Use of Decision-Aid Technologies in Soccer

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By

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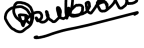
On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: 

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Introduction

Soccer is the most popular sport in the world, with more than a billion fans. In the last few years, soccer has been a hot topic of discussion in the sports world, not only due to the big tournaments and games but also due to the use of decision-aid technologies that is deciding the outcome of the big tournaments and games. Decision-aid technologies consist of a set of technologies like video assistant referee (VAR) and goal-line technology (GLT) that are designed to help match officials make the right decision. Although soccer, in comparison to other sports like tennis and cricket, was late in adopting the technology, the use of decision-aid technologies in soccer has skyrocketed since the 2014 World Cup. Decision-aid technologies are now used in almost every major soccer tournament. However, there have been many controversies regarding the adoption of these technologies in soccer.

Fédération Internationale de Football Association (FIFA), the most powerful governing body of soccer, was reluctant to bring the new review technology under the presidency of Sepp Blatter (previous president of FIFA). Blatter believed that mistakes of players, coaches, and referees bring a human touch to the game (Alvarez, 2017). After the resignation of Sepp Blatter in 2015, various technologies were introduced to minimize the referee's error. For the first time in Soccer World Cup history, FIFA introduced VAR in 2018. Even though FIFA claims that these technologies help to make the game fairer, it has created myriad controversies and divided people on the decisions made by VAR.

Gianni Infantino (current FIFA president) stated: "We can see in the matches, where the game is being interrupted, this creates an additional moment of tension where everyone is waiting" (Govind, 2018, p. 1). Many people complain that VAR also has taken away the instantaneous joy of goal celebration, which is detrimental to the atmosphere in stadiums (Evans,

2018). Fans are worried about the goal being taken away before celebrating goals due to the possibility of a review. However, there were also many controversies regarding referees' decisions before GLT and VAR. For example, in a 2010 World Cup game between England and Germany, the referee disallowed a goal when the ball bounced inside the goal line and came out of the line (Smyth & Murray, 2014). Similarly, there were also many offside goals and unidentified foul plays before VAR, which used to cause heated arguments between fans. For example, an infamous Diego Maradona's goal by the "hand of god" in the 1986 World Cup. Therefore, I will explore the impacts of these technologies on the players, coaches, referees, fans, all other stakeholders, and the game of soccer itself.

Case Context

A need for the decision-aid technology was felt when the error made by referees changed the final result of a couple of games during the FIFA World Cup 2010. Since then, a lot of efforts have been made to minimize the referee's error in the game. Currently, there are two primary decision-aid technologies: GLT and VAR. GLT works in a simple way. The referees on the field are instantly alerted on their watch if the ball crosses the goal line. It was introduced in 2012 as a result of a project conducted by the Royal Netherlands Football Association (KNVB) called Refereeing 2.0, which had an aim to "reinvent refereeing" (Medeiros, 2018, p.1). VAR was also an outcome of the same project. Upon asked about the reason behind using VAR, Lukas Brud, secretary at the International Football Association (IFAB), said, "With all the 4G and Wi-Fi in stadia today, the referee is the only person who can't see exactly what is happening and he's actually the only one who should. We knew we had to protect referees from making mistakes that everyone can see immediately" (Medeiros, 2018, p.1). In 2014, KNVB began informally petitioning IFAB, the organization responsible for developing the laws of the game, to introduce

video-assistance in football matches. In 2016, at IFAB's Annual General Meeting, a decision was made to start a two-year experiment to validate VAR scientifically. Then, under the supervision of IFAB, Major League Soccer (MLS) and A-League Australia started the live trial for the VAR system (Alvarej, 2016, p.1). FIFA World Cup 2018 was the first major international tournament where VAR was used. After the World Cup, VAR gained popularity all over Europe, and all the major leagues began using VAR.

