Perception of Using VAR Technology in Football After Completion of Training and Education and Experiences of Croatian Video Assistant Referees (VARs) and Assistant VARs (AVARs)

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Abstract - By introducing VAR technology in football the process of decision-making during the game has been made easier for referees on the field, where they coordinate with a team of experts that are inside the VOR room. Additional education and practical experience of all participants involved in this process is required for the application of VAR technology in football in order to ensure the accuracy and adequate speed of the decision-making process. This paper shows the results of the research on the perception(s) of using VAR technology in football of Croatian Video Assistant Referees (VARs) and Assistant VARs (AVARs) that received training and education regarding the use of VAR technology on the football field. The results and findings of this paper can help all those who want to contribute to the advancement of application and functionality of VAR technology in football.

Keywords – VAR technology; video assistant referees; football; VARs; AVARs

I. INTRODUCTION

Football is one of the most popular sports nowadays and it attracts large masses of people that can watch a large number of games on a daily basis. Among the key participants in football games are football referees who make the final decisions that can influence the outcome of the game.

During football matches, disputable situations happen that need to be resolved fairly and correctly by the referees. The practice has shown that there is a problem in detecting certain irregularities that happen during matches due to the impossibility of reviewing said irregularities within a given (actual) time frame. Additional problems arose when the viewers watching matches on TV, and instant replays, could see from other angles that the referees had made incorrect calls decisions based on their poor assessment of certain situations during the matches they were refereeing [1].

Therefore, the introduction of Video Assistant Referee (VAR) technology in football has had a clear and defined goal: help the referees mitigate their mistakes during football matches that have a significant impact on the outcome(s) and quality of said matches; provided it doesn’t undermine their authority. This allows for bigger transparency and fairness of outcomes of matches, which has an impact on the satisfaction of all participants, referees, players and supporters [1].

However, for a group sport with such a rich tradition, introducing technology and changing fundamental rules of the game presents a large change, which has been met with wide opposition from players and coaches alike [1].

For the application of VAR technology during football matches a team of trained experts is needed, and it includes: Video Assistant Referees (VARs) and Assistant VARs (AVARs) and Replay Operator (RO) that work in the Video Operation Room (VOR) [2, 3, 4].

Practice has confirmed the advantages of introducing VAR technology in football, but it has also indicated the possibilities for improvement of its application. As an example, Spitz et al. [5] have found that the accuracy of correct decision after VAR intervention in relation to the initial referee’s decision significantly increases from 92.1% to 98.3%. On the other hand, based on the analysis of data from Spanish LaLiga during 2018-19 season, Errekagorri et al. [6] have found that the use of VAR system in matches hardly has any impact on the game in elite football when playing time and technical-tactical and physical performances are taken into consideration.

Samuel et al. [7] emphasize that the critical aspect of refereeing football matches is the decision-making process by referees, and have concluded based on results of research (sample of 20 elite referees and assistants), that the factors that influence the referees’ decision-making process are: physical fitness and fatigue, field positioning, visual attention, contextual factors, game management, expertise and cognitive processing, psychological factors, and team factors (including Video Assistant Referees).

In order to improve VAR and its use further, it is imperative to investigate the opinions and attitudes of VARs and AVARs on the matter.
This paper puts a special emphasis on the introduction of VAR technology in Croatian football. The main aim of this paper is to examine the perception(s) of use of VAR technology in football after completion of training and education and experiences of Croatian Video Assistant Referees (VARs) and Assistant VARs (AVARs).

The following section contains the most important characteristics and results of previous research regarding the application of VAR technology in football, followed by a description of the research methodology, research findings and discussion which was conducted on the sample of 24 Croatian VARs and AVARs. A short conclusion is given in the last section.

II. RELATED WORK

A. VAR technology in football

Video Assistant Referee System was used in football for the first time in a big tournament at the 2018 FIFA World Cup in Russia; however, the International Football Association Board (IFAB) approved the use of Video Assistant Referee (VAR) in March 2016.

The use of Video Assistant Referee System in football matches is only permitted if competition organizer has received written permission from The IFAB and FIFA, i.e. if they meet the requirements (as set out in the VAR Handbook) and all the VAR protocol. The main principles on which the use of VAR system is based is the assistance to the referee on the field, but only in case of “clear and obvious error” or “serious missed incident” in relation to: Goal/no goal, Penalty/no penalty, Direct red card (not second yellow card/caution), mistaken identity of player [3, 4].

