

An Analysis of the Social and Technological Barriers of Instant Replay Technology in the National Football League

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Ben Carper

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On my honor as a University student, I have neither given nor received unauthorized aid on this
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Signed:



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Approved:



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Kent Wayland, Lecturer, Department of Engineering & Society

Problem Frame:

The National Football League (NFL) currently sits at a precarious crossroads regarding the incorporation of varying instant replay technologies. These technologies include a combination of cameras, a centralized review system, and handheld tablets to aid referees in the decision-making process of critical calls. Although the NFL just entered its 100th year of existence, video and instant replay technologies are relatively new ideas. While the technology is new in the grand structure of the league's history, the decision to incorporate varying available technologies remains controversial.

Before discussing the details of instant replay technologies, it is necessary to understand the key actants that influence the development of the league. In the NFL, several critical stakeholders are vital to the game's success; these include the referees, coaches, players, team owners, and fans.

The point of a referee in any sport is to maximize the fairness of the game and to provide objective rulings; the referee acts as a governing body between two opposing sides. Coaches, players, and team owners form unique groups that fall under the governing body of the referees.

The fans provide input and act as a large revenue source but do not fall directly under the governing line of the referees. Each stakeholder has unique issues and the relationships between them shape the way the technology is implemented.

For example, the length of instant replay review has become an increasing concern in the eyes of league officials and fans, often extending games unnecessarily. Extending games with lengthy reviews that do not always produce a conclusive result is an issue for all of the key parties involved. The NFL is at a critical point in time finding the best way to incorporate the appropriate technology. They must do so while also engaging all of their stakeholders to find the quickest, fairest, and most accurate methodology without jeopardizing the legitimacy of calls.

This in-depth analysis will look at the social and technological factors behind the NFL's approach to instant replay technology. Readers will gain a more thorough understanding of the complex relationships between stakeholders and the potential usage of additional innovative technologies. By using Actor-Network Theory, this research will focus on answering the question, "Is instant replay technology practical in the current state of technological and sociological applications?"

The History of Instant Replay in the NFL:

The first nationally televised football game was broadcasted in 1940, but the first instance of replay technology was not introduced for another 36 years during a Monday Night Football Game between the Dallas Cowboys and the Buffalo Bills. The director of officiating at the time, Arty McNally, decided to experiment with a stopwatch and a single video camera to determine how much time a video review would extend a game. During this trial event, McNally observed a missed call on OJ Simpson, and at that moment, he knew review with video cameras would benefit the game.

Two years later in 1978, as a result of McNally's video trial, the league tested an instant replay system in seven preseason games. The technology was a good idea in theory, but at the time was causing lengthy delays in the game often with no conclusive evidence. Additionally, instant replay was requiring more cameras than broadcasters and was deemed too costly and largely ineffective because many plays were indecisive after prolonged amounts of time. At one point, the supervisor of officials at the time Nick Skorich stated, "Electronically, I don't know if we are advanced enough yet..." to manage instant replay technology (History of Instant, n.d., para 8). Fast forward ten years later to 1985 and instant replay was suddenly being talked about as an option again. Because the technology had greatly improved since the previous trial including

decreased lag time communication and increased camera clarity, the league decided to try with another eight preseason games. Following this series of preseason games, the league became so optimistic about the technology that the next season 23 out of the 28 league owners voted to use it moving forward. The decision was that the new technology would be implemented on a year-by-year basis so the stakes were low and potential rewards were high. The majority of the calls at the time were only initiated by the in-booth referee, and all plays were overturned only with “indisputable video evidence”.

However, the implementation of new technology presented new challenges the following season. For example, a replay review miscommunication on a controversial touchdown occurred when the assistant supervisor of officials relayed an incomplete pass and the on-field official heard “complete pass”. The game ended with the final score of 24-17; the controversial touchdown made the difference between winning and losing leaving league owners and coaches infuriated with the league changes.

Over the next 5-10 years, the NFL went through many iterations to improve the instant replay system. The technology was constantly improving including upgraded review monitors and human knowledge was also increasing requiring referees to attend replay training clinics every offseason. Then, in 1991, due to the lengthy increases of game duration and lack of overturned calls, only 17 owners voted to use replay for the upcoming season, and it was again discontinued. Table 1 describes the replay review trends throughout this period.

