

Denison University

**Critical Essay Assignment:
The Implications of Technological Advancement in Soccer**

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INTRODUCTION

Soccer, or football as called in the rest of the world, is known as The Beautiful Game, referring to the appealing aesthetic and community-oriented flavor of the sport. I have been a soccer fan from a very young age, as it is the most popular sport in Asia and, with certainty, in the rest of the world. I remember growing up watching English Premier League games broadcasted weekly on television, reading the daily sports newspaper from the local shop near my house, talking with my friends about our favorite teams and favorite players, playing soccer in the schoolyard with a bunch of classmates, or getting rowdy and festive for the World Cup competition every 4 years. In the past few years, the mass adoption of technology has transformed soccer into a completely new game: The Internet and social media that allow fans to get connected with others and the players, training tools used to enhance body performance, analytics for team building and scouting, instant information through real-time reporting and mobility, goal-line technology and video refereeing for in-game events, and advancement / innovations in boots, gear, kits, balls. At both sides of the table, there are positive and negative impacts that I can think of from observing this adoption movement.

On the positive side: (1) Ease of play is a huge benefit from the addition of technology in soccer. Advanced boots, kits and pitches mean that playing soccer is easier than ever before. Gear and kits are more comfortable, lightweight, and effective than in the past. Kits can now keep the player cool while staying lightweight and becoming flexible and elastic. Boots cushion the impact of the ball while increasing friction and grip on the playing surface. Balls are now more aerodynamic by their panel design and are made for increased friction on the boot so the player has control and can curve the ball. Playing surfaces are now more even and can be played in more conditions. Pitches are also more level and are well maintained for consistency

throughout the pitch with ball speed and bounce. (2) Fairness and equity are incredibly important in modern day sport and are no exception in soccer. With more reliable and consistent pitches, the ball will bounce and travel evenly throughout the pitch. With the introduction of video refereeing and goal line technology, officiating is now more accurate and can pick up errors and mistakes that human eyes can't. (3) Spectating is now easier and more convenient with the introduction of online spectating and live TV broadcasts. Watching a game of soccer is as simple as going to a website and streaming a match directly to your laptop, phone, or TV. This technology also lets the players interact with the game and provide odds on specific outcomes and likelihoods.

On the negative side: (1) Many of the advantages that players have in modern day soccer come at a price including balls, kits, boots and training. These advantages may not be affordable for all players and can leave many without the same opportunities. The high prices from leading sports manufacturers mean that people living in poverty have a disadvantage compared to someone that is growing up with access to the best equipment and facilities. Even though such disparity has always been around, technology adoption only widens that gap. (2) Training is one of the key elements in soccer and is what helps players progress their skills and game knowledge. Training, however, can be very expensive, even for regular sessions with the use of facilities or equipment. Wealthy nations can afford to implement and utilize such facilities, as such they will leave poorer nations behind. For example, countries in Europe and North/South America are significantly better at soccer than the rest of the world because they have the resources to invest in research and development on technology that can improve their game. (3) Technology costs a lot of money and the money could be used for other purposes. Thousands of hours of research and time spent experimenting and testing new products is dedicated to the

production and manufacturing process of technology in soccer. Companies like Adidas, Nike, Puma release many different models of boots, balls, kits, training equipment and they spend billions of dollars annually.

These observations lead to my research question: What are the implications of the impacts that technological advancement brings to the game of soccer? I argue that technology has democratized the performance, construction, and operation of soccer; and thus, made the game more respected and inclusive. There are three lenses that I will be using to assess such impact: (1) Wearable technology provides a means for players to perform better; (2) Big data & analytics help the coaches, teams, and institutions construct better solutions; and (3) Goal-line technology assists the referee to operate the game with utmost fairness and equity.