Considering the complexity of the activities performed by VAR team members and referees during the refereeing of football matches with the help of VAR, additional education and training is required beforehand; in terms of both theoretical and practical application of VAR technology.

Ruiz et al. [8] have introduced the concept of “digital referees” and have emphasized that football referees must have technical, management, and fitness skills but that they also must develop new digital skills and knowledge about the new digital rules of match(es). Therefore, the choice of didactic teaching strategies and correct program to train video assistant referees is very important. For example, in other contexts, the results of research conducted by Armenteros et al. [9] confirm that referees and assistant referees are willing to use multimedia teaching materials for education for their activities, which is a good indicator of acceptance of innovative technologies in future work.

Results of a study by Carlos et al. [10] show that after using of VAR system in elite football, there was a decrease in the number of the off side situations, fouls and yellow cards and an increase in the number of minutes added to the playing time.

Successful application of VAR technology in football depends on the following factors: the accuracy of reviewed decisions, number of reviews and their duration, and the impact of reviews on the match and its emotional aspect.

Moreover, insufficient number and poor positioning of cameras can have an influence on the transparency of the referee’s decision, which can reflect on the quality of the match. Also, the communication between VAR team members, both amongst themselves and with the referee on the field is of extreme importance, and it has to be clear and understandable [1].

Also, Ugondo and Tsokwa [11] have explored communicative frame reference for Video Assistant Referee and field-based referees and found that major factors that impact the decisions of the field-based referee in contestable situations are: angular lens, camera perspective and the rules of the game alongside referee's prejudice.

B. Application of VAR technology in Croatian football

The preparations for the introduction of VAR technology in Croatian football had lasted one year, and VAR system was used for the first time on 31st January 2020, in a match of Croatian First Division Football League.

There are 16 referees with the education necessary to work with VAR; 12 VARs, 14 AVARs, and 5 technicians, i.e. ROs (Reply Operators) [12]. It is important to take into consideration that one VAR person is an instructor and that one AVAR is an instructor's assistant and due to this fact they are neither operating as VAR/AVAR in the competition, nor taking part in this research.

VAR system in Croatia is implemented at every stadium in a specially designated room. The Croatian Football Federation (HNS) has opted for a plan with 6 or 8 cameras, depending on the requirements of each specific game [13].

Croatel Company, as a technical partner of the Croatian Football Federation, is in charge of setting up VAR system in Croatian football. It sets up cameras on stadiums and it is in charge of TV coverage of matches. The VOR (Video Operation Room) also has access to said coverage. Croatel operates using a system called Xeebra, designed to offer video-assistance to referees. The system was developed by EVS Company.

III. EMPIRICAL STUDY

The aim of this study was to examine perceptions of using VAR Technology in Football after completion of training and education and practical experience by Croatian Video Assistant Referees (VARs) and Assistant VARs (AVARs).

A. Procedure

The research in this study was conducted through a Google Forms online questionnaire from 20 to 23 June 2020. The research was conducted through an email request to fill out the online questionnaire sent to all VARs and AVARs of the Croatian Football Federation (HNS), 24 in total, by the Federation’s main VAR instructor. Participation was voluntary and anonymous.
B. Apparatus

For the purposes of this research, a new questionnaire was developed containing 35 closed-ended questions and 1 open-ended question. 9 questions were related to general characteristics of the participants, 26 questions were related to perceptions of use of VAR technology in football. Responses to the questionnaire items were modulated on a five-point Likert scale (1 = totally untrue; 2 = mostly untrue; 3 = neither true nor untrue; 4 = mostly true; 5 = totally true).

Some items in this questionnaire were adapted from two technology acceptance models: Technology Acceptance Model - TAM [14], and Unified Theory of Acceptance and Use of Technology – UTAUT [15], and some items were newly developed.

The last question in this questionnaire was an open-ended question regarding the drawbacks of VAR technology from the technical (IT) aspect.

After the initial form of the questionnaire was created, it was sent to an expert of VAR technology application in football, i.e. VAR instructor of the Croatian Football Federation.