According to the rules set by IFAB (2017), VAR is restricted to be only used when there is "clear and obvious error" in match-changing situations like possible infringement just before a goal, penalties, red cards, and instances when the referee mistakenly cautions the wrong player. Various officials are involved in making decisions in those match-changing situations. There is the main match referee, two referees on the sideline, a fourth official, and a video assistant referee (VAR). VAR referee has his team of technicians to help him see any event from different angles and speeds. All referees are always in contact with each other through the headset. When any match-changing event occurs, and if it is in clear sight of the on-ground referees, they give decisions without consulting with VAR. Even when VAR is not asked, VAR check every decision made by on-ground referees and communicate with them if their decision is wrong. However, if any event is difficult for on-ground referees to judge, then they will ask VAR to provide them more information. In a very rare case, where VAR cannot make any decision, the main match referee goes to the sideline and watches the video himself to make the final decision.

Technological Momentum and Decision-Aid Technology

In order to understand how the decision-aid technology influences and gets influenced by various social groups and individuals over time, I will use Thomas P. Hughes' (1994) framework of technological momentum. The idea of technological momentum is that both society and

technology influence each other depending upon the age of the technology. According to Hughes, technological momentum avoids the extremism of technological determinism and social construction by presenting a more complex, flexible, time-dependent, and persuasive explanation of a technological change. He says that a technological system can be both a cause and an effect of the changes seen in society. Hughes (1987) described that a new technological system evolves through various phases like invention, development, innovation, technology transfer, and growth, competition, and consolidation. However, the phases do not necessarily have to be sequential.

There are primarily two types of inventions: radical and conservative. An invention that occurs during the inventive phase, which gives rise to a new technological system, is radical. Whereas, inventions that primarily happens during competition and growth phases that help to improve or expand the existing system are conservative inventions. Both types of the invention can be seen in the life-cycle a technological system. After the invention phase, a technological system goes into the development phase, where economic, political, and social characteristics are given to the invention. Then, the previous inventions are combined with the new

inventions to make a new product in a phase called innovation. Afterward, the technology is altered or improved to fit in the new environment during the phase known as technological transfer. A technology also gains style in this phase. A style of the technology can be shaped by the economic and social condition of a place at the time of transfer. After this phase, technology enters into the phase of growth, competition, and consolidation. In this phase, the use/production of technology is scaled up for efficiency. Then, as technology grows, new similar technologies come into the market to compete, but only better technologies get consolidated in the market. During the phase of growth, various components in the technological system that slow down the growth of the entire system are identified. They are called ‘reverse

salient.' Inventors solve this problem through conservative inventions. At last, after prolonged growth and consolidation, the technology gains a lot of momentum. It still does not become autonomous and deterministic, but at this phase, it requires massive social forces to change or stop it. Older technologies are more independent of outside influence and deterministic in nature compared to the newer technology due to its momentum. Its momentum arises from the number of organizations and people involved in the system.

Hughes (1994) uses a case study of a technological system of EBASCO (The Electric Bond and Share Company) to show how the socio-technical system both shaped and was shaped by the society on various occasions. When EBASCO was just formed, it was influenced by political and economic forces of society to change the way it operated, but once it started gaining momentum and getting bigger, it started shaping other industries and communities. Hughes identifies the distinct phases of technology and describes its characteristics. Similarly, in this research, the decision-aid technology system is analyzed using this framework to understand its various phases, and pattern of growth and evolution. Moreover, reverse salient, technological style, and system builders are also identified and discussed in this research.

Research Question and Methods

The research question that I seek to answer is how have decision-aid technologies, primarily video assistant referees (VAR), impacted various stakeholders and the overall game of soccer? This research focuses mainly on understanding how fans and players have been affected by the technology. I reviewed various case studies and articles about the decision-aid technology and have used them extensively to answer my research question. To understand the perspective of soccer fans, I looked at social media sites like Reddit and Facebook groups that focus on the English Premier League (EPL) and Spanish League (La Liga) to collect information about the

opinions of soccer fans about decision-aid technology. I watched the videos of the matches, in which the decision-aid technology changed the decision of the on-ground referee. Moreover, I also looked at the press conference of the games, after decision-aid technology was used, to understand how players, coaches, and fans felt about the technology being used in the match.

