Goal line technology in soccer: Are referees ready for technology in decision making?

J. SURUJLAL AND D.B. JORDAAN

North-West University, Faculty of Economic Sciences and Information Technology, P.O. Box 1174, Vanderbijlpark 1900, South Africa. E-mail: Babs.Surujlal@nwu.ac.za or bsurujlal@gmail.com

Abstract

The announcement that goal line technology will be used in the 2014 FIFA World Cup to be hosted by Brazil has sparked renewed interest and debate regarding its accuracy and reliability, its influence on the fluidity and rhythm of the game, its influence on the nature of the game, its practical implementation and the psychological effects it would have on referees. When controversial decisions are made, the referee comes under extensive scrutiny by players, fans and spectators as well as commentators who have the tendency of *scapegoating* the referee. The purpose of the study was to examine the perceptions of soccer referees regarding the use of goal line technology in soccer. A qualitative research approach which involved conducting in depth interviews was adopted for the study. A database of qualified referees which was created by a senior referee was used to recruit a purposive sample of referees within easy access to the researchers. Referees were selected based on the following criteria: a) having a qualification to referee soccer matches, b) having at least 4 years refereeing experience, and c) being aware of goal line technology. An analysis of the transcripts revealed consistency in the responses of the respondents regarding most of the questions. The following three themes are a synthesis of the findings of the study based on their significance in terms of how frequently they were mentioned and articulated by the respondents: *knowledge of technology, technology vs human factor, fairness and justice*. The results of the study suggest that while referees are aware of goal line technology, they do not possess in depth knowledge of the phenomenon. It is therefore important for them to take proactive measures to update their knowledge so that they are prepared when the technology is introduced in South Africa.

Keywords: Goal line technology, soccer, referees, fairness, justice, knowledge.

Introduction

The world of sport has evolved at a rapid pace over the years. The attire, facilities, rules and equipment have changed to such an extent that the original format of many sports appears to be a pale shade of the game being played today. Consequently there has been a significant change in spectator behaviour. Increased sponsorship, player endorsements and aggressive marketing strategies

have resulted not only in an increase of ardent fans and spectators but also the expectations and demands of fans and spectators.

Recently the use of technology to improve the game has made a dramatic impact on how most of the popular sports are played and how decisions are arrived at in the modern day. The days of total reliance on tough decisions being left totally to human judgment, integrity and respect are a thing of the past (Keller, 2009). Athletes, fans and other stakeholders are increasingly becoming accustomed to instant TV replays on big screens at public sports bars, in the luxury of their homes and on the field. Slow motion replays from different angles and computer graphics coupled with commentary and expert analysis of different incidents have become an integral part of the spectator experience.

The introduction of technology in sports is not without its supporters and critics. On the one hand the use of technology is viewed as slowing down the speed of the game while on the other hand for many people it makes watching it more enjoyable to see the correct decisions being made. Fowler (2013) posits that technology affects sport by addressing controversial or incorrect decisions made by match officials, improving the accuracy of decision making and reducing the number of controversial decisions.

Technology in sport

There are various technologies that have been introduced in different sports. These include multi-camera based ball trajectory analysis, electronic field manipulation and video/TV replays (Fowler, 2013). Among the different technologies used in sport the most popular is the Hawk-eye technology – a computer and camera system which traces a ball's trajectory – used in tennis and cricket, and instant TV replays. In international cricket TV replays are used by the third umpire (who sits off the ground) to adjudicate and advise central umpires via wireless technology communication on disputed decisions (such as leg-before-wicket, catches and boundaries). In tennis the Hawk-eye technology is used to decide on disputed calls by the umpire. In these instances, there is huge reliance on the technology and no consultation regarding the decision takes place between the umpires.

While sports such as basketball, tennis and cricket have already embraced technology, soccer has constantly resisted the assistance of technology. However, due to increased pressure from different interest groups the decision was taken to introduce goal line technology in the forthcoming 2014 Fédération Internationale de Football Association (FIFA) Soccer World Cup. Goal line technology is expected, in the main, to decide whether a ball has passed over the goal line. However, instant TV replays could assist in deciding on off-side disputes, fouls and penalties.

Technology in soccer

In soccer the outcome of a match is decided on the number of goals scored. A goal is scored when the referee has decided that the ball has fully crossed the goal line while the ball was in play (Umeda, 2013). In order to assist the referee in making the correct decision with controversial goals several goal line technologies were introduced in soccer. Among these are the 'vanishing spray', 'smartball', 'Goal Ref' and 'Hawk-Eye'.