C. Participants

Twenty-four Video Assistant Referees (VARs) and Assistant VARs (AVARs) participated in this research. The results (see Table I.) show that all of the participants were male (24; 100%). All of the participants were of three age groups; most of them were between 31 and 40 years of age (15; 62.5%), 6 were between 41 and 45 years of age (25.0%), while the rest were between 46 and 50 years of age (3; 12.5%). A little over half of the participants were assistant referees (14; 58.3%), while the rest were referees (10; 41.7%). In terms of VAR technology officials, more than half of the participants were AVARs (14; 58.3%), while the rest were VARs (10; 41.7%) (see Table I).

As shown in Table I, most of the participants in this research have had 5 to 10 years of refereeing experience in the Croatian First Division Football League (10; 41.7%); 8 of them (33.3%) have had 10 to 15 years of refereeing experience; 5 (20.8%) have had more than 5 years of refereeing experience in the Croatian First Division Football League; while only 1 participant (4.2%) has had less than five years of refereeing experience. Among VARs and AVARs participating in this research, most have active (officiating) referee status (20; 83.3%), while 4 (16.7%) are retired and are only VARs or AVARs.

The data analysis (see Table I.) shows that most of the participants, 11 of them (45.8%), have refereed more than 10 matches with the help of VAR technology, while 10 of them (41.7%) have refereed between 5 and 10 football matches with the help of VAR technology. Furthermore, only 3 participants have refereed with the help of VAR technology for less than 5 years.

The aforementioned data analysis shows that Croatian VARs and AVARs have enough practical experience to assess their satisfaction in terms of refereeing football matches assisted by VAR technology.

| Table I. Basic characteristics of Croatian VARs and AVARs in the study (N=24) |
| --- | --- | --- | --- |
| **Variables** | Gender | Age | Type of VAR technology referee |
| **Frequency** | Male | Female | Less than 20 years | 21-30 years | 31-40 years | 41-45 years | 46-50 years | 51-55 years | More than 55 years | VAR | AVAR | Referee | Assistant referee | VAR/AVAR |
| **Percentage of participants in relation** | 24 | 0 | 0 | 0 | 15 | 6 | 6 | 3 | 0 | 0 | 14 | 14 | 10 | 14 | 4 | 16.7 |
| **Status** | I am an active referee | I am only VAR/AVAR | 20 | 83.3 | 4 | 16.7 |
| **Refereeing experience with the help of VAR technology** | Less than 5 matches | Between 5 and 10 matches | More than 10 matches | 3 | 12.5 | 10 | 41.7 | 11 | 45.8 |

With regard to the question: “How would you assess your knowledge in the field of application of VAR technology in football?” all of the participants believe they are able to apply VAR technology in football more than well. 15 of the participants (62.5%) consider their knowledge to be very good, while 9 (37.5%) consider their knowledge to be excellent, as shown in Table II.

Furthermore, the results of the data analysis show that 16.67% of the participants (four of them) are mostly satisfied with the education and training conducted for the purpose of using VAR technology, while 83.3% of the participants are completely satisfied with the conducted education and training.

D. Findings

The items were measured by a 1-5 point Likert scale for responses (1 – totally untrue; 2 – mostly untrue; 3 – neither true nor untrue; 4 – mostly true; 5 – totally true).

The following table shows the results of the data analysis, collected for the purpose of this research, regarding the use and attitudes of VARs and AVARs toward the application of VAR system as means of assistance in refereeing football matches. The items in Table II. were measured by a 1-5 point Likert scale for responses (1 – totally untrue; 2 – mostly untrue; 3 – neither true nor untrue; 4 – mostly true; 5 – totally true).

The results in Table II. indicate that, on average, VARs and AVARs responses to the items vary from 1.38 (“totally untrue”) to 4.88 (“totally true”).

According to the data gathered (see Table II.), all participants (24; 100.00%), VARs and AVARs of the Croatian Football Federation, have agreed with the items
that they find it easy to use VAR system in football matches since they have the necessary resources, knowledge and skills; also that they consider the introduction of VAR system in football a very good idea, and that they are satisfied with the quality of the results the use of VAR in football has yielded.

Furthermore, all the participants (24; 100.00%) agree that communication between VARs and AVARs and ROs (Reply Operators) during the matches is clear and understandable; they would recommend the application of this technology to everyone else, and they wish to continuously improve their skills in the application of VAR system in football.

The arithmetic means (see Table II.) indicate that around 96% of the participants consider that the use of VAR technology in football increases the transparency of the refereeing and the effectiveness i.e. correctness of the decisions made by the referees on the field, as well as that using VAR during football matches has become a normal occurrence for them. Moreover, most of the participants (87%) consider that the players believe that using VAR technology in football is a very good idea; and also that they have no problem “forgetting” about VAR technology during the matches, and that the functionalities that VAR has at its disposal provide enough support to the referees on the field (e.g. screen size, image clarity, slow motion, etc.).

