



A fuzzy inference system with application to player selection and team formation in multi-player sports

Madjid Tavana^{a,*}, Farshad Azizi^b, Farzad Azizi^b, Majid Behzadian^c

^a Business Systems and Analytics Department, Lindback Distinguished Chair of Information Systems and Decision Sciences, La Salle University, Philadelphia, PA 19141, USA

^b Industrial Engineering Department, Faculty of Engineering, Shomal University, Amol 46134, Iran

^c Industrial Engineering Department, Mehrabz University, Tehran, Iran

ARTICLE INFO

Article history:

Received 24 April 2012

Received in revised form 5 June 2012

Accepted 5 June 2012

Keywords:

Fuzzy inference system

Fuzzy sets and logic

Player selection

Team formation

Soccer

ABSTRACT

The success or failure of any team lies in the skills and abilities of the players that comprise the team. The process of player selection and team formation in multi-player sports is a complex multi-criteria problem where the ultimate success is determined by how the collection of individual players forms an effective team. In general, the selection of soccer players and formation of a team are judgments made by the coaches on the basis of the best available information. Very few structured and analytical models have been developed to support coaches in this effort. We propose a two-phase framework for player selection and team formation in soccer. The first phase evaluates the alternative players with a fuzzy ranking method and selects the top performers for inclusion in the team. The second phase evaluates the alternative combinations of the selected players with a Fuzzy Inference System (FIS) and selects the best combinations for team formation. A case study is used to illustrate the performance of the proposed approach.

© 2012 Sport Management Association of Australia and New Zealand. Published by Elsevier Ltd. All rights reserved.

1. Introduction

The process of player selection and team formation in multi-player sports is a complex multi-criteria problem with conflicting objectives. Selection of players in a team is always a difficult decision making task with many dimensions. Coaches are required to consider a large number of qualitative and quantitative attributes in the player selection process. These attributes may include the player's individual skills and performance statistics, combination of players, physical fitness, psychological factors, and injuries among others (Arnason et al., 2004). Some coaches may also use importance weights to determine the impact of each attribute. Importance weights are useful to coaches since they indicate how the impact of a particular attribute relates to the probability of a successful outcome.

Soccer (more commonly known as football in many regions) is a team sport that is popular in almost every country in the world. The player selection process for professional soccer teams is crucial in the quest for winning. So much so that a wrong selection can cost a soccer team the championship and even millions of dollars if the player turns out not living up to the team's expectations. Traditionally, professional soccer teams use a variety of sports psychology assessments for evaluating players. There is no doubt that these assessments are of great benefit and are extremely useful when trying to form a winning soccer team. However, this is just one part of the big puzzle when trying to assess a player's suitability for a team. The ability

* Corresponding author. Tel.: +1 215 951 1129; fax: +1 267 295 2854.

E-mail addresses: tavana@lasalle.edu (M. Tavana), f.azizi_ie@yahoo.com (F. Azizi), azizi_ie@yahoo.com (F. Azizi), behzadian_ie@yahoo.com (M. Behzadian).
URL: <http://tavana.us>

to select suitable players and arrange an effective team formation is indispensable for reaching the top for team sports (Boon & Sierksma, 2003).

Katzenbach and Smith (1993) defined a team as a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable. The main goal of team building is teamwork, which is the vehicle for integrating information, technology, competence and resources based on human interactions (Kinlaw, 1991). A variety of approaches for the selection of team members have been proposed in the literature. Most of these studies have focused on the use of teams in business and industry. The business and industry's adoption of a teamwork methodology in the pursuit of cost effectiveness and greater innovation has spawned significant research (Chen, Cheng, & Chuang, 2008; English, Griffith, & Steelman, 2004; Kirkman, Rosen, Tesluk, & Gibson, 2004; Mannix & Neale, 2005).

The conceptual work of several scholars has highlighted five key elements for team-building: clear goals with measurable outcomes, clinical and administrative systems, division of labor, training, and communication (Baldwin, 1994; Cohen & Bailey, 1997; Fried, Topping, & Rundall, 2000).