The 'vanishing spray' concept, although hotly debated, has been used in high level matches (US Referee Connection, 2013). This technology is used by the referee to mark the area from which a free kick is to be taken or where a foul occurred. It is also used to mark the area where the defensive wall could be set up. In this way referees were able to promote fair play as well as encourage players to be honest.

In its experimental stages a promising initiative to introduce technology in soccer has been a "smartball" loaded with a computer chip, jointly developed by German companies Cairos Technologies and the Fraunhofer Institute for Integrated Circuits, an engineering research and software development company (Fowler, 2013). Electronic cables are run under the pitch and a network of receivers are placed around the field designed to track the ball's precise position in real time - including exactly when it has fully passed the goal line. Low range sensors fitted inside the football measure the magnetic field and transmit encrypted information regarding the exact location of the ball to a central computer system. When the data regarding the location of the ball suggests that the ball has crossed the line, a radio signal is transmitted in less than a second to a watch-like device worn by the referee (Cairos, 2012). Because of problems encountered with this technology, the Hawk-Eye technology was seen as possible alternative, given its success in other sports such as tennis and cricket.

For long Hawk-Eye technology has been a leading multiple ball tracking system (McIlroy, 2008). Initially this system was used in cricket and tennis. In cricket fixed cameras are used in specific locations on the field. These cameras track a ball's trajectory from the moment it has left the bowler's hand until it stops moving. The Hawk-Eye is able to process the resultant images from the cameras into 3D images providing a precise trajectory of the ball. The software is so accurate that only 25% of the ball is required to be visible to track it. Complicated image processing algorithms then determine the ball's relative position. But a decision can be made only after watching a replay. These images can then be used to rule on leg-before-wicket decisions, boundaries and catches. The technology is used mainly in the review system in cricket. The Hawk-Eye technology is also used in tennis. Similar to the review system in cricket, tennis players are able to challenge a decision by an umpire if they think the decision

was incorrect. In this technology ten high-speed cameras which operate at 1000 frames per second are placed at different spots around the court to determine where the ball has landed within five seconds of landing. A positive aspect of this technology is that it is resistant to overcast weather conditions, sunlight, wind and artificial lighting and has an error margin of 3.6 mm (Hawk-Eye, 2012).

Goal Ref is another goal line technology that has won favour with FIFA (Fowler, 2013). It is based on magnetic fields. There are two opposite magnetic fields on either side of the goal line. The ball has an electronic device embedded in the ball as well as three magnetic strips located in the outer lining of the ball. In addition sensors are placed inside the goalpost as well as the crossbar. As soon as the ball crosses the line, a change in the magnetic field is detected by antennae behind the goal which sends a signal to the referee's watch within a second. This technology requires changes to be made to the pitch and goals to install the system. Although this has been deemed effective and accurate and shares many of the benefits of the Hawk-Eye, concerns have been raised regarding the transmitter inside the ball and whether it can be dislodged inside the ball resulting in wrong decisions that could have a margin of error in mere millimeters (Zeddy, 2012). While the Goal Ref is cheaper than the Hawk-Eye there are also concerns regarding its implementation at grassroots level (Colwell, 2000).

Significance of the study

The announcement that goal line technology will be used in the 2014 FIFA World Cup to be hosted by Brazil has sparked renewed interest and debate regarding its accuracy and reliability, its influence on the fluidity and rhythm of the game, its influence on the nature of the game, its practical implementation (Ryall, 2012), and the psychological effects it would have on referees. Several questionable decisions by referees, which in retrospect proved to be incorrect, have resulted in increased calls for the introduction of goal line technology. Those against the introduction of goal line technology argue that instant television replays should be sufficient to assist in arriving at a final decision regarding a controversial call. They argue that goal line technology would give rise to other technologies which would rob the game of its very foundations. Those that are positive about the technology argue that justice would be served immediately through use of the technology, thereby avoiding a controversial decision. This study intends to provide a few perspectives from those officials who are at the centre of this debate – referees.

Problem statement

Technology has always played a significant role in improving the experience of players, game officials and other stakeholders. Basic technology such as watches, clocks, balls, playing fields, shin guards, headgears, goal posts, nets and so on, which are meant not only to ensure fairness in competition but also to improve the safety of all participants are part and parcel of the game (Nlandu, 2012). The introduction of new technologies will inadvertently result in some change whether in shape or approach. In most instances the introduction of new technologies is intended to bring about improvement in the game and players, enhance the sport experience of fans and spectators and provide value for money to sponsors.

