions (objective and subjective)

Overturns have more influence than all other VAR interventions on net scores (see figure 3) with disallowed goals (for and against) also being very impactful. Its impact on cumulative team scores, however, is negligible.

Fairness: The average net subjective scores are around zero, indicating that teams generally win or lose an equal number of times on subjective decisions.

Frequent Overturns: Less than three weeks into the tournament, already there had been five overturned decisions a quarter of all VAR plays were being revised.

Cancelled Goals: VAR cancels goals even more often than it overturns other decisions, and when it does intervene in a controversial situation, few things can feel more damaging to the integrity of a game. This consists of awarding or disallowing goals in a game, potentially changing the course and scoreline.

Effect of Subjective VAR Calls: Balanced subjective calls are visible with "Subjective decisions for" and "Subjective decisions against" having similar impact suggesting balanced distribution without repeat bias against or in favour of teams. This fairness is also corroborated by the low "Net Subjective Score," suggesting relatively even decision-making across teams, with no long-term advantage.

Overturns as the Most Influential VAR Decisions: Overturns averaged higher than any other category, suggesting a strong impact from VAR on games. Such decisions commonly pertain to key incidents such as goals, which affect the scoreline and consequently the match result.

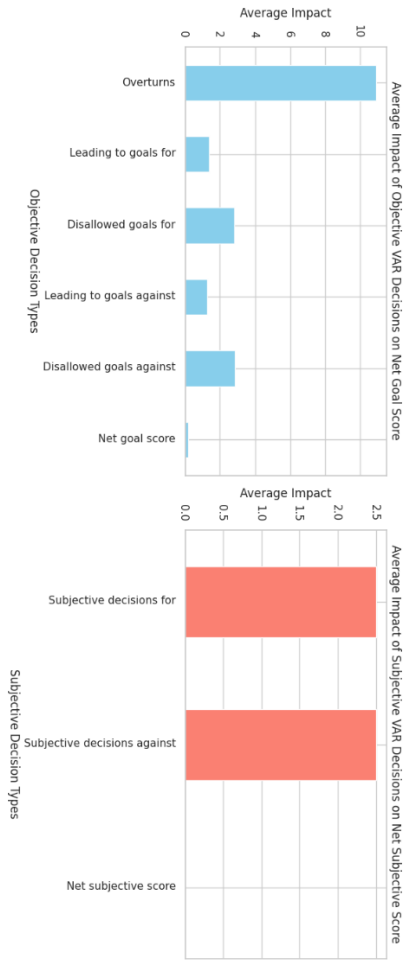

Figure3: shows the difference between subjective and objective decisions made by VAR based on Net goal Score and subjective decisions

3. Home vs. Away Analysis

Analysis of Home vs Away:

Along with this analysis of the effect on teams playing at home or away, it aims to find if VAR decisions actually impact teams differently based on whether they are playing at home or away.

Assumptions:

Assumption 1: the dataset does not tell us if matches are home or away, so we assume

1." Generally a home advantage for "Goals against," "Leading to goals for," and "Disallowed goals for" because of crowd effect.

2." Away matches where the home crowd is behind their team naturally have higher chances of "Leading to goals against" and "Disallowed goals against".

Impact Score Calculation:

Home Impact Score = (Goals for) − (Disallowed goals for)

Away Impact Score = (Goals that lead to goals against) − (Goals that are nullified against)

Hypothesis Testing:

We used the paired t-test to compare Home and Away Impact Scores.

The null hypothesis says that there not much difference between Home and Away Impact Scores (**H_0:** μ Home – μ Away = 0).

H_1: There is a difference between home and away teams (μ Home – μ Away $\neq$ 0)

significance value (α): 0.05(5%).

Results:

Since each team has both a series of scores (they are paired), we performed a paired t-test. The t-stat had a value of 0.27 (p = 0.7923).

Conclusion:

We notice that the p-value (0.7923) is larger than 0.05 so we cannot reject the null hypothesis. This shows there are no significant differences at all between Home and Away Impact Scores which means that VAR decisions do not significantly favour/penalize home crowds.

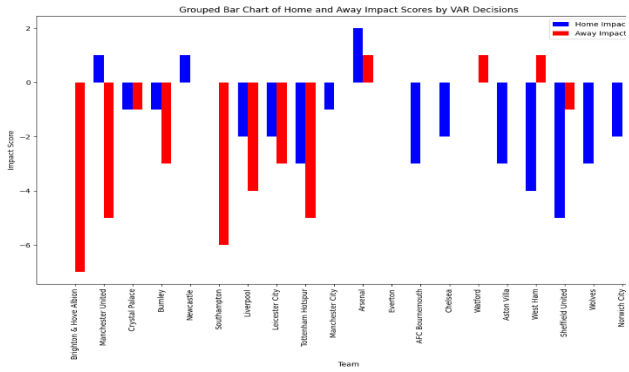

Figure 4:difference between home and away teams VAR decisions impact

1.Home / away advantage: The graph reveals how the VAR decisions influence each side at home and away games. Some teams appeared to have higher home results (blue bars high) and as you see, some do better away (red bars higher) But for some teams, it's a different story

2.Equality by VAR :The test we ran examines whether there is a significant differentiation in how VAR decisions impact home versus away teams. This result suggests that any differences we observe are probably just chance fluctuations and not evidence of an overall VAR preference for either home teams or away teams.

conclusions

Overall Impact:

Mixed But Slight Positive Impact

Based on the descriptive analysis, it appears that teams (like Manchester United and Brighton and Hove Albion) have a net goal score above zero indicating they were on the positive side of VAR interventions. The opposite was true for Aston Villa and Sheffield United, who had a negative net effect. This suggests that VAR has benefitted some but then others, and hence people's opinions on its fairness have largely differed.

VAR Decision Consistency: No Substantial Bias Found

The results of the t-test analysis comparing home and away impact scores indicated that there is no statistically significant difference ($p > 0.05$), which suggests that VAR favours neither home nor away teams. It goes totally against the narrative that home crowd pressure has an impact on VAR decision-making. These results indicate that VAR is used in a neutral and consistent manner, regardless of match context.

Impact on the Flow of the Game: Overturns and Disallowed Goals Coming Fast and Furious

The match results are strongly influenced by the VAR interventions, especially on overturns and disallowed goals. However, these decisions are made to improve the validity of critical calls (for instance an offside or a handball) and therefore, these decisions might hinder normal game flow and affect strategies of the respective team ultimately resulting into jam-packed scenarios in the game.

What Is Your Perception of Bias and What Are the Data You have you think feel there might be biased somewhere, well too bad because the systematic bias is not able to derive any evidence up till now.

While teams are complaining about possible bias in subjective calls, fans are whining about the very same thing skipping over loud shouts of “SEC bias”, study those claims.

Takeaway Final: VAR Is Accessible?

Yes, but with limitations. VAR helps increase decision correctness, particularly for decisions that need to overturn erroneous on-field calls. But it is not equally beneficial for all teams and frequent usage may break the rhythm of play. Referees of the future need to be better trained and have more clearly defined frameworks for how VAR is used, with more intention behind its use — if such measures will increase levels of consistency and reduce apprehension towards it from clubs and supporters.

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