Results in Table II show that a smaller number of participants (3; 12.5%) believe that VAR system doesn’t fit well enough with the existing culture of football matches, and 1 participant (4.17%) is undecided; while most of the participants (20; 83.34%) believe that VAR technology fits well with the traditional football environment.

Most of the participants (75%) agree with the item: “Considering the results yielded by VAR system, I find it simple to referee football matches”, while 25% remain undecided. Also, 75% of the participants agree with the item: “VAR system improves the quality of football”; 4 participants (16.67%) remain undecided on the matter, and only 2 participants (8.33%) disagree.

The mean of 3.13 (SD=0.83; Mdn=3) indicates that, on average, the participants are undecided with regard to the item: VAR system is reliable and there are no software glitches. A little more than half of the participants (13; 54.17%) remain undecided and 29.17% of them are of the opinion that VAR technology has no software glitches; while 4 (16.67%) of the participants disagree with the item. Since satisfaction with the use of software is one of the most important factors in the acceptance of technology, generally; the results of the data analysis in this research show that Croatian VARs and AVARs have indicated the need need for the development of even higher quality VAR technology software.

Furthermore, most of the participants (10; 41.67%) couldn’t decide with regard to their opinion on the simplicity of acquisition of skills required for using VAR, while 1/3 of the participants (8; 33.33%) have disagree with this item. These results are confirmed by the mean which indicates that, on average, the participants (M=2.71, SD=1.05; Mdn=3) are undecided. These results show that the application of VAR technology isn’t simple and that it requires certain user competencies which are acquired through both theory and practice; i.e. by refereeing football matches.

A little over half of the VARs and AVARs of the Croatian Football Federation participating in this research, 54.17% of them, disagree with the item: “Cameras used by VAR in Croatia are sufficient to cover all the necessary angles during a match”; while 8 (33.33%) are undecided, and only 3 (12.5%) of the participants agree. This is confirmed by the mean (M=2.46, SD=0.87; Mdn=2.5) which indicates that, on average, the participants disagree with this item (Table II). This result is expected, seeing as internationally a larger number of cameras is used, thus enabling better field coverage and higher transparency in decision-making. With a larger number of cameras available, difficulty of the decision-making task for the referee is lower because more quality information is provided to the referee by VARs and AVARs.

Moreover, the mean (see Table II.) indicates that in this research, on average, VARs and AVARs (M=1.71, SD=0.89; Mdn=1.5), have found the item: “I believe that the use of VAR technology could be done successfully without ROs (Reply Operators), provided that I attend the course on using VAR technology within the scope of ROs’ functions” to be mostly untrue. It is interesting to note that 2 of the referees (8.33%) believe they could successfully implement the aforementioned; while one referee (4.17%) has remained undecided. These results indicate that the RO (Reply Operator) is an integral member within the VOR room that performs important and specific activities. The data shown in Table II., indicate that, on average, the participants (M=1.38, SD=0.63; Mdn=1), have found the item: “I am apprehensive about the possibility of losing control of the match due to the use of VAR technology” to be totally untrue; and only 2 participants (8.33%) are undecided on this matter. This offers the conclusion that VARs and AVARs have sufficient level of competence to use VAR system during football matches, and that they believe in its functionality.
In this respect, most of the participants, 11 of them (45.83%) indicated “insufficient number of cameras for full quality coverage of all the necessary angles of the football field”; 4 (16.67%) of the participants indicated it was “a VAR system crash during match”, while 1 (4.17%) participant indicated “The Virtual Offside Line (VOL)” as a drawback of using VAR technology in football.

1) Difference between VARs’ and AVARs’ perceptions of using VAR technology after education and experience

The Mann-Whitney U test was used to compare differences between two independent groups, VARs and AVARs, regarding their perceptions of using VAR technology in football after experience and education. All items shown in Table II. were analyzed.