I also used a survey by YouGov, a British international market research and data analytics company, who published results of a survey about VAR conducted on 1,396 people who regularly watch soccer games (YouGov PLC, 2020). It contains questions that cover almost all aspects of VAR, see Appendix A for the full list of questions. The survey was conducted in various parts of England, Scotland, and Wales so that it includes all the regions of all EPL teams. The survey was conducted from January 15 to January 22 of 2020. Since VAR was introduced in the English Premier League (EPL) on this season (2019/20), survey participants are more likely to be well-known about the VAR and be able to express explicit opinions about it.

Results From Case Studies

Different stakeholders of soccer have been impacted differently by the current implementation of decision-aid technologies. For players, the technology has been used to neat-pick the minor errors and has caused a lot of controversies. For example, VAR is taking minutes to catch players who are offside by merely a few millimeters. Players have started to change their natural game to take advantage of the technology. Similarly, coaches are using VAR breaks to make tactical changes. A lot of Soccer fans, who are the most important stakeholders, have been affected negatively as well. They have mainly complained about the technology taking away the instantaneous joy of goal celebration, slowing down the game, and not being able to see the reviewed incident's video on the stadium's screen. Overall, it has changed the way fans experience soccer by reducing the enjoyment of the match.

Decision-aid technology is slowly beginning to gain momentum as most of the international and domestic tournaments have started using it to officiate the games. Because of its momentum, it has already begun to influence players to change the way they play their game. During the 2019 Women's World Cup, VAR enforced goalkeepers to stay within the goal line when the penalty kick was taken. Another chance of penalty kick was awarded if goalkeeper moved off the edge of the line, which goalkeeper had been doing for years (Gregory, 2019). Similarly, VAR has also impacted the way coaches plan their game. Austin Reynolds (2019) describes the changes brought by the implementation of VAR on the way coaches communicate with players during the game. He uses examples of some of VAR review instances during matches of the 2018 World Cup and 2018 Champions League to show how coaches have used the 'VAR breaks' to communicate changes in strategy with players (Figure1). Therefore, he blames VAR for making soccer more technical and tactical than natural and original.

Figure 1. Jurgen Klopp, Coach of Liverpool Football Club (LFC), speaking to his players during a 2018 Champions League match while VAR was the reviewing decision (Image source: Botterill, 2018)

According to James Milner, a midfielder of LFC, many players do no favor the use of technology to aid referees (Latham-Coyle, 2019, p. 1). He also blamed VAR for ruining the atmosphere for football matches. He, however, praised GLT by saying, "Goal-line technology is incredible. Instant decision. Black and white." He also said that VAR is amazing if it is improved. "If the VAR took away controversy, I'd back it 100 percent. But we're still having discussions about VAR. I don't think many footballers feel differently," he clarified. Besides that, Jurgen Klopp, Coach of Liverpool Football Club, said VAR creates a lot of confusion for players and makes no sense of the way it works (Latham-Coyle, 2019, p. 1). He expressed his displeasure on VAR by giving an example of the incident that happened during a match between Liverpool and Leicester City on October 5, 2019. His main concern was that referees let the game run even if there is a foul because VAR can check it later, but VAR may not be able to review if the video is unclear or blocked by other players, which means the wrong decision will stand.

Besides coaches and players, soccer fans have been impacted a lot by the implementation of decision-aid technology. Mathiew Winland and Craig Fergusion (2018) used a quantitative approach based on an online questionnaire to collect the information from the Scottish football supporters to understand their perceptions toward GLT. By analyzing the data from the interviews, they found out that the decision-aid technology had significantly impacted the atmosphere of the stadium, which fans consider is the most crucial component of satisfaction at a sports event. The introduction of decision-aid technology like Goal Line Technology (GLT) has lessened the live supporters' satisfaction at the game event. Similarly, Michael Lynch (2019) has also argued how VAR is destroying the ambiance and mood in the stands by stopping the continuous flow and rhythm of the game. He believes that the continuous and constant

movement of the play is what makes soccer unique from other sports, and VAR is removing that fundamental part from soccer.