Recently there has been an increased use of technology in a number of sports to achieve the afore-mentioned objectives. Slow motion TV replays and very descriptive commentary evoke the emotional responses of fans and spectators whose ever-changing expectations of the game result in increasing demand for better a quality experience.

Soccer is a fast-paced game which requires the undivided attention of the referee over a period of ninety minutes or more. Not only is the referee required to follow the flight of the ball continuously over this period of time, he/she is also required to monitor and control unsporting behaviour of the players as well as be attentive to the cues of his/her linesman. In order to perform this demanding task, the referee has to be physically fit, mentally alert and have a thorough understanding of the rules of the game.

The ultimate outcome of matches hinges on the decisions made by the referee. Because of the many demands placed on referees, which many players, coaches, spectators and fans do not understand (Mascarenhas, Collins & Mortimer, 2005) it is not uncommon for the referee to be blamed for influencing the result of a game because of a perceived incorrect or biased decision. Referees are expected to digest and evaluate a situation and make an appropriate decision within seconds of an incident (Mascarenhas et al., 2005). When controversial decisions are made, the referee comes under extensive scrutiny by fans and spectators as well as commentators who have the luxury of access to modern technologies such as slow-motion replay as well as replay showing differing angles.

Purpose of the study

The present study examines the perceptions of soccer referees regarding the use of goal line technology in soccer.

Methodology

In addition to a comprehensive literature review of goal line technology, a qualitative research approach which involved conducting in depth interviews was adopted for the study. The rationale in using this approach was to explore real life experiences and perceptions which are meaningful and applicable to the chosen sample in relation to the phenomenon being researched (Patton, 2002). Unlike a quantitative approach which forces respondents to select from fixed responses, the qualitative approach used in this study allowed for the collection of rich data in the respondent's own words.

Sample and procedures

A database of qualified referees which was created by a senior referee was used to recruit a purposive sample of referees within easy access to the researchers. Referees were selected based on the following criteria: a) having a qualification to referee soccer matches, b) having at least 4 years refereeing experience, and c) being aware of goal line technology.

An interview schedule which specifically focused on the perceptions of soccer referees regarding goal line technology was developed. Two experienced researchers and one referee assessed its content validity. It was found to be acceptable. A research assistant not involved in the study was trained to conduct the interviews. The researchers decided not to conduct the interviews to ensure that their personal involvement and feelings about goal line technology would not influence the responses of the participants. A pilot test of the instrument was conducted to determine the most logical and smooth-flowing order of questions, identified issues that needed clarity and determine the approximate duration of the interview.

The interview was structured in a way to make it possible to probe the responses of respondents and make the interviews conversational to produce rich data (Smith & Osborn, 2003). Repetition of responses received in previous interviews at the 7th interview indicated that technical saturation of information was reached and no new information was forthcoming (Groenewald, 2004; Strauss & Cobin, 1998).

The following ethical issues were addressed: a) the purpose of the study was outlined to the participants, b) informed consent was obtained from each participant to interview them; c) participants were informed that participation was voluntary and they could terminate their participation at any stage without any repercussions, and d) core ethical issues such as respect, honesty, anonymity and confidentiality were adhered to during the study. In addition the responses of participants were recorded with their permission.

Data analyses

The interviews were transcribed verbatim from the recordings. Each researcher analysed the data independently using an interactive and recursive process (Miles & Huberman, 1994) which involved listening, reading and summarizing the raw data to identify meaningful categories. These categories were assigned descriptive titles which illustrated the themes they represented. The themes were compared and discussed until consensus was reached that they represented the findings of the dataset (De Vos, 2005).

Reliability and trustworthiness

Patton (2002) posits that experience is important for the credibility of the data in qualitative research. The research assistant, having excellent knowledge and experience of soccer, and being familiar with the terminology used in soccer conducted all the interviews.

Credibility checks are important for the trustworthiness of the findings (Elliot, Fischer & Rennie, 1999). In addition to both researchers examining the data independently, one of the researchers who assisted in ascertaining the content validity of the interview schedule was requested to examine the data as well as the themes which emerged through the data analysis and comment thereon. Comments received from the independent researcher indicated that the resultant themes were in congruence with the data which were analysed. In addition, reliability was ascertained using member validation as proposed by Lincoln & Guba (1985). Three referees who participated in the study were requested to examine the transcripts of their interviews to ascertain whether the information was representative of the interviews. Subsequent feedback indicated that the data was captured accurately.

