

DEVELOPMENT OF A DATABASE AND DECISION SUPPORT SYSTEM FOR PERFORMANCE EVALUATION OF SOCCER PLAYERS

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Abstract: *In this study, we investigate the general parameters to evaluate the performance of soccer players and develop a database for performance evaluation of soccer players and a relevant decision support system (DSS) to help people such as technical director. In the proposed DSS, the data is collected by Data Collectors by using a proposed database. It helps the technical director to realize the performances of soccer players quickly with real-time during games.*

Keywords: *Performance Evaluation, Database Development, Decision Support Systems*

Introduction

In this study, we investigate the general parameters to evaluate the performance of soccer players. Since soccer is a team play, evaluation of individuals of the team is rather difficult task. Evaluation of soccer players' performances is underprivileged of statistical analysis and the people dealing with soccer (interpreters, coaches, club technical directors, etc.) may have different comments on the same soccer players' performance. Therefore we believe that current evaluation methodology is subjective. We try to find objective parameters for each one of the soccer players in a soccer team by using a new database to remove this subjectiveness of evaluation. We believe that by adding an extensive motion analysis of soccer players and exclusively by team, result an objective evaluation of soccer players.

All we know that soccer is played by eleven soccer players which they play in different regions such as defense, midfielder, forward and goalkeeper region and they all have different responsibilities. In this study, we focus only on these regions not on any specific soccer player. For each region we perform a motion study to define responsibilities and response of each region and the corresponding parameters such as for a goalkeeper number of saves, number of successful game starting or for a forward soccer player number of goals, number of shots on target etc. We decide on expectations for each region soccer players and we have some general parameters to evaluate their performances during some games. Also we define unique parameters for each region soccer players. At the same time, soccer presents many opportunities for soccer players to display extraordinary individual skills. While no single soccer player is expected to carry the team, each soccer player has chances to stand out and to shape the defining moments of a soccer games. This is true at every region on the field. The goalkeeper can make a diving to save a goal to ensure the victory, the defender can execute a game-saving tackle, and the forward can set up or scores the winning goal. Soccer's team orientation takes the pressure off individual soccer players in ways not seen in other popular sports. In baseball, basketball and soccer, individual confrontations often determine who wins and who loses. In baseball, for example, the baseball player who strikes out to end the game with the tying run on base may shoulder the blame for the loss. In soccer, most often teams win and lose as one; rarely do individual soccer players carry the burden of defeat. That being so, many tentative young soccer players find a comfort on the soccer fields, they may not find in other sports.

Many sports businesses are based around assets of significant capital value but there may be difficulties in creating income out of that capital value. Also sport industry involves selling of sport clothes, TV rights, exchanges, etc. The sports industry is principally based upon the development, protection and exploitation of commercial rights in sport. Rights holders, whether they are individuals, clubs or governing bodies are at the

heart of the sport business. Their threefold responsibility to the sport, spectators and investors gives rise to increasingly complex issues. Soccer industry facilitates economic growth and has other developing effects all over the world. It also promotes to employments enlargement, development of tourism resources, TV and radio enterprises. Soccer based businesses are different in many ways from businesses in any other sectors. Soccer clubs belong in a community that creates its own responsibilities and restrictions but when times are hard can be the means of ensuring continuity for the club. A successful strategy of soccer clubs is to seek reputable and highly skilled soccer players to attract crowds and improve league performance. As an example the clubs pay \$10 million transfer fee and \$40,000 a week wage for four years. A total investment is excess of \$18M for a highly skilled soccer player. For eleven soccer players total expenditure exceeds \$200M. As one can see that, numbers can grow exponentially. Since world-class clubs run more than billion dollars, soccer industry is a huge business in the world. As today's business environment, today's soccer world is dynamic, nonlinear, highly complicated.