Askin and Sodhi (1994) have presented a novel method for organizing teams in concurrent engineering. They developed five different criteria for team formation and discussed team training, leadership, and computer support issues. Zakarian and Kusiak (1999) proposed an analytical model for the selection of multi-functional teams. They used the analytic hierarchy process and the quality function deployment method to prioritize "team membership" based on customer requirements and product specifications. Braha (2002) has proposed a team-building approach based on task partitioning by specifying task dependencies and partitioning the tasks among a number of teams. Chen and Lin (2004) proposed a team member model for the formation of a multi-functional team in concurrent engineering. They used the analytic hierarchy process and Myers–Briggs type indicators to model team member characteristics. In the software development field, Gronau, Fröming, Schmid, and Rüssbüldt (2006) developed an algorithm to propose a team composition for a specific task by analyzing the knowledge and skills of the employees. In the project management field, Durmusoglu and Kulak (2008) proposed a team building process using axiomatic design principles. They proposed to establish teams by identifying the needed skills and preparing a skill development procedure to ensure maximum utilization of team members' talents. Feng, Jiang, Fan, and Fu (2010) proposed a member selection method in cross functional teams where both the individual performance of the candidates and the collaborative performance between candidates were considered.

Fuzzy set theory has also been used in the team member selection and team formation research. Liang and Wang (1992) proposed integrating fuzzy logic into weighted complete bipartite graphs and developing a polynomial time algorithm for solving personnel placement. Yaakob and Kawata (1999) used triangular fuzzy numbers to evaluate the workers' skills and measure their suitability in work teams. DeKorvin, Shipley, and Kleyle (2002) developed a model for the selection of personnel in multiple phase projects, which took into account the match between the skills possessed by each individual, the skills needed for each phase, and flexible budget considerations. They used the fuzzy construct of compatibility to measure the fit of a person's skill set to the goal set for each project phase in fuzzy environment. Dereli, Baykasoglu, and Das (2007) used simulated annealing and proposed a fuzzy mathematical programming model for the formation of quality audit teams. Shipley and Johnson (2009) proposed a fuzzy set-based model for selecting project membership to achieve cognitive style goals.

The above studies demonstrate the importance of team member selection in a wide variety of applications. In spite of the importance of member selection and team formation research in business and industry, this subject has not been widely researched in the sport science literature. The current literature on player selection and team formation in multi-player sports is very limited and scattered. Boon and Sierksma (2003) formulated a linear optimization model to headhunt or scout a new team in soccer and volleyball by combining the qualities of the candidates and players with the functional requirements. Merigó and Gil-Lafuente (2011) analyzed the use of the ordered weighted averaging (OWA) operator in the selection of human resources in sport management. They used the Hamming distance, the adequacy coefficient and the index of maximum and minimum level to parameterize these decision-making techniques and select of a football player for a team. Ahmed, Deb, and Jindal (2011) considered the overall batting and bowling strength of a cricket team and proposed a constrained multi-objective optimization model for selection of the players on the team.

Fuzzy sets and fuzzy logic are powerful mathematical tools for modeling uncertain industrial, human and natural systems. They are facilitators in decision making by means of approximate reasoning and linguistic terms. Their role is significant when applied to complex phenomena not easily described by traditional mathematics. Moreover, users often feel more comfortable using linguistic terms instead of precisely specified numerical values. Sport management often involves decision making in the absence of precise and complete information. Fuzzy sets and logic can be effectively used in sport management applications such as sport operations, sport economics, sport marketing, sport human resources, and sport facility management.

In this paper, we propose a Fuzzy Inference System (FIS) for player selection and team formation in soccer. Fuzzy sets are used to transform the linguistic variables used for assessing the players' performance on multiple attributes into triangular numbers. The linguistic variables are used to deal with the difficulty in expressing players' skill levels and performance ratings with discrete values. Fuzzy numbers are very useful in promoting the representation and information processing under fuzzy environment (Dubois, 1978). The linguistic variables are also used to assess the performance of each candidate player in different positions.

A FIS is a non-linear system that employs fuzzy IF–THEN rules to model the qualitative aspects of human knowledge without employing precise quantitative analyses. The most popular fuzzy logic modeling techniques can be classified into

Download English Version:

<https://daneshyari.com/en/article/140957>

Download Persian Version:

<https://daneshyari.com/article/140957>

[Daneshyari.com](https://daneshyari.com)