LITERATURE REVIEW

Past research studies have looked at the role of technology in competitive sports. To address performance-enhancing technology in sport, I look at Sigmund Loland, a prominent scholar in the field of sports and kinesiology. He examines the various kinds of sport technology from the perspective of three normative theories of competitive sport.¹ The first theory is the non-theory - “a theory of the external goals towards which sports can be an efficient means, such as prestige and profit” (3). The non-theory accepts any kind of sport technology as long as it helps the athletes reach their desired goals. The second theory is the thin theory, which “accepts all means of performance enhancement as long as there is equality of opportunity in terms of equal access to all competitors” (4). The underlying premise in this theory is that sport is an arena for the testing out of human limits in objective terms. The third theory is the thick theory – “technology that requires athlete efforts and skills, to which there is equal access, and that does not represent unnecessary risks for harm, is acceptable and in fact of fundamental constitutive

function and value in sport” (5). Thick theory represents an important premise: the norms and values of sport ought to be respected, protected, and cultivated. Loland’s ending argument is that thick theory is the only possibility of a sound technological ethic in sport, because “the thick theory represents a critical and systematic understanding of sport technology and prescribes the choice of the technology that seems to promote human values and respect for the individual athlete, and it rejects technologies that do not” (8). I am going to use this grounding argument in the examination of wearable technology in soccer to see if it meets the thick theory standard.

As someone who is extremely interested in statistics and big data, I am very inclined to look at data analytics usage in sports. One major source that informs my thinking is an independent research study conducted by Thomas Davenport that was published on the International Institute for Analytics on February 2014.² The report is based on a series of interviews with professional sports teams and vendors in the US and Europe. Davenport describes major areas of analytical activity in sport and presents examples of teams that are employing key analytical applications. With a key assumption that professional teams are small businesses, Davenport’s findings result in a series of lessons and steps for teams to take to succeed with sports analytics. This research has many concrete examples of analytical applications in a variety of sports (football, baseball, basketball, hockey), and so that will help me with directions regarding the exploration of analytics usage specifically in soccer. Another source that I look at is Michael Lewis’s 2003 book “Moneyball”, which chronicled Oakland Athletics’ General Manager Billy Beane’s use of sabermetrics to discover the secret to success in the often times unfair and imperfect science of baseball player evaluation.³ This was the first known use of prioritization of statistics and data to make personnel decisions in professional sports. Beane determined that scoring runs was the fruit of certain analytics. In short, his theory

was that a team with a high on-base percentage was a team more likely to score runs and, as a result, more likely to win more games. Beane drafted and traded for players that fit this system, and only those players. The immediate result was that the Athletics were a team that drew far more walks than strikeouts. This high efficiency, low out system has not only revolutionized baseball's modern era, but professional sports as a whole. There's a reason, though, that soccer hasn't yet seen the kind of earthshaking data breakthrough that changed baseball Oakland A's, as dramatized in "Moneyball." Data is still new to soccer. A lot of traditionalists don't like it. Teams that have embraced data are still trying to figure out how to best use it. While analytics has not and will not replace strong players and good coaching as recipes for team success, they have certainly become established as important augmentation for those basic success factors.

Last but not least, I consult a few sources on the use of goal-line technology for my study. Goal-line technology is one of the most recent adoption to soccer, precisely when FIFA agreed to implement it for the 2014 World Cup as a response to the prominent incident in the 2010 World Cup in which a legal goal by England's Frank Lampard had been denied because of human error. In contrast to other sports that were quicker to embrace officiating technology, the highly conservative sphere of soccer, and its governing body FIFA, aimed to retain its traditional roots. Sepp Blatter, in a statement on FIFA's website, gave 8 reasons why goal line technology should not be implemented. These reasons can be broadly separated into 3 categories: those dealing with the nature and value of the game of soccer, those related to issues of justice, and those concerned with its practical implementation (Ryall, 2012)⁴. There are critics who are for and against the use of goal-line technology in soccer. A strong argument is that they want to keep the game human, keep the game universal, and, in what perhaps soccer's greatest appeal over sports that have adopted technology, keep the game simple (Williams, 2013)⁵. Another argument

is that the issue lies in the balance between justice and tradition. The traditionalists believe a key facet of the game is its simplicity, and technology will interfere with that; whereas the pro-justice address that the human eye is fallible and that even the most experienced officials are not always able to discern whether a ball crossed a line – meant that justice was not always served, and so technology can be the solution (Ryall, 2015)⁶. I would argue for the pro-justice opinion because with justice come democracy and equality in sports.