Table 1: A detailed view from 1986-1991 of the reversal rates of plays reviewed and the amount per game

Year	Games	Plays Reviewed	Reversals
1986	224	374 (1.6 per game)	38 (10%)
1987	210	490 (2.3 per game)	57 (11.6%)
1988	224	537 (2.3 per game)	53 (9.8%)
1989	224	492 (2.1 per game)	65 (13%)
1990	224	504 (2.2 per game)	73 (14.4%)
1991	224	570 (2.5 per game)	90 (15.7%)
1986-1991	1,330	2,967 (2.2 per game)	376 (12.6%)

The instant replay technology became a major point of contention, once again, in the league. The instant replay system was being decided by team owners, but many had contrasting ideas on how the review system should be implemented. In the NFL, the competition committee is the main, overall governing body of the NFL for rule changes and technology implementation. They gather information about potential changes to the rules and technology and currently consists of two team owners, two presidents, two general managers, and three head coaches. During these years of contention in the '80s (and still today), the competition committee would analyze the faults and successes of instant replay and its accompanying technology and report its findings at an annual meeting where all 32 owners of the NFL teams would reside. At these meetings, the owners would be the final voice of decision and determined that "...to be adopted, a new rule or a revision must have the support of 75 percent of the owners (24 yes votes out of 32 clubs)" (The

NFL Competition Committee, n.d., para. 6). In the late '80s, several owners suggested that instant replay technology should be improvised rather than discontinued entirely, and even had the commissioner of the league, Paul Tagliabue, eager to improve the current system. However, two definitive sides regarding instant replay implementation remained. One group felt the cost in terms of game time, inconclusive results, and lack of technology was still too high. The other believed an instant replay system was mandatory to make pivotal calls.

After a 5-year gap with a lack of official instant replay system, the league re-introduced a new and improved replay system to test in 1996. There was a new generation of coaches who were eager to understand this new system. Additionally, these new coaches did not have the same pessimistic attitude toward the instant replay system since they had not struggled through the early days of implementation.

The league went through a similar year-by-year voting process until 1999 when a combination of improved technology and lenient policies helped so, "...voters felt like this was a compromise" (History of Instant, n.d., para. 54). These new policies helped shape a similar system to what the league implements today including 1) coaches are allowed two challenges per half, 2) coaches are charged for an unsuccessful challenge, and 3) the replay booth initiates all reviews within 2 minutes of each half. Finally, in 2007, instant replay became a permanent fixture in the league ending the yearly acceptance vote.

The idea of instant replay and its enhancements has been an iterative process throughout the history of the league. This issue among stakeholders is constantly reoccurring in today's game and can be derived into two varying groups consisting of knowledge and performance. The knowledge group is concerned with understanding what happens during a play and where the ball ends up; the performance group ensures the perception of the audience matches the

conclusions of the review. These key elements shape the way the technology is formed and the perceptions of the actant groups.

Current state and usage of technology – including consequences of continuing action

The NFL is as much of a major production company as it is a sports company, and every regular-season game consists of 12-20 cameras deployed simultaneously by the broadcasting company.

These cameras focus on all angles of the football play to provide the replay crew the best view of the play under contention. These innovations in camera technology have provided increased visibility for all parties interested in seeing plays including referees, coaches, fans, players, etc.

However, there are many instances in which the cameras are unable to get the exact view that the referees need. This can be attributed to poor camera angles and/or players obstructing camera views leaving a lack of sufficient evidence to make informed calls. When calls are left

unanswered due to the lack of sufficient evidence, the question of how plays are reviewed and concluded must be brought into consideration. For example, indisputable video evidence (IVE) is the standard when referees analyze the current system for instant replays. IVE is the idea that if, after reviewing all angles, the referees do not have the sufficient video angles to either confirm or reverse a play, they must keep the call on the field as stands.

The increased transparency through technological advances has increased demand for calls to be called correctly across all sports. Coaches, fans, and players all have instant access to plays on jumbotrons up to 11,000 square feet and mere seconds after plays occur. The social norm for referees is to review plays when there is doubt, then either confirm or reverse plays based on the camera varying video reviews they observe. However, if the 12-20 cameras that are simultaneously deployed miss the angle that could definitively confirm or reverse a call, the

referees must stick to the call on the field. This approach is not taken lightly when egregious human errors are made and a play must stand as called.

The question then arises, if there are more advanced technologies currently deployed in other sports for location tracking, why does the NFL still rely on simple camera angles? Additionally, is it fair to call a play on the field as it stands simply because the camera was not at the right angle at the stadium? These questions have drastic consequences in terms of player development, player career legacy, financial benefits. As currently called, these decisions can also alter the way the future of the league is shaped.