Literature Survey

Most of the studies on the performance analysis of soccer players are team based instead of individuals and after the game analysis instead of real time analysis. These studies are very important because they prove that taking the right data and evaluating the exact performance analysis in soccer is more difficult than the other team games. In soccer, there are more players, the field is bigger and the combinations of movements are more complicated than other team games. Reilly (1991) indicates that soccer practitioners are mainly concerned with performance and a scientific approach towards analyzing the game can employ an ergonomics perspective as a broad thrust. This can operate on a number of fronts by studying work-rate during games, severity of training, fitness of soccer players, physiological stress, physical stress and injuries and daily energy expenditure. In this study consideration is restricted to the performance aspect and the physiological investigations. Huges (1991) indicates that one of the main solutions to the difficulties facing any single individual attempting to analyze and remember objectively the events occurring in complex team games has been the use of the notation analyze system. The aim of his work is to review not only the data that have been produced, but also assess the major innovations and developments in the systems used for notation analysis. There are two kinds of notation systems: Hand and Computerized notation systems. Hand notation has the advantages of being cheap and accurate but the systems are more sophisticated and it takes longer to learn the codes and the application processes. Computerized notation has the advantage of reaching data quickly and making queries but data entry can be difficult, laborious and require keyboard skills. Özkara (1995) wants to make the analysis of the technical behavior of Turkish National Team soccer players' during four games at the third group elimination. And as a result, Turkish National team has developed the game more on the wings rather than the middle section of the playing field. Özbar (2002) wants to determine the similarities and differences between game score and game parameters with the analysis of international standard technical parameters. As a result she found a statistical significant difference between selected winner teams and loser teams playing in Professional Turkish Divisions. Dogan (1998) wants to determine that whether there is any meaningful difference between the champion teams of professional Turkish league and other teams. At the end of this study he had found that there is significant difference in terms of passes and runs criteria. There is no significant difference in terms of dribbling, clear, header, cross, foul, shot criteria. Software named "LeaguePad" prepared by the firm PcSoccer¹ uses statistical techniques to evaluate the performance analysis of soccer players, teams, games, etc. The software LeaguePad is highly configurable and can adapted and fine-tune for different types of sports and competitions. The heart of LeaguePad is its statistics engine. The statistics like team, soccer player, game statistics features are grouped according to who or what they apply to. Statistics are made up with ranking of teams, soccer players, referees, scoring trends and patterns, summary of global league data and much more. Similarly, FSTATS Sports Management Entertainment and Information Group² developed software to evaluate the performance of soccer players. It is not a real time applications, it evaluates the performances after the game. Rettinger (2004) and Luhtanen et al. (2001) study non real time team performance. Rettinger (2004) outlined a technique that uses data obtained from prerecorded soccer games for supervised neural network learning. Luhtanen et al. (2001) study selected offensive and defensive variables of field players and goalkeepers in

¹ www.pcsoccer.com

² www.fstats.net

the EURO 2000 and to relate the results to the final team ranking in the tournament. Pollard and Reep (1997) and Palomino et al. (2000) study real time team performance. Pollard and Reep (1997) study the effectiveness of a team possession. They evaluate both the expected outcome of a team possession originating in a given situation, as well as the actual outcome of the possession. In this way, they quantify and compare the effectiveness of different strategies occurring during the possession. Palomino et al. (2000) propose a simple game theoretic analysis of this game, and found some empirical support for it. The more interesting aspect is that rationality and passion, two factors of seemingly opposite nature, also coexist. The evidence seems to show that teams react rationally to the evolution of the game and to changes in the current score. On the other hand, there is evidence of behavior that is difficult to characterize as rational.

Methodology

We develop and test the proposed database for performance evaluation of soccer players by watching eight soccer games for fourteen different teams. While taking the data, we did not watch the same team's games that results biasness. Each team has specific tactics so the data may become intense on some events. (e.g. goalkeeper and defenders' data in strong teams are less than competent teams). While developing the database, we watch the games sometimes more than once; we continuously discuss and comment on every critical event until we believe that every parameter covers the exact expectations. Some difficulties are faced during developing the database for performance evaluation of soccer players. It is virtually impossible to collect the data of eleven soccer players in real-time so we have to record the games. Whole game field could not be seen when recording the games because the TV camera sometimes focus irrelevant fields and we have no chance to see whole game field and events that may affect the results. Replays during the live broadcast could result some missing actions or event during replay times. The performances of soccer players may be affected by the referees' decisions. It was hard to define some of the parameters because there were too many events and some events may occur once in a single game. For that reason we tried to define the parameters in order to measure the exactly real performances. We mainly consider the parameters that have direct effects for performances of soccer players. The core aim of this paper is not making statistical analysis or interpreting the data. The parameters are determined to develop a database for evaluation of exact performances of soccer players.

We divide the soccer field into four regions: goalkeeper, defenders, midfielders, attackers regions. The boundary of each region will be slightly different for each technical director since they use own tactics. We can give a simple example to explain their difference as follows: if the team plays offensive then the defenders region will be more close to the midfield region and midfielder region will be close to the attacking region. In this section, we define parameters for each region soccer players. We determine the expectations for each region and we have some general evaluation criteria for their performances during the games. First of all, we define our expectations for each region soccer players then we define the expectations in general and for each region soccer players.