CRITICAL ANALYSIS

Wearable Technology in Soccer

The strive for success in soccer as in many sports has led coaches and players to search for the best possible means of improving performance. Many technologically advanced equipment exists out there but I am going to specifically address wearable technology, which allows for improvement of performance for both individuals and teams. In 2015, FIFA announced the creation of standard wearable devices for world soccer, and I am going to examine some of these devices.⁷

The first device is Viper Pod, the world's leading performance monitoring tool for football.⁸ It includes building sensors into clothes that players can wear on the training ground or even in matches. Moreover, Viper Pod is packed with a GPS module, a series of motion sensors and a heart rate receiver. Therefore, it is able to monitor valuable metrics such as distance, speed, acceleration, step balance and heart rate. It can also report collisions and give players a fatigue index. The second device is Dash, a tiny sport wearable sensor that improves your skills by measuring every move.⁹ The Dash wearable sensor provides instant data regarding speed during the game, distance covered and hear rate. The third device is Qualcomm Smart Legging, which is built with 5 sensors strategically positioning at knee, ankle and base of the spine of the

clothing.¹⁰ It tracks the postures and positioning at the pitch while playing. And then, the players' data will be sent to a smartphone to coaches via Bluetooth. The fourth device is Inside Coach, which is a smart soccer ball that is perfect for training.¹¹ The smart ball contains motion detection technology that records force of impact, spin, position, trajectory, number of ball passes, number of ball touches and playtime. After that, the data will be sent directly to mobiles in real-time. Thus, players can be their own coach on the field. The fifth device is GPSports' Vest, which is an activity tracking shirt.¹² The smart vest can track around 150 football teams and their performance. It has a built-in slot which is designed for GPS-enabled High Performance Unit. On the other hand, it enables heart rate monitoring, chest strap and accelerometer. All the data (heart rate, speed, density) is instantly uploaded to GPS software. Last but not least, Wearable Experiments created a fan jersey that makes the fans feel the game and enhance their experiences.¹³ Haptic technology is embedded on the shirt that connects fans with the game through touch. By doing this, the soccer fan shirts are physically and digitally connecting the fans to their favorite team in a brand new way that has never done before.

What are then the implications of all these wearable technology devices in soccer? It is obvious that technology can provide numerous benefits for the sport, whether this be in training, competition, injury prevention and rehabilitation. I would even go further and say that the technology "promotes the human values and respect for the individual athletes", to borrow from Loland's thick theory. Humans are apt to progress, recover from setback, and make their individual choices. The equipment mentioned above measures the players progress on training, prevent them from injuries, and let them make choices (on boot and ball) that optimize their performance. In this manner, wearable technology surely puts players in a level-playing field and makes soccer a more interesting game.