Results

An analysis of the biographical data revealed that the refereeing experience of the respondents ranged from 5 years to 24 years. Six of the seven respondents refereed in the Vodacom League and higher. All respondents indicated that they were either accused or guilty on occasions during period they refereed matches of incorrect decisions associated with goalmouth incidents. All respondents except for one respondent indicated that the occurrence of such incidents was more than once every five matches they refereed. When asked whether they were aware of goal line technology all respondents answered in the affirmative.

An analysis of the transcripts revealed consistency in the responses of the respondents regarding most of the questions. The following three themes are a synthesis of the findings of the study based on their significance in terms of how

frequently they were mentioned and articulated by the respondents: *knowledge of technology, technology vs human factor, fairness and justice*.

Discussion

Several interesting outcomes emerged from the in depth interviews enlightening the study on the preparedness of referees for goal line technology.

Knowledge of Technology

In the context of this study knowledge is described as a state of mind which focuses on one expanding one's personal knowledge of a phenomenon and applying it in a particular situation (Alavi & Leidner, 2001). In the refereeing context it can be viewed as a process of simultaneously having access to information, knowing and applying the knowledge in a football match.

The theme *knowledge of technology* encompassed the following sub-themes: awareness of the application of the technology, information on the technology and the usefulness of the technology.

It was evident from the responses of all the interviewees that they were aware of goal line technology and the intention to use such technology in future high profile matches. What was surprising, though, was how little 'real' knowledge they had of the technology and how it functioned. All interviewees required prompting from the interviewer to determine the extent of their knowledge regarding the phenomenon. This implies that while there is ample literature and debate concerning goal line technology available to the general public, not sufficient attention has been paid by sport organisations to formally 'educate' individuals (referees) that such technology is most likely to affect. It is also a concern that none of the interviewees indicated that they were formally informed or taught on the technical functioning of goal line technology. Excerpts from the in depth interview which illustrate this point are:

"*I heard about the technology but I don't know too much*" "*We are waiting for FIFA to tell us*"

Given the fact that all referees were qualified i.e. having a qualification to referee at a high level, their lack of training or knowledge of the technology could have serious implications for the game in the future.

Regarding the interviewees' perceptions regarding the usefulness of the technology, it is interesting to note that while all perceived the technology to be useful to an extent there were also a few negative perceptions associated with it. With regard to its usefulness, interviewees were of the opinion that referees

would be relieved of a great deal of the 'burden' to deal with controversial decisions. Excerpts which illustrate this point are:

"*Spectators will behave better*" "*There will be no one against the referee*" "*I will be protected*"

On the other hand, there were concerns that with the introduction of the technology referees would become over reliant on it and this could lead to other incorrect and controversial decisions. Excerpts from the in depth interviews which encapsulate the perceptions are:

"*It will make me rely on it*" "*Referee will rely on the technology. Referee will not run after the ball. The referee's fitness will be a problem*"

It is interesting to note that while there were differences in opinion regarding the introduction of goal line technology, there was also a willingness to embrace the technology.

Technology vs Human factor

The theme *technology vs human factor* is associated with the views of interviewees regarding the introduction of goal line technology in soccer as opposed to the utilisation of additional officials. While the respondents initially welcomed the introduction of goal line technology in soccer, their stance changed drastically when they were posed the question "*If you had a choice between goal line technology and any other technology/mechanism to assist referees at arriving at a fair decision which would you choose?*" Their choice was overwhelmingly in favour of additional officials to assist the referee. In most instances, because of their lack of knowledge of goal line technology, most respondents perceived that the technology would result in prolonged matches. In fact one respondent was of the opinion that a match would take as long as an hour more than the normal time to finish. Respondents were of the view that additional officials to monitor the goal line would be more appropriate than reliance on goal line technology. Some of the excerpts which reflect the views of the respondents are:

"*There must be a back-up. What if the signal is lost?*" "*It will contradict the rules of the game. Now the referee's decision is not final. The technology will have the final decision*" "*I think more officials will be best*"

The sentiments echoed by the interviewees were similar to those of prominent personalities associated with football. Pele, a scorer of more than a thousand goals and a World Cup winning legend opined that mistakes are always going to happen – technology or not (T3, 2012). His view was that extra referees behind

each goal would be more effective. Pele felt that the introduction of one technology would give rise to other technologies and that if technology was used and if referees did not get it right every time, fairness in the game would not be increased. Conway (2013), in similar vein, reported that the introduction of goal line technology may possibly be the start of a technological revolution in soccer.