Usage of varying applicable technologies

There are several compelling technologies currently used in multiple sports to aid in critical decision-making situations. The question then arises, since more advanced technologies exist why does the NFL still rely on simple camera angles and the IVE approach? A look at FIFA Soccer provides an example of the use of enhanced technology integration when using instant replay equipment.

In the South African FIFA Soccer World Cup in 2010, there were several instances of balls that were believed to cross the plane of the goal, but the referees called no goal and vice-versa. After the conclusion of the world cup, there was a widespread cry for advanced technology in replay review by the international soccer community. This demand for goal-line technology was almost immediately incorporated in test trials at the 2012 Club World Cup.

The Video Assistant Referee (more commonly referred to as VAR) is an additional referee added to all high-level soccer matches. The VAR is meant to be used to correct binary calls rather than subjective calls including goal vs. no goal, offside calls, and penalties. The system is used only in “clear and obvious errors” with the goal of not breaking the flow of the game.

Alongside multiple screens and camera angles, the VAR also uses a novel technology implemented by a company named Hawkeye, which installs 7 cameras per goal. This goal-line technology uses a combination of cameras and magnetic fields to help determine with more precise accuracy whether the ball crosses the plane of the goal. These cameras all provide unique images and identify the areas of the goal line that "...are definitely not the ball" and "...is able to locate the ball even if it is only found in 2 of the 7 cameras". As a matter of fact, "There has never been a goal-line incident where the ball would not have been seen by any of the Hawkeye cameras" according to the Hawkeye technology official website and VAR, "How it works" page.

Additionally, in tennis, the usage of Hawkeye technology has been incorporated in the sport since 2002 to determine if a ball lands in or out of play. This enhanced technology can measure the ball within five millimeters of the correct landing spot equivalent to ~7% the width of a tennis ball (Gage, S, 2013, para. 12). The most compelling argument stated in the Hawk-Eye innovations VAR technology "How it works" page is that the high-speed camera takes photos at a frame per second rate rapid enough that they are capable of removing the players from the image to ensure the ball is fully visible. The NFL, however, still sticks to only 12-20 broadcasts and relies on human judgment, IVE, and a cameraman to make correct calls; these calls are often game and career-changing.

There are more advanced forms of technology that the NFL is choosing not to incorporate. These choices for important stakeholders are much deeper than surface-level decisions when it comes to how the technology should be incorporated. Often coaches, owners, players, and league officials have contrasting opinions on what would best help make critical decisions. Many sides believe the technology would not benefit the game but hurt the integrity of the sport. Others

believe it would allow for many subjective calls to be measured objectively. The next portion of the analysis will focus on the underlying social, economic, and technological barriers to implementation that prohibit the technology from immediate use in the league.

Literature Review

Scholarly literature has been written about the topic of instant replay in the NFL specifically regarding the standards of officiating and the basis of reviewing and overturning calls. Berman (2011) draws on the idea of “Indisputable Video Evidence” and the consequences of using this system of review. He also includes a proposal for a fairer system. Berman argues that there are two main consequences of using the IVE method: 1) an intended consequence, “...to drastically minimize the number of times a correct initial call is reversed...” and 2) an unintended consequence, “...to ensure that a large number of mistaken initial calls are permitted to stand uncorrected...” (Berman, 2011, p. 10). In other words, correctly called plays are rarely overturned but incorrectly called plays are frequently allowed to stand.

He concludes that with the given assumption that the NFL is not inherently biased in their selection of error minimization, the current system favors correctly called plays on the field to stand more than incorrectly called plays to be overturned. Berman’s proposal for a new basis of evidence would follow a more relaxed standard of review, a *de novo* review. This system is used in legal practice meaning “from the new” and would mean the instant replay review would be independent of the ruling on the field. In other words, rather than needing IVE to overturn the ruling on the field, the review procedure would be unconnected from the previous call. Berman states that this system would correct more errors and incur fewer costs than the currently used IVE system.

Kolbinger & Lames researched the impact of technological officiating in varying sports in 2017. This research goes into detail about the philosophy and jurisprudence behind using advanced technologies for officiating in sports. The premise of their paper defines that in refereeing there should be three types of technology decision categories: the first, technologies that support the decision-making process, technologies that replace the decision-making process, and the third, technologies that help the referee enforce rules. This new taxonomy and ideas are drawn upon throughout this research paper and aid in the analysis.