Big Data & Analytics in Soccer

Soccer is cautiously embracing data analytics. The trend is beginning to influence the way professional players are evaluated and choices coaches make when planning on-field statistics. Top clubs in Europe and the US are hiring computer scientists and mathematicians to try to gain an edge.¹⁴ Personally, I believe that there are three ways data analytics can improve efficiency, accuracy and profitability in soccer: (1) Predictive insight into fan preferences, (2) Data from wearable technologies, and (3) Influence on coaching decisions. Firstly, analytics can advance the sports fan's experience as teams and ticket vendors compete with the at-home experience. Today's sports fans are coming into stadiums with smartphones that are changing the in-person experience. Fans expect technology to enhance game days. And in response, the organizers of major sporting events and owners of sporting venues are turning to new cloud, mobile and analytics technologies to deliver a great fan experience.¹⁵ Secondly, as argued earlier, data from wearable technology devices such as Google Glass, GPS trackers and fitness trackers provides real-time stats on each player, including speed, heart rate and acceleration. Such devices are also helping in reducing players' injuries. No team wants its star players to sit out a match due to injuries. Thirdly, data can help coaches and players make more-informed decisions that could decide the outcome of a game. Coaches can select the best players, field the most effective teams and make smarter decisions on the field.¹⁶

However, resistance to soccer analytics does exist, if the understanding is that it will replace rather than compliment the sport itself. I propose that there are two prominent parties involved in this debate about soccer analytics: the coaches and the statisticians. Soccer coaches are scared of statisticians due to their fear of potentially being replaced, their fervent belief that the sport cannot be completely quantified and their understanding and admiration of art and

romance within the sport. Statisticians are scared of soccer coaches because they've never played the sport or have been in the trenches of a high-level, competitive, athletic environment; they don't understand the human nuances that cannot be quantified yet, and their inability to effectively translate their findings into the tangible, on-field applications. The specific application of the analytics is difficult when there doesn't exist a bridge between the individuals performing such analysis and the individuals who create and structure the sport itself.

From my research and expertise knowledge, the widespread collection of data within a sport can only serve positive and constructive purposes. The accurate analysis of the collected data can be useful tools in complimenting the human intuition that already exists in the game of soccer. More knowledge, more understanding of both parties, more communication between these sides is the recipe for balanced and accelerated progress. The integration rather than encouraged polarization between traditional and progressive soccer ideologies is crucial for analytics to positively impact the sport. The experienced, educated coach can identify successful patterns more easily and accurately with the assistance of analytics. In general, the purpose of soccer analytics is to be able to identify more complex patterns, in larger quantities, faster across a larger set of data. It would be unreasonable to think that anyone in the soccer industry would find this to be a disadvantage. To completely trust the human would be regressive, but to completely trust the data would be shooting in the dark. The magic lies in between.

Goal-Line Technology in Soccer

I discussed in the literature review section the controversy surrounding the use of goal-line technology, but have not defined what it is yet. Goal-line technology is essentially a bundle of technologies that together monitor the path of the ball and detects when it crosses the goal line.¹⁷ There are several systems currently approved for use by FIFA, but the two main ones are

Hawk-Eye and GoalRef.¹⁸ Hawk-Eye is already used in cricket and tennis. It employs high-speed video cameras dotted around the pitch to triangulate and track the position and flight of the ball. Seven cameras are required per goal mouth, allowing the system to still operate when several cameras are blocked. On the other hand, GoalRef makes use of electromagnetic induction. A sensor is embedded inside the ball, which detects the magnetic field produced by thin wires run underneath the penalty box. A computer tracks the position of the ball via the sensor and detects when the ball crosses the goal line. The objective of goal-line technology is not to replace the role of the officials, but rather to support them in their decision-making. The technology must provide a clear indication as to whether the ball has fully crossed the line, and this information will serve to assist the referee in making his final decision.

In my opinion, there are many positives that can come out of goal-line technology. Firstly, bringing in the technology will stop any controversy over goals after the game has finished. When the technology is put in place, it will give a team an accurate decision which is the final decision, meaning the players, managers, and fans have nothing to dispute in terms of the goals. The referee then would have less pressure and anger from fans, managers, giving them a better reputation. Secondly, the technology itself will not slow the game down. Research done by FIFA has shown that it takes less than 5 seconds to come to a decision, shorter than if there was no technology – because the referee must take time to rationalize under tense pressure.¹⁹ Finally, the technology will provide visual pleasure and confirmation for the spectators, because they can freely engage with play-by-play actions. The only negative part about goal-line technology is that they are not easily duplicated at all levels of the game, because the lower league clubs would be unable to introduce the technology since the price would be far out of their reach. But considering the stakes at modern day soccer, this is one sacrifice that FIFA had

to make. There can't be another goal-stolen incident in a high-stake tournament like the World Cup, and goal-line technology would ensure that equality and fairness are in order.