Fans' Discussion on VAR

While searching for online posts about decision-aid technology on Reddit, I found a lot of posts where people expressed their opinions about the changes brought by VAR. There were broadly three different types of posts based on the people's opinion about VAR. They are: VAR is destroying the game and should be removed completely, VAR is working perfectly, and VAR is good for the sport but needs a few changes. People who didn't like VAR primarily complained about VAR altering the natural flow of the game, destroying the ambiance of the stadium, being overly picky about the offside decision, and wasting time. Here is what one user, who disliked VAR, posted:

> The most important factor [of soccer] is the actual nature of the game There is no guarantee of a win for either side, there is not even a guarantee of goals. Goals (or points) are indeed relatively rare compared to most other sports. The individual scoring unit in cricket, basketball, tennis or rugby are very different and more common. And there is the issue of variable reward since a 0-0 is the default state which may never change. The key is that without any guarantee of a result, let alone a goal, when a goal does come it does so in a huge release of nervous energy, fear, hope and tension. Such a release is magnified by context; time of the game, a comeback, against your rivals, against all odds, near the end of the season etc. etc. The football scoring unit is rare and uncertain, the tension magnifiers are many.
>
> When VAR is introduced and your team scores a goal, will you celebrate? Or will you take a moment to look at the ref to see if you can celebrate without imminent

> contradiction? If you do that even for a second that instant moment of release will be muted. Wait 40 seconds - the maximum review time for VAR - and the explosion of joy will never come. We cannot have reviews for goals AND keep the most intense moments in this sport. ("VAR will ruin football," 2018, para. 3-4)

There were many other follow-up comments and other posts that were similar to this post. But some users had different opinions of VAR as well. People who liked the current implementation of VAR seemed to only care about the accuracy of the referee decision and ignore the costs of it. Here is a post from a person who supported VAR:

> I'd rather have VAR and have 90% of incorrect decisions fixed, than not having it and keeping 100% of incorrect decisions wrong. Football has always been prone to human error, yes, but if we can help referees get most things right, then why shouldn't we?
>
> So many teams that have been knocked out of tournaments due to phantom goals, offside goals, uncalled penalties, etc. Every one of us has probably been on the receiving end a couple of times. So, anything that helps bring justice to the table, is well received imo.
>
> As for the time it takes, well, I don't like 5-minute interruptions. But I'd rather have that than taking 30 seconds and coming up with a sloppy/wrong decision. It may break the flow of the game, but allowing/disallowing a goal that shouldn't influences the flow of the game much more than a prolonged interruption. ("The Debate: Is VAR ruining football?", 2019)

Whereas, there were also a lot of posts from the people who liked VAR but were unhappy with the way it was implemented currently. These people wanted the International Football Association Board (IFAB), a body responsible for determining the laws of the game, for explicitly defining "clear and obvious error," have a better on-field referee, and fewer VAR

reviews and time limits on each review. They believed that decision-aid technology could also be successful in soccer like in tennis and cricket, if used properly. Here is an example of this type of post:

> The technology is fantastic, it's the people using it that are [messing] it up. Look at how well video tech is used in sports like tennis or cricket. Football has a wider reach and no standardized policy about how to implement VAR, and that's what's hurting it. ("The Debate: Is VAR ruining football?", 2019)

While there were hundreds of posts on VAR, most of them fall into one of these three broad categories. The posts that are shown above represent most of the posts of each type. While roughly counting the number of posts of each nature, there were significantly fewer people who liked the current implementation of VAR (Type 2). Most of the people either wanted VAR to be removed entirely or to be implemented with some modifications.

Results From Survey

Furthermore, I looked at the survey done by YouGov on VAR to find what proportion of people have a positive, negative, or neutral opinion about VAR. It was conducted on people who watch premier league very or fairly frequently. According to the survey, 27% of the respondents said VAR worked well, 60% said it worked badly and, 13% were neutral or didn't have an opinion. Similarly, 12% said it made the premier league more enjoyable, 67% said it made less enjoyable, and 20% said it did not make any difference. Moreover, 8% said they would want VAR to be used as it is being used right now, 74% said to keep using by changing the way it is implemented, and 15% wanted to stop using VAR completely. 70% of the people said they would like to have a time limit for VAR decision, 81% would like to see the video of any event

being reviewed live in the stadium (which only referees can see right now) and 73% would like to hear the conversations between referees and VAR.

