A methodology for football players selection problem based on multi-measurements criteria analysis

M.A. Qader [a], B.B. Zaidan [b], A.A. Zaidan [b,*], S.K. Ali [a], M.A. Kamaluddin [a], W.B. Radzi [c]

[a] Department of Mathematics and Science Education, Faculty of Education, University of Malaya, Malaysia
[b] Department of Computing, FSKIK, Universiti Pendidikan Sultan Idris, Malaysia
[c] Sports Center, University of Malaya, Malaysia

ABSTRACT

Football is one of the most popular sports in the world. Professional football has become a significant contributor to global economics and business. The game attracts considerable funds, which motivate participants of the sporting process (players, coaches, club owners, administration, etc.) to strive for better athletic results. However, such a motivation simultaneously promotes internal and external rivalry. The increasing number of players, the teams' desire to attract better team members, and the improved athletes' performance boost the use of assessment and rating processes. The most popular and widely used player rating systems are based on performance statistics, which reflect situational factors of the game. Most specialists believe that such systems lack objectivity. Thus, this paper presents a new methodology to assess and rank football players based on multi-criteria decision making (MCDM). A hands-on study is conducted for the assessment. A sample of 24 players is grouped into four separate groups consisting of six players for each group. The age of U17 is examined by 12 tests distributed as follows: three anthropometrics, five fitness, and four skills tests. Players are ranked on the basis of a set of measurement metric outcomes using the technique for order performance by similarity to ideal solution (TOPSIS) method to select the appropriate player using a one-shot experiment. Then, this study utilizes the mean and standard deviation to ensure that the four groups of players undergo systematic ranking, respectively. Findings are as follows: (1) systematic: TOPSIS is an effective tool used to solve player selection problems, and (2) statistics: group number one is the best group among the four groups, identical to the results of the system.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

Football is one of the most popular sports in the world, and its number of players annually increases at an explosive rate [1]. Soccer is a multi-player game. Accordingly, coaches are continuously seeking the most efficient technique for identifying outstanding players to form an elite team [2,3]. A team is adequately described as a small number of people with particular skills dedicated to a common goal, purpose, and approach for which they believe themselves mutually responsible.

The player selection process for professional soccer teams is crucial in the quest for winning. Such a process is so important that a wrong selection can cost a football team the championship and even millions of dollars if the player fails to live up to the team's expectations. Traditionally, professional soccer teams use various sports psychological assessments for evaluating players. Undoubtedly, these assessments are significantly beneficial and are extremely useful when attempting to form a winning soccer team. However, this process is only one part of the huge puzzle when attempting to assess a player's suitability for a team. The ability to select suitable players and arrange an effective team formation is indispensable in attaining the highest point for team sports [4].

The player selection process for a particular team intends to choose the most suitable player for a particular play position and role [5,6]. The procedure for player selection in n-player sports such as soccer is a complex multi-factor problem with multi-objectives. Player selection within a team is a difficult decision-making task with several measurements. Assessing several qualitative and quantitative factors is compulsory for coaches and their technical committee to produce the most elite players [7]. These factors may include the player's individual, anthropometric, fitness, and skills [8,6].

Anthropometry is a technique to measure physical characteristics body size, shape of specific body parts, and proportion) of living beings, including men. Anthropometry has been widely applied in various disciplines, such as ergonomics and health sciences. Given its convenience, anthropometry has also been applied to understand athletes' physical characteristics in the field of sports science while targeting the improvement of athletic performance [8]. As the correct application of anthropometric techniques and the interpretation of information facilitate health management in athletes while improving their performance, support staff in athletic fields (including sports dieticians) must share their knowledge associated with anthropometry [9].

Physical fitness can be defined as "the ability to carry out daily tasks (work and play) with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies". Fitness requires a significantly specific and extremely clear definition. These terms are called the components of fitness, such as health-related components and motor skills components [35,36].

Skills can be defined as the ability to carry out a task frequently with pre-determined results within a given amount of time, energy, or both. Skills can be divided into two categories, namely, domain-general and domain-specific [37]. In soccer, a skill is the ability of a player to perform complex physical movements, such as controlling the movement of the ball [10].