Goalkeeper

Goalkeepers should have excellent hand-eye coordination and have excellent reactions. The basic expectations for goalkeepers are saving shots, organizing defenders and inserting the ball with positive passes adjusting or warning the soccer players in the defend region with a back view, taking the right positions during attacks. We determine the following parameters to evaluate the goalkeeper's performance such as *shots saved*, in penalty area, one-to-one, out of penalty area, free kicks, penalties, head, balls taken from crosses, balls cleared away, *goals given away*, free kicks, head, in penalty area, one-to-one, out of penalty area, penalties, *passes*, *hand*, positive, key, negative, outline, opponent, *kick*, *short*, negative, outline, opponent, positive, *long*, negative, outline, opponent, positive, key, *fouls*, fouls committed, fouls done, yellow cards, red cards, penalties committed, *goals*, penalty goals.

Defenders

The defenders (usually 3 to 5 per team) play near their own teams' goal and are primarily assigned to prevent shots being taken on their goal by the opponent. They also take returns from the goalie and are directed to get

the ball to the midfielders. The basic expectations for a defender are stealing the ball, positive passing, marking, tackling, struggling and taking the right positions due to situation. We determined the following parameters to evaluate the defender's performance such as *balls stolen*, during struggle, key, heading, key, between opponent passes, key, *ball lost*, *clear away*, key, *out of control*, key, *balls cut*, head, key, foot, key, *unsuccessful challenge*, head, key, foot, key, *disturbing*, air-ball, key, ground, key, *fouls*, committed, being done, *penalties*, committed, being done, yellow cards, red cards, *throw-in*, successful, unsuccessful, *cross-ball*, right, negative, positive, key, negative, positive, key, *shots*, *shots on target*, in penalty area, head, kick, bar, out of penalty area, head, kick, bar, *shots not on target*, in penalty area, head, kick, out of penalty area, head, kick, *passes*, positive, negative, short, long, head, air ball, ground, to goalkeeper, same zone, key, backward, key, forward, key, *dribbles*, successful, key, unsuccessful, key, *dribbles cut*, key, *dribbles not cut*, key, *corners*, right, left, negative, positive, key, *goals*, in penalty area, head, kick, out of penalty area, head, kick, free-kick goals, penalty goals, own goals, assists, off-sides, *free-kicks*, successful, unsuccessful.

Midfielders

The midfielders (usually 3 to 6 per team) primary task is to steal the ball and redirect it to the forwards, and to take shots at the goal. Accurate passing is required. The basic expectations for a midfield soccer player are stealing the ball in the midfield region, tackling, marking, pressing, taking the right position, positive passing, assists, piece-taking (setting up the game). We determined the following parameters to evaluate the midfielder's performance such as *passes*, positive, negative, short, long, head, air ball, ground, to goalkeeper, same zone, key, backward, key, forward, key, *cross-ball*, right, negative, positive, key, negative, *dribbles*, successful, unsuccessful, key, *dribbles cut*, key, *dribbles not cut*, key, *corners*, right, left, negative, positive, key, *free-kicks*, successful, unsuccessful, *shots*, *shots on target*, in penalty area, head, kick, bar, out of penalty area, head, kick, bar, *shots not on target*, in penalty area, head, kick, out of penalty area, head, kick, *disturbing*, air-ball, key, ground, key, *goals*, in penalty area, head, kick, out of penalty area, head, kick, free-kick goals, penalty goals, own goals, assists, off-sides, *balls stolen*, during struggle, key, heading, key, between opponent passes, key, *ball lost*, *clear away*, key, *out of control*, key, *balls cut*, head, key, foot, key, *unsuccessful challenge*, head, key, foot, key, *fouls*, committed, being done, *penalties*, committed, being done, yellow cards, red cards, *throw-in*, successful, unsuccessful, positive, key.