The gap in knowledge that scholarly literature, up to this point, fail to address the complex relationships between owners, coaches, and players and the recent advances of technology that could currently be applied specifically in the NFL. No literature proposes technological solutions for implementation in the NFL and analyzes the key barriers that are prohibiting it from happening. Additionally, this research paper will discuss where the technology cannot be applied and the consequences of implementing too much technology when it is not necessary. The research specifically addresses how novel technologies can be applied to the NFL and the judgment of fairness when making calls.

Social Barriers

The NFL has a longstanding tradition of upholding key rituals of the game. One of these aspects is the tradition of measuring a first down through two physical sticks connected by a chain. This way of measuring first downs has been the tradition since the Spalding's Official Foot Ball Guide in 1907 introduced the chains "...to assist in measuring the progress of the ball" (Branch, J, 2008, para. 19). The measuring sticks and chains contribute to the overall production and show that the NFL puts on weekly. Part of this so-called production includes the dramatic effects of the officials walking from one side of the field to the other with the bulky chains to the spot of

the ball. Former Director of Officiating Mike Pereira even stated in an interview that “When we measure, we make sure the players are clear so that TV can get a good shot of the actual measurement” (Branch, J, 2008, para. 15). Socially, the NFL producers and league officials find value in the dramatic suspense and “show” aspects of the first down markers, so they are reluctant to make any significant changes at the time. This social barrier of upholding traditions is embedded in the NFL and is one of the main arguments against new technology implementation. The value seen in introducing novel technology and eliminating discussion is much less geared toward the league than it is geared toward leaving the discussion open for debate; it seems to keep the viewers wanting more. In this case, stakeholder expectations shape the extent of the technology introduced into the league by sticking to grassroots traditions. One of the most integral parts of the NFL, and largest financial contributors, are the fans. With the ever-increasing referee transparency and accountability due to increased instant video accessibility, the standards of referees are at an all-time high. They are judged for any type of incorrect call and are publicly accountable on giant video boards in front of 60,000+ fans weekly. The NFL’s current replay review system is centered around the idea of indisputable evidence - stick with the call on the field unless the review shows 100% otherwise. However, fans now have the same access as referees to all the same angles in real-time, and the fans form their own opinions on matters. While the decision may seem like a simple one in real-time to the casual fan, the lack of transparency from league referees to what they are discussing causes fans to become impatient and lose faith in the credibility of referees.

This social interaction between fans and referees is a tense one that, often with a single wrong call, can ruin the fans’ perception of the league referees. The relationship between fans and referees has not always been as tense as it is today. Due to an increase in available technology

and information, people can rely on their intuition and less on the referees in charge to make the calls. This situation described above puts league officials at a critical decision-making point to keep relevant stakeholders interested in the product.

Several approaches in other sports have worked to ease the tensions between fans and referees including in the XFL (Xtreme Football League) and the NBA (National Basketball Association). In the XFL, referees are required to wear microphones during all reviews for increased transparency during critical calls. In the NBA, referees also must be transparent with any reviews as they announce the calls and reasoning to the sideline announcers. Additionally, the NBA releases a detailed “Last Two Minute Report” which highlights all calls and non-calls and determines whether or not the right call was made. These initiatives help referees understand officiating mistakes and help fans understand why certain calls were made or if they were missed. The initiatives are relatively new and seen as proactive because they help improve relationships between fans, coaches, players, and referees. The NFL has not taken proactive approaches to transparency in calls. Current Senior Vice President of Officiating, Al Rivieron, “does record videos and post them to Twitter ... when he feels like it” but “...you’ll never hear from Rivieron when a call is clearly missed.” (Hurley, M, 2019, para. 29).

An intriguing study from the NFL on the productivity of referees is analyzed yearly through a study of their performances. This study is performed as a weekly analysis going over every play to see whether referees made correct or incorrect calls during games. This culmination report helps justify the league's choices of referees by analyzing their performances to decide whether they are making the right calls or not. Per the NFL operations website in 2018, 99.1% of all plays were called on the field without enacting instant replay (These Officials Are Really Good, 2019, para. 27). The average game consists of 154 plays; over the course of the 17-week season, there

are a total of 256 games. This means the average total of plays per season comes out to 39,424. Of the total games played, 99.1% plays called on the field are not reviewed meaning that per year on average there are ~ 355 plays reviewed or 1.34 per game. The NFL states that "... an official's initial ruling on the field is confirmed nearly two-thirds of the time." (These Officials Are Really Good, 2019, para. 28) Thus, out of the 355 plays reviewed per year, approximately 117 are overturned from the initial call on the field or less than a half a call per game.