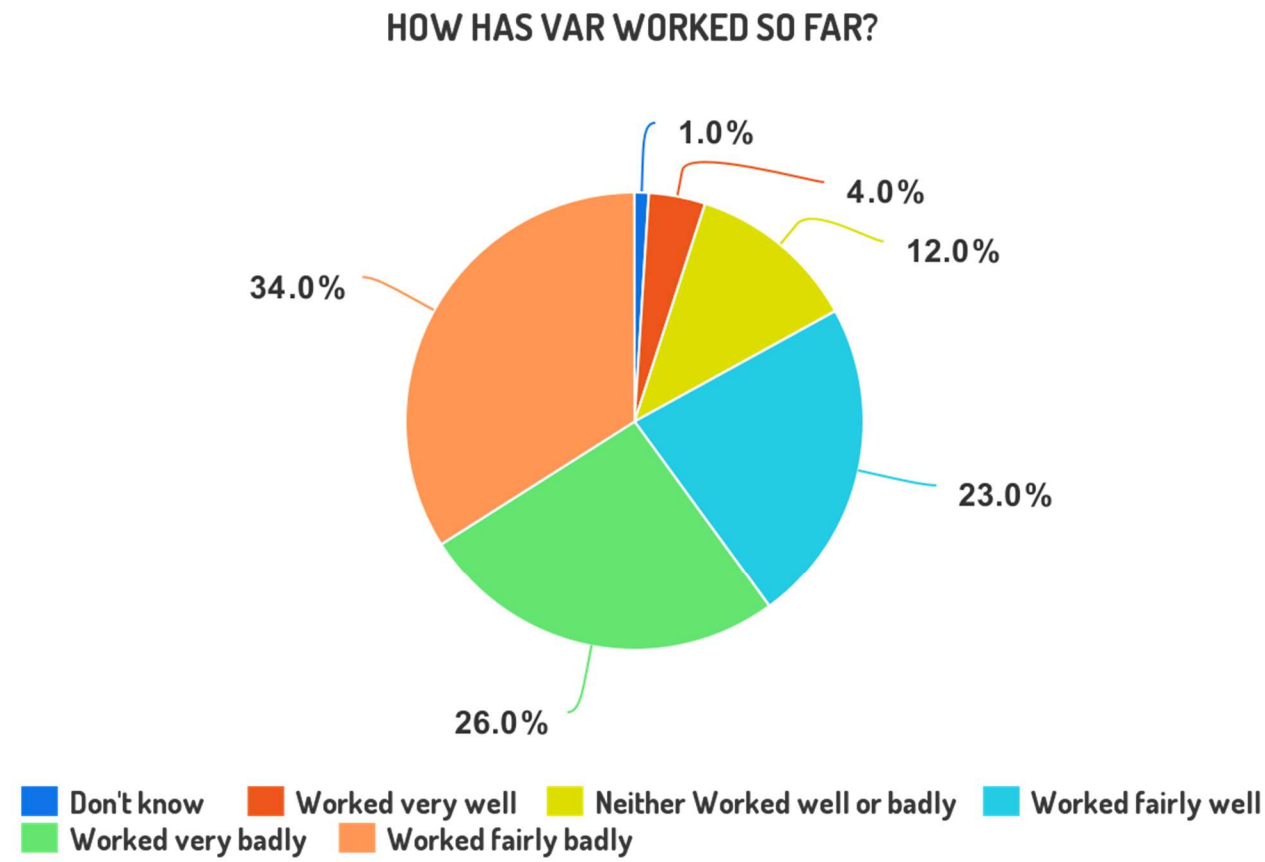

Figure 2. Pie-chart showing data of "how has VAR worked in EPL" question of the YouGov survey.

