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Multi-criteria assessment and ranking system of sport team formation based on objective-measured values of criteria set

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ABSTRACT

Basketball is one of the most popular sports games in the world. Professional basketball has become a significant contributor to global economics and business. Considerable funds attracted by the game motivate participants of the sporting process (players, coaches, club owners, administration and etc.) to strive for better athletic results, this way promoting internal and external rivalry. A large number of players and the desire of teams to attract better team members as well as improve the quality of the already available athletes, 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. Meanwhile, the Authors suggest a systematic solution, i.e. an adjusted well-known TOPSIS method and principles for the design of the algorithm based on the method. As a consistent problem solving system, algorithms based on multi-criteria decision-making are regarded to be simple and clear, suitable to substantiate solutions as well as easily applied in practise. Methodologies used by the Authors will help ensuring a greater efficiency of player and team rating, more accurate prognoses of sports results, team formation, and optimisation of the training process considering individualism of team players and encouraging their versatility, i.e. conformity to general physical preparedness norms of the team. The suggested research methods could be used in other sports. Furthermore, these principles could be used in business management for team formation.

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1. Introduction

Some authors argue that basketball requires reciprocal coaching with leadership and decision-making based on sharing (Erculj & Supej, 2009) as well as on a collaborative and facilitating environment, which is rather different from dominant and controlling basketball coaching described by (Adler & Adler, 1988). Basketball involves many continuous motor skills. However, shooting is a relatively discreet skill (Stec, 2012). Thus, basketball requires a tremendous amount of gross motor skills that involve the movement of the whole body. In basketball, taking a foul shot is a relatively closed environment when compared to the movement required to execute an offensive set. The sequence of plays is unpredictable and dependant on a situation. To a large extent, success depends on the ability to effectively execute discrete tasks. This does not imply that basketball has nothing to do with continuous motor skills; however, the emphasis is on creating the greatest number of opportunities for the athlete who has the best ability to score. Positions tend to be differentiated by geographic space, point guards, shooting guards, centre and power forward, each with different expectations. There is certainly a skill overlap, but only on a very magical occasion you would find a point guard playing a centre. Basketball requires continual responses to the ever-changing environment. To a large extent, coordination is decentralised and efforts are dedicated to finding a position where the team has an advantage, and these match-ups are often the game within the game. The results of the present study demonstrate a strong relationship between a body composition, aerobic fitness, anaerobic power and positional roles in elite basketball (Ostojic, Mazic, & Dikic, 2006). A qualitative judgement could improve the assessment of a player. However, it needs to be made by true experts (Martínez & Martínez, 2011). To achieve the effectiveness of the game, it is essential to search for player rating methods that would consider anthropometric, physical preparedness and functional capacity rates. Basketball players could be clas-

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sified according to the tasks they are responsible for: a point guard, a shooting guard, a small forward, a power forward and a centre. It is essential that the coach focuses on staff selection and takes action to evaluate and rate candidates. This process requires defining key competences of basketball players and rating them depending on aims. However, the evaluation performed and