Player selection based on the above factors can frequently become a problem for coaches on one platform in all tests. In other words, many problems may be faced by the coach during the selection process, such as the chosen players, based on all the tests we have mentioned earlier with the player and the available time for the selection process. Thus, a decision support system that can assist the coach during player selection is significantly beneficial for future games. This study presents a new methodology to assess and rank football players based on three different criteria, namely, physiology, fitness, and skill characteristics, using multi-attribute decision making. The remaining sections of this paper are organized as follows: Section 2 covers the literature review. Section 3 describes the decision-making methodology for the assessment and ranking of football players. Section 4 presents the results and discussion. Sections 5 and 6 discuss the contributions and limitations of this research, respectively. Sections 7 and 8 conclude and provide suggestions for future direction, respectively.

2. Literature review

The current literature on player selection and team formation in multi-player sports is limited and scattered. Nevertheless, some studies have attempted to create a framework for player selection.

Arnason et al. [8] offer the most related research in this study by proposing the use of a fuzzy inference system (FIS) for player selection and team formation in football fuzzy sets to transform the linguistic variables used for players' performance assessment in multiple attributes into triangular numbers. The linguistic variables are used to address the difficulty in expressing players' skill levels and performance ratings using discrete values. Fuzzy numbers are useful in promoting the representation and information processing under fuzzy environment. The linguistic variables are further used to assess the performance of each candidate player in different positions. FIS addresses the gaps in the sports science literature on the effective and efficient player selection and team formation. It uses a meaningful and robust multi-criteria model to aggregate both qualitative judgments and quantitative data. However, it considers imprecise or vague judgments that lead to ambiguity in the decision process.

Kasap and Kasap [11] investigate the general parameters to evaluate the performance of soccer players and develop a database for performance evaluation of soccer players, including a relevant decision support system (DSS) to assist people, such as the technical director. The framework is still in the proposal stage, but no players are evaluated through the system.

Johnson [12] shows that the sports domain offers an excellent opportunity to investigate decision-making domain. One reason for this is the topical scope of sports. This scope of decision making involves a number of different decision agents (coaches, players, etc.), tasks (play-calling, ball allocation, etc.), and contexts (during play, during time out, etc.), thus offering an opportunity to examine various interesting designs. Johnson added that each combination of the above factors produces a unique interaction of important elements that affect how decisions are made. Although no "standard" type of decision exists in sports, some characteristics seem general enough to abstract from this domain.

Bozbura et al. [29] propose a decision support system for player selection in the National Basketball Association (NBA). Six selected criteria, including four skills criteria with age and player salary, are created. However, their result is limited to six players only. Khatib et al. [13] evaluate the effectiveness of players using the decision-making framework by selecting the skills criteria to evaluate the players. Sathya and Jamal [14] use artificial intelligence to select a team of optimal players. They use a sample of 50 players, and their criteria are for skills only. Merigó and Gil-Lafuente [15] analyze the use of the ordered weighted averaging operator in the selection of human resources in sports management. They use the Hamming distance, the adequacy coefficient, and the index of maximum and minimum level to parameterize these decision-making techniques and selection of football players for a team. Ahmed et al. [16] consider the overall batting and bowling strength of a team and propose a constrained multi-objective optimization model for the selection of the players in the team. Raut et al. [17] proposed procedure is based on a decision-making method to assist in the selection of a suitable player from among several available players for a game based on skills criteria. Zhongyou [31] introduces a decision-making method for the evaluation of foreign players during the introduction of foreign players in CBA teams. The skills criteria are used on the evaluation, and the experiment is limited to four players only. The study claims to have achieved a good result. Ahmed et al. [30] propose decision-making approaches to team selection. They attempt to select the best team from a group of players with a certain budget. Specifically, they attempt to select 11 from 129 players within a certain budget. They analyze the result by selecting four teams with four different skills criteria, Tavana et al. [7] develop a system to assist the coach in selecting the game formation by using the skills criteria to determine the good players. However, further study on the fitness and physiological test is necessary for all the above studies.

Miralles et al. [18] explore individual players' strategies to assess the adequacy of shooting (in a simulation laboratory task) in varying situations and degrees of physical defensive pressure, rebound, defensive balance, and shooting distance. A decision-making approach based on these criteria is necessary for the present study.

Dadelo et al. [19] suggest a systematic solution as a consistent problem-solving system. Algorithms based on multi-criteria decision making (MCDM) are regarded as simple, clear, suitable to substantiate solutions, and easily applicable in practice. Methodologies used by the authors help ensure a greater efficiency of player and team rating, more accurate prognoses of sports results, team formation, and optimization of the training process. Furthermore, these methods consider the individualism of team players and encourage their versatility, that is, conformity to the general physical preparedness norms of the team. However, the