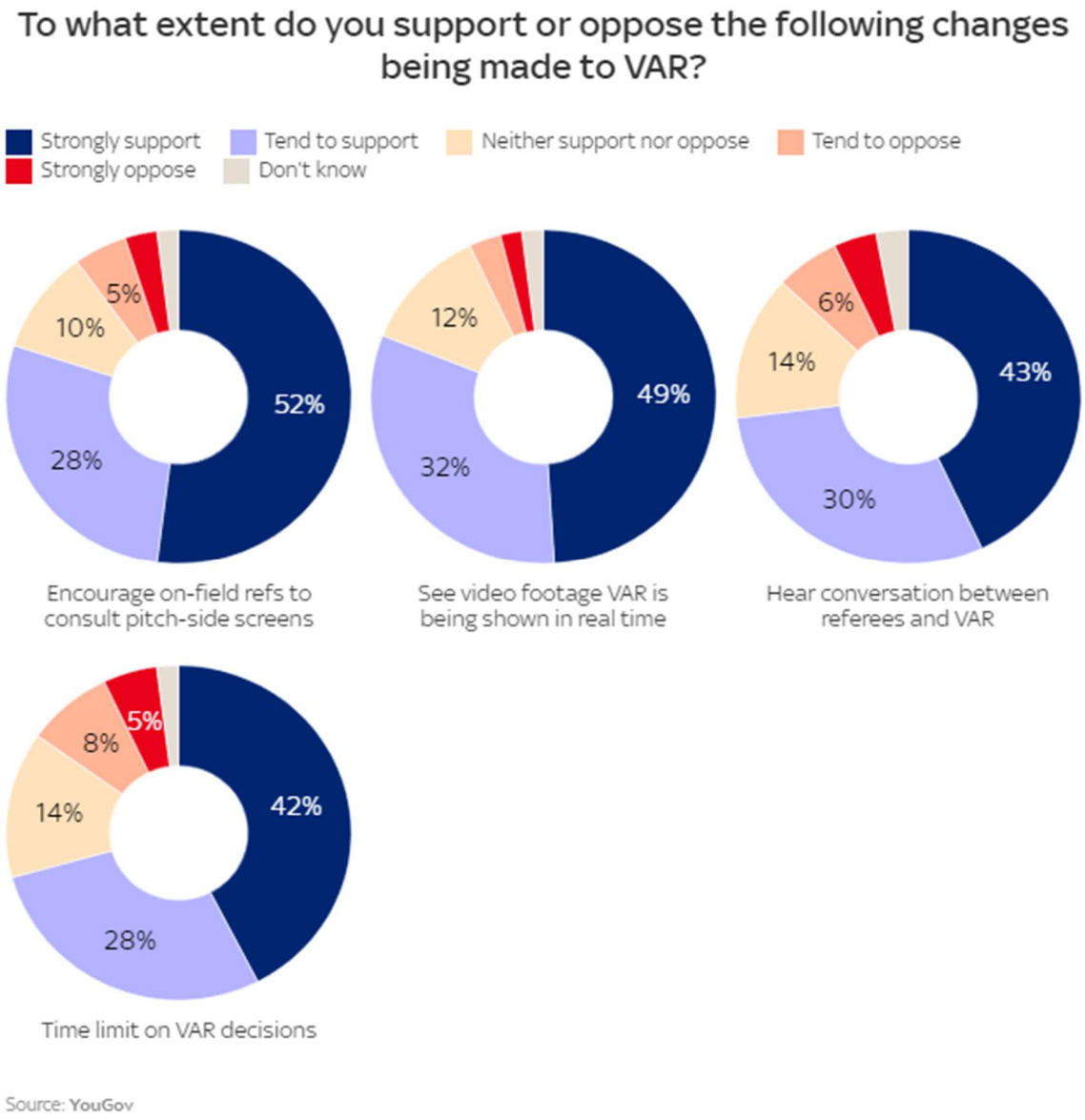

Figure 3. Pie-chart is showing the data about the VAR features that the survey respondents want to see in the future implementation of VAR (Smith, 2020).

Sky Sports, a popular sports TV channel, also asked ten soccer pundits about their opinions on the same questions as the survey ("VAR survey: What do the pundits think? Gary Neville, Jamie Carragher, Paul Merson and more," 2020). The results were very similar to the survey result. On a question about their preference for the future use of VAR, nine of them voted to keep using it but change how it is used. On another question about what changes they wanted

to see about VAR, six of them voted to have a time limit to make a decision, seven of them voted to show the reviewed incident's video footage to the audience in the stadiums, and nine of them voted to be able to hear the conversations referees are having regarding the decision.