One respondent commented on the high cost of the technology. He felt that the money spent could be put to better use both in developing the sport and developing aspiring young players. This is in congruence with the views of Platini, the former French international player and UEFA president, who believes that the use of additional referees is sufficient and the money could be put to better use by investing in the grassroots and development of football (Coerts, 2012). Therefore UEFA remains ideologically opposed to goal line technology (Conway, 2013). Zeddy (2012) is also of the opinion that the probability of an incorrect decision may be diminished by the presence of extra officials. Human officials can make split-second decisions accurately taking a high number of variables into account while technology can measure one or two variables at a time and will still require human interpretation. Collins (2010a) opines that while technology could be used to avoid errors which are obvious to all, the referee's judgement should be paramount.

Fairness and justice

The theme *fairness and justice* is concerned with the fairness of the technology. Interviewees were unanimous in their response regarding the positive effect that technology would have on the game. The common thread regarding this theme was that there would be a greater degree of fairness and justice in the game and that the referee would be 'protected'. This finding is in congruence with Ryall's (2012) assertion that the greater use of officiating technology may result in greater levels of justice in the game. Excerpts which illustrate the respondents' views regarding the benefits of fairness and justice include the following:

"*It will be fair. It will be good for the players*" "*It will boost the morale of the players*" "*You cannot take long to make a decision. The spectators will not fight with the referee*"

One of the reasons why Sepp Blatter, President of FIFA, was initially reluctant to introduce goal line technology in football was because he was concerned with its accuracy and reliability (Ryall, 2012). Wright (2008), in contrast, is of the opinion that while errors are likely to occur, it is acceptable if the technology is 95% accurate. Similar sentiments were echoed by Arsene Wenger, coach of the Arsenal Football Club, in favour of goal line technology when he stated "you like justice to be respected" (Nlandu, 2012).

Decisions made by the referee can affect the eventual outcome of the game (Leveaux, 2010). Over the past few years there have been numerous 'incorrect' decisions for which the blame has been placed squarely on the shoulders of referees leading to their *scapegoating* (Nlandu, 2012). The introduction of goal line technology could perhaps lead to improved and fairer decisions. Collins (2010b) is of the view that sound judgements and justice in sport has become distributed to groups of people such as spectators and TV commentators who are first to question the decision of referees and this is not healthy for the sport.

Limitations, implications for further research and recommendations

A limitation of this study is the small sample size. The generalisability of the results can thus be contested. A larger sample size using a quantitative approach may perhaps have provided a more comprehensive result regarding the phenomenon.

The findings of this study provide a sound basis for further studies in this field. A significant follow-up step to this exploratory qualitative investigation is the construction of a valid and reliable questionnaire to assess the perceptions of other important role players such as the players and coaches. The instrument could also investigate other preferred alternatives to goal line technology.

Since referees play an important role in a match it should be compulsory for them to undergo refresher training regarding the implementation of the latest technology. This can be done through formal workshops organised by the governing body of the sport.

Referees officiating at the highest level must be able to demonstrate competency in the use of the latest technology. This should form part of the qualification requirement. Failure to demonstrate competency should result in the qualification not being awarded to the referee.

Conclusion

The purpose of the study was to elicit the perceptions of soccer referees regarding the introduction of goal line technology in soccer. The results of the study suggest that while referees are aware of goal line technology, they do not possess in depth knowledge of the phenomenon. It is therefore important for them to take proactive measures to update their knowledge so that they are prepared when the technology is introduced in South Africa.

References

Alavi, M. & Leidner, D.E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25(1), 107-136.

Cairos (2012). Goal Line Technology (GLT) System. Available at: http://www.cairos.com/unternehmen/gltsystem.php. Accessed on 18/02/2013.

Coerts, S. (2012). Platini: Goal-line technology too expensive. Available at: http://www.goal.com/en/news/755/europe/2012/12/11/3594474/platini-goal-line-technology-too-expensive. Accessed on 21/02/2013.

Collins, H. (2010a) How should referees use technology in football? Available at: http://phys.org/news197978582.html. Accessed on 18/02/2013.

Collins, H. (2010b) The philosophy of umpiring and the introduction of decision-aid technology. *Journal of the Philosophy of Sport*, 37(2), 135-146.