Attackers

Attackers (usually 1 to 3 per team) play near the other team's goal and are charged primarily with scoring goals. Forwards playing near the touchlines are called '*wings*' while those in the midst of the field are called '*strikers*'. Since their primary focus is scoring goals, power is more important than skill. They don't generally have to be concerned about another soccer player '*trapping*' the ball. Accuracy in shooting is a premium for these soccer players. The basic expectations for an attacker are scoring goals, stealing the ball in the attack region, tackling, marking, dribbling into penalty area, pressing, taking the right position, positive passing, assists, gaining the ball from midfielder and transfer with a positive way to wings or the other teammates, emptying the region for the other teammates. We determined the following parameters to evaluate the attacker's performance such as *goals*, in penalty area, head, kick, out of penalty area, head, kick, free-kick goals, penalty goals, *shots*, *shots on target*, in penalty area, head, kick, bar, out of penalty area, head, kick, bar, *shots not on target*, in penalty area, head, kick, out of penalty area, head, kick, *dribbles*, successful, key, unsuccessful, key, *dribbles cut*, key, *dribbles not cut*, key, assists, off-sides, *fouls*, committed, being done, *penalties*, committed, being done, yellow cards, red cards, *free-kicks*, successful, unsuccessful, *cross-ball*, right, negative, positive, key, negative, *out of control*, key, *corners*, right, left, negative, positive, key, *disturbing*, air-ball, key, ground, key, own goals, *throw-in*, successful, unsuccessful, *balls stolen*, during struggle, key, heading, key, between opponent passes, key, *ball lost*, *clear away*, *balls cut*, head, key, foot, key, *unsuccessful challenge*, head, key, foot, key, positive, key, *passes*, positive, negative, short, long, head, air ball, ground, to goalkeeper, same zone, key, backward, forward, key.

Applications

One obvious application of our study is an objective performance evaluation of a soccer player, who signs a contract with a new/current team, individually at the transfer season. Another possible application is the

multiple criteria decision making for a team when they have more than one soccer player candidates to sign a new contract. Another application of performance evaluation and statistical analysis of developing the soccer players is to provide real database for computer game programmers. The computer programmers can use this database for performing soccer player specialties. Another application of the database can be considered for soccer managers and managerial companies for soccer players. The clubs may offer a price for a soccer player to managerial companies or the companies may recommend a price for a soccer player according to the data of this soccer player.

One of the important applications is a decision support system for the technical director that we focused on this application.

A Real-Time Decision Support System Application

The term “decision support system” (DSS) remains a useful and inclusive term for many types of information systems that support decision making. The design and capabilities of our DSS influence the fact-based decisions we can make. In this section, a real time DSS for technical directors is explained. Performance evaluation of soccer players is the mostly important for technical directors. For example, a technical director might query a database to ask questions like what is total successful passes for each of midfield soccer players; what passes have been cause a serious attack. According to these quarries he may decide on changes of players during game or rearrange the squad for next games. The technical director may look at the data for the next opponent team, and then he determines a new tactic, a new formation or gives an order to one of his team’s soccer players to prevent a special strong fact of opponent team. Furthermore when the performance evaluation of soccer players is real-time, it can be more useful and easy to take preventions for opponent team during games. So, we propose a DSS to evaluate performances of soccer players during games. The data taken from the game is given to the technical director as a summary of what he wants. It helps the technical director to see the performances of soccer players quickly with real-time during games. It helps technical director to think clearly under high pressure. The technical director can decide on new tactics, formations or substitutions for changing the flow of game with performed DSS. In the proposed DSS, the data is collected by data collectors by using the developed database. Then the data is transferred to the data analysts. Data analysts analyze the data according to the technical director’s needs. That process is summarized in Figure 1.

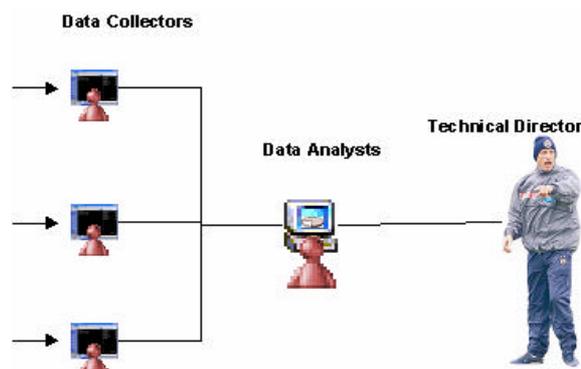


Figure 1. DSS Chart for a Technical Director

Summary, Conclusion, Recommendation

A database for performance evaluation of soccer players and a relevant DSS to help people such as technical directors is developed. The purpose of this study is to remove the subjectiveness on the soccer and soccer players’ performances and to bring an objective point of view on soccer. The parameters of our database are more complicated than the current methods (in newspapers, magazines, internet, etc.). If the database can be transferred to the technical director in real time, the technical director can determine his own tactics for every game according to the data of the opponent teams’ last games. Furthermore, in the transfer period, the

performance of soccer players can be determined according to the previous games by this study. An estimation of the transfer money can be determined for the soccer players by the help of this study. This study is aimed at developing a more understandable and extensive database. Furthermore, this study can be a substructure of computer software that the technical directors and all other people can follow-up the flow of the game clearly by the means of the real-time flow of data during soccer games.

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