Discussion

Looking through the lens of technological momentum, decision-aid technology is in the transition phase from technological transfer to growth, competition, and consolidation. They are the phase after invention, development, and innovation. Since the phases are not sequential, there can still be more development and innovation after transfer. Currently, the technology is being tweaked and altered to fit in various soccer tournaments around the world by the system builders like FIFA and other national soccer organizations. The English premier league (EPL), which started using VAR from 2019-20 season, has come up with a different way of implementing the VAR compared to other tournaments. VAR officials have been told to review a subjective incident (like handball or foul decision) a maximum of three times at full speed and three slow-motion replays - and if the offense is not 'clear and obvious,' they should move on with their original decision (Duncan, 2019). The technology is not in its stable form yet. Some fans have positive opinions about technology, whereas many have complaints and think it should be further improved. Based on the news articles and interviews, it can be observed that a lot of players and fans do not like the use of decision-aid technology in the current form. According to the results from the YouGov survey as well, the majority of people wanted to keep using VAR, yet change the way it is being implemented currently.

During this phase of technological transfer, technology starts to get matured and thus gains technological style. But it is also in the phase when reverse-salients within the technological system can be identified. In the case of VAR, video recording technology seems to

be the reverse-salient. Currently, video operators struggle to find the right video angle and frame that will help referees to make the correct decision. Therefore, referees sometimes take a few minutes to come to a decision, as VAR currently does not have a time limit. According to the survey, taking a long time to make a decision was also one of the main problems with the current implementation of VAR, which people wanted to be fixed. This problem can be addressed by IFAB, a system builder, by innovating new video technology or by developing a new rule that sets the time limit for VAR.

Limitations/Caveats

Even though GLT was the first technology to be used to aid the referee in making decisions, it didn't create any significant controversies. Most people were fine with GLT because it was quick, simple, and, in many cases, fans would not even notice if the technology was used. I also found very few sources that discussed about GLT. So, I focused more on VAR than GLT on this research paper.

In the United States, Major League Soccer (MLS) is the only professional soccer league where VAR is used. The regular season for 2020 began on February 29. So, I was planning on watching a live match from the stadium to observe the live reactions of players and fans when VAR would be used. However, I could not attend the live match because of the matches being postponed due to Coronavirus. So, I watched match videos read online articles and surveys to gather data. I also read discussion posts on Reddit about the use of VAR. Discussion posts provided me a detailed and variety of opinions, which I could not obtain from surveys and case studies. Although it was hard to come up with exact data from discussion posts like surveys, I was able to categorize the posts into a different category and roughly estimate the number. In the

future, I would attend the match from the stadium and also try to interview fans in the stadium and get their direct opinions instead of using Reddit posts.

This research made me look deeply at a topic and to investigate the technical as well as the human and social dimensions of the research topic. I learned to look at a problem from the perspectives of different stakeholders. I also learned to analyze an issue using the existing STS framework. Although the research topic is not related to my future career, I will use this method of researching and analyzing a topic to write a research paper in my future research projects.

Conclusion

Technology can create unexpected and unanticipated problems if it is used to solve a technical or social problem without assessing its future impacts. In soccer, decision-aid technologies were used without considering its implications on fans and players. Even though it reduced the number of incorrect referee decisions, it has created a lot of other problems. The system builders of this technology failed to pay careful attention to the impacts the technology could have on fans and players. Broadly, this research can be used to see how technology can impact sports or other activities in society and how more problems can be created if the social and human dimension is not taken into consideration while addressing an issue. Moreover, anyone researching a similar topic can see how the technological momentum framework can be used to analyze new technology and understand its various phases. By identifying the phase of the technology, we can understand the status or situation of technology and determine how it will impact or be impacted by society.

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Appendix A

A list of questions from YouGov's survey about VAR

1. At the beginning of the 2019-2020 season, the English Premier League introduced Video Assistant Referees (commonly known as VAR) to all matches. How well or badly would you say VAR has worked in the Premier League so far?

2. Overall, how much more or less enjoyable has VAR made watching Premier League football matches, or has it made no difference?

3. What would be your preference on the future use of VAR in Premier League football matches?

4. To what extent do you support or oppose the following changes being made to VAR use in English Premier League football matches?

    a. A time limit on how long it can take for decisions to be made using VAR

    b. Being able to see the video footage the video assistant referees are being shown at the same time they are being shown it