Colwell, S. (2000). The 'Letter' and the 'Spirit': Football laws and refereeing in the twenty-first century. *Soccer and Society*, 1(1), 201-214. Available at: http://www. tandfonline. com/doi/abs/10.1080/14660970008721259. Accessed on 18/02/2013.

Conway, R. (2013). Goal line technology: Premier League votes in favour for 2013-2014. Available at: http://www.bbc.co.uk/sport/0/football/22107409. Accessed on 21/04/2013.

De Vos, A.S. (2005). Qualitative data analysis and interpretation. In A.S. De Vos, H. Strydom, C.B. Fouché & C.S.L. Delport (Eds.), *Research at Grass Roots for the Social Sciences and Human Services Professions* (3rd ed.) (pp. 339-349). Pretoria: Van Schaik Publishers.

Elliot, R., Fischer, C.T. & Rennie, D.L. (1999). Evolving guidelines for publication of qualitative research studies in psychology and related fields. *British Journal of Clinical Psychology*, 38, 215-229.

Fowler, S. (2013). How feasible is officiating technology in football. Paper presented at the Interactive Multimedia Conference '13. Southampton, United Kingdom.

Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods*, 3(1), 1-26.

Hawk-Eye (2012). Sports Officiating: Football, *Hawkeye Innovations*. Available at: http://www.hawkeyeinnovations.co.uk/page/sports-officiating/football. Accessed on 18/02/2013.

Keller, C. (2009). Is technology taking over decision-making in sport? Available at: http://www.adelaidenow.com.au/sport/is-technology-taking-over-decision-making-in-sport/story-e6frecj3-1111119021767. Accessed on 18/02/2013.

Leveaux, R. (2010). Facilitating Referee's Decision Making in Sport via the Application of Technology. Available at: http://www.ibimapublishing. com/journals/CIBIMA /2010/545333/545333.pdf. Accessed on 21/02/2013.

Lincoln, Y.S. & Guba, E.G (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage.

Mascarenhas, D.R.D., Collins, D. & Mortimer, P. (2005). The accuracy, agreement and coherence of decision-making in Rugby Union officials. *Journal of Sport Behaviour,* 28, 254-263.

McIlroy, P. (2008). Hawk-Eye: Augmented reality in sports broadcasting and officiating. *International Symposium on Mixed and Augmented Reality*, 2008, p. xiv. Available at: http://dl.acm.org/citation.cfm?id=1605312. Accessed on 18/02/2013.

Miles, M.B. & Huberman, A.M. (1994). *Qualitative Data Analysis* (2nd ed.). Thousand Oaks, CA: Sage.

Nlandu, T. (2012). The fallacies of the assumptions behind the arguments for goal-line technology in soccer. *Sport, Ethics and Philosophy*, 6(4), 451-466.

Patton, M. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Thousand Oaks, CA: Sage.

Ryall, E. (2012). Are there any good arguments against goal line technology? *Sport, Ethics and Philosophy,* 6(4), 439-450.

Smith, J.A. & Osborn, M. (2003). Interpretative phenomenological analysis. In J.A. Smith (Ed.), *Qualitative Psychology: A Practical Guide to Research Methods*. London: Sage.

Strauss, A. & Corbin, J. (1998). *Basics of Qualitative Research: Grounded Theory, Procedures and Techniques*. Newbury Park, CA: Sage.

T3 (2012). Pele on goal-line technology. "It's just too complicated." Available at: http://www.t3.com/features/pele-interview-goal-line technology. Accessed on 12/03/2013.

Umeda, Y. (2013). Technology in sports: Goal line technology in soccer and sports engineering. Available at: http://www.pitt.edu/~yuu4/issues.html. Accessed on 18/02/2013.

US Referee Connection (2013). Use of vanishing spray approved. Available at: http://www.usrefereeconnection.com/#!use-of-the-vanishing-spray-aproved/c18c9. Accessed on 12/03/2013.

Wright, S. (2008). Should goal line technology be used to determine whether a ball has crossed the goal line? Available at: http://www.helium.com/debates/146153-should-goal-line-technology-be-used-to-determine-whether-a-ball-crossed-goal/side_by_side?page=4. Accessed on 21/02/2013.

Zeddy, F. (2012). Is football ready for technology in decision making? Available at: http://www.sportskeeda.com/2012/04/16/is-football-ready-for-technology-in-decision-making/#ixzz2LEZVEJAE. Accessed on 18/02/2013.