Table 2: *Tabular view of plays overturned per game on average over the 2018 season*

Games/Year	Plays/Game	Plays/Year	Reviewed/Year	Overtuned/Year	Overtuned/Game
256	154	39,424	355	117	0.457

The interesting insight behind these numbers is the discussion about whether the NFL is using the best metric to evaluate referee success and if they are using all of their technological resources to fairly call games to the best of their ability.

A Bleacher Report interview of former NFL referee, Jerry Frump, reveals the insight behind the NFL's grading criteria. Frump stated, "The NFL has a very sophisticated evaluation system" with, "a live evaluation being done by somebody on-site" (Schalter, 2017, para. 14-15). These particular ratings are not released publicly; however, the evaluation system effectiveness can best be quantified by the annual referee turnover rate. Per Kevin Seifert, an ESPN Staff Writer, in 2015 the NFL replaced 20 officials in 2 years demonstrating the referee turnover rate represented, "...the highest over a two-year period in more than a decade" (Seifert, 2015, para. 3).

Importantly, the current system's metric rewards NFL referees for finding the correct call on the field and not overturning an initial ruling. In other words, the more correct calls a referee makes on the field and does not overturn, the more highly rated he/she is. However, if that initial ruling is not correct but there isn't sufficient evidence to overturn the call, then the ruling on the field must stand. Under NFL referees' current performance reviewal system, the referees are rewarded for getting calls correct on the field; therefore, the current system incentivizes the NFL referees to not overturn calls unless they are certain, with the camera angles provided, that they must overturn. This underlying social construct thus shapes the technology because referees are incentivized to not overturn the initial ruling on the field to earn higher ratings. Moreover, they can replace referees who are underperforming, in their estimation, while indicating to the public that the referees are performing remarkably.

Technological & Economic Constraints

Beyond the social barriers that mutually shape innovative technologies from being incorporated into the current NFL replay system, there are a variety of technological constraints that are shaping the current system. One of these innovative technologies, as stated before, is the Hawkeye technology that is currently used in both VAR for high-level soccer games and tennis matches. Another similar system introduced in 2003 by the inventor of the post-it-note, Alan Amron, has been proposed to the NFL. Amron, an American inventor and entrepreneur introduced laser projection systems to be attached to the first down chains that would show the fans a similar view that is projected on TV. The league officials "...made it very clear to us that they didn't want to eliminate the chains, but augmenting them wouldn't be a bad idea." (Richmond, B, 2013, para. 11).

This idea did not gain much traction as evidenced by the 17-year gap in lack of innovative technology, regarding the use of the chains. Amron has been pitching the idea alongside the late Pat Summerall, former NFL player, and sports broadcaster. Amron stated “We have officials that endorse using our line. We have coaches that endorse using our line. It’s just such a political deal” (Ubben, 2016, para. 9). The issue of implementing advanced technologies in the sport thus goes beyond a technological standpoint – it is a fundamental political issue in the league. Full system implementation of Amron’s technology would cost \$750,000 per stadium. With annual revenue of \$14.48 billion for the NFL, the money is a mere afterthought (Gough, 2020). It is evident that the technology is available and the league refuses to accept for larger underlying social and historical issues than technological barriers.

Another example of a technology company that has shown proof of installation is Hawkeye – the company that deploys sideline technology for tennis and goal-line technology for soccer.

Hawkeye technology’s current system can remove players when analyzing the ball in goal-line decisions to view the exact placement at differing time frames. Thus, the argument appears to be an ongoing battle of overcoming the social barriers and less technological barriers since the technology is available.

Conclusion

The NFL stands at a pivotal point deciding whether to implement new technologies to enhance the instant replay review system. All of the social groups including players, owners, fans, referees, and coaches have varying opinions on the matter. However, in the end, all of the stakeholders want the game to be called in the justest and most technologically capable manner.

The current system has worked for over twenty years now but is constantly being shaped due to the evolving needs of the league along with the evolving technologies that become available. The

consequences of not adopting new technologies are incorrect calls which can at times occur in pivotal situations and alter player and franchise trajectories. However, the consequences of implementing new technologies are aggravating those same stakeholders in adapting to new learning curves. The refereeing process involves a line of subjectivity that technology is not able to interpret but could help in the aid of human decision making. It could assist in location tracking for spotting of the ball but cannot be stretched to decide whether or not a player should be ejected for an egregious foul. In considering new technologies in the future, the NFL must consider all social factors. They must look at the key rituals, referee transparencies, and the referee performance metrics to find the right intersection of objective measurement while maintaining the integrity of the game.

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