CONCLUSION

Attempting to find different ways to understand a subject matter is synonymous with curiosity. Actually discovering tangible ways to dissect said subject matter is progression. And, applying successfully tested and reinforced methods of dissection to the subject matter is evolution. The evolution of soccer as a sport is closely associated with the adoption of new technology, and I argue in this essay that wearable devices, big data analytics, and goal-line technology are 3 successful examples to illustrate that assertion. I am going to give another recent success story which is the Germany National Team at FIFA World Cup 2014, in which they became world champion. While their success can be attributed to many things, the Germans, known for technological know-how, had a trump card in their hands. Many soccer fans raised their eyebrows when it was revealed that the national squad wore Adidas' miCoach elite team system during training sessions before and during the competition.²⁰ The physiological monitoring service collects and transmits information directly from the athlete's bodies, including heart rate, distance, speed, acceleration and power, and then display those metrics live on an iPad. All this information is made available live on an iPad to coaches and trainers on the sideline during training, as well as post-session for in-depth analysis. Interestingly enough, analysis of the data can help identify the fit players from those who could use the rest. This story clearly demonstrates how players and coaches can make the best use of technology to reach their desired goals.

So what's the future of soccer going to look like? I am absolutely certain that more technological innovations are going to be incorporated into the game that can bring about a lot of

benefits: helping the players to train better, allowing the coaches to devise appropriate strategies, giving talent scouts accessibility to early-age talents, enhancing the fan experience, and most importantly, making the game more beautiful. Personally, I am most interested in what soccer analytics can teach us about the game. For many American fans, soccer's nuggets of analytic insight remain as foreign as the game itself. There are set pieces to orchestrate, attacking strategies to plan, areas of the defense to exploit – and it isn't always apparent which tactics are the best. But analytics has clear advice on how to do some things right. A research done by FiveThirtyEight shows that a team's probability of scoring goes up as it strings together more successful passes.²¹ The implication of this statistical about-face is that maintaining possession is important in soccer. There's a good relationship between a team's time spent in control of the ball and its ability to generate shots on target, which in turn is hugely predictive of a team's scoring rate and its placement in the league table. As for the long ball, it's proven futile in today's game. During the 2013-14 EPL season, the percentage of a team's passes classified as "long" was very negatively correlated with how many goals it scored. The same goes for trying to spearhead an offense from the wings instead of attacking up in the middle. During the 2013-14 season in Europe's "Big 4" leagues (England's Premier League, Spain's La Liga, Germany's Bundesliga, and Italy's Serie A), the percentage of a team's attacks made up the middle did have a moderately positive relationship to its scoring rate relative to the league average, while the relationship between wing attacks and scoring was of the same magnitude and in the negative direction. This, coupled with the fact that corner kicks are surprisingly ineffective at generating goals, is probably related to the negative correlation between a team's propensity for winning aerial duels and its overall goal-scoring rate. By the numbers, it's a losing bet to count on goals in the air via set pieces – or even off crosses in open play – as a steady way to generate offense,

just as it is to rely on the long ball to consistently produce chances. Instead, the statistics seem to support an approach more in line with the artful tiki-taka style exemplified most notably by FC Barcelona and the Spanish national team.

At the end of the day, in soccer, data and aesthetics are not mutually exclusive. The data have the potential to provide soccer with broad strategic conventions comparable to the sabermetric-minded rules of thumb in baseball and basketball. None of these is a hard-and-fast decree, but they offer guidelines generated by actual data instead of blind hunches.

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