In the continuation of this paper, only the results that have revealed statistically significant difference between VARs and AVARs are shown. The analysis of the collected data has revealed that VARs (Mdn=5) recognize significantly more (U=26.00, p=.004) that with the help of VAR technology the referees on the field can make more factually correct decisions in relation to AVARs (Mdn=4). Results of the analysis indicate that VARs (Mdn=3.5) recognize significantly less (U=38.50, p=.049) that the use of VAR improves the quality of football in relation to AVARs (Mdn=5). VARs (Mdn=4) believe significantly less the use of VAR technology in football matches to be “better than expected” (U=37.00, p=.039) in relation to AVARs (Mdn=4.5). Finally, significantly more (U=30.00, p=.006) AVARs (Mdn=5) consider it has become normal (natural) for them to use VAR during football matches in relation to VARs (Mdn=4).

Aside from the aforementioned items, other items (see Table II.) bear no statistically significant difference between VARs and AVARs.

IV. DISCUSSION

VAR technology in football can be viewed as an innovation that has its course of acceptance by all participants in its process of implementation. The main task of this video technology is to help and assist the referees on the field in their decision-making process during the matches, and thereby increase the transparency and fairness of the outcome of the game, as well as the quality of football in general.

Some national football leagues have already accepted, implemented and are using VAR during their matches, while others are still in the acceptance phase. The implementation of VAR system isn’t simple, seeing as the quality of its use depends on a larger number of participants in this process (VARs, AVARs, ROs, referees and others).

For the implementation of VAR system certain skills, knowledge and competencies are needed, and these are acquired through both theory and practice.

Satisfaction with the use of technology is crucial for its acceptance and development. VARs and AVARs help and assist the referees on the field, thus their competencies and perception(s) of use of VAR system are of great importance. Seeing as the outcome of the quality use of VAR is dependent on the environment, the matter of the
perceptions of those taking part in this process is always important and discussed anew.

The research results in this paper, which are based on the data collected from 24 Croatian VARs and AVARs of the Croatian Football Federation, indicate that they find it easy and simple to use VAR system and that they believe that its introduction in Croatian football has been a good idea.

They have indicated their complete agreement with the main characteristics of the use of VAR technology, i.e. pointed out that it enables them to:

- make more factually correct decisions,
- make the refereeing process easier for the referees,
- increase the transparency and efficiency of the refereeing, i.e. the accuracy of the decision-making process on the field.

Also, Croatian VARs and AVARs that have participated in this research have indicated that the application of VAR technology in football matches doesn’t represent a burden for them when it comes to making decisions and that they are able to forget about VAR during the match without any problem; as well as that they are not apprehensive about the possibility of losing control of matches due to the use of VAR technology; and they have also indicated that they believe that a referee’s decision doesn’t depend solely on the functionality of VAR system. The obtained results have confirmed that after completion of training and education and practical experience, Croatian VARs and AVARs have recognized and acknowledged the basic advantages of introducing VAR technology defined by [1]. As the drawback of the application of VAR technology Croatian VARs and AVARs have indicated the problem of insufficient number of cameras to cover all the necessary angles during matches, while only one of the participants has indicated the problem of “The Virtual Offside Line (VOL)”, which are necessary to make the correct decisions. Similar results have been obtained in previous research e.g. [1, 10, 11].

Also, the participants in this research have pointed out that VAR system isn’t 100% reliable because it has been known to crash in some cases, which is a glitch in technology that requires additional time to repair; which can be a challenge for the refereeing process and the continuation of the game.

The data analysis indicates slight but statistically significant differences between VARs and AVARs in relation to their perceptions of use of VAR technology in football. More AVARs than VARs believe that the use VAR system in football increases quality and that said quality is “better than expected”, as well as that it has become normal (natural) for them to use VAR during football matches; while more VARs than AVARs believe that VAR system enables them to make more correct and fair refereeing decisions. These results are in correlation with the difference in their activities; it is believed, however, that the obtained results require additional investigation, seeing as there are other factors that could have an influence on the confirmed difference in their perceptions. It is especially important to point out that there is a need for additional technical and software solutions in the future in order improve VAR even further.

V. CONCLUSION

Based on the results obtained in this paper, it can be concluded that VAR technology has largely met the expectations of VARs and AVARs of the Croatian Football Federation, based on the satisfaction shown with their education and practical experience, as well as their intention to continuously improve their skills in the application of VAR system in football. Therefore, it is necessary to invest in lifelong learning programs for further development of VARs and AVARs, as well as to introduce new technology in education programs at all levels of formal education. [8, 9].

Our findings can help researches as a foundation for future research, as well as all practitioners who aim to further improve and develop VAR technology in football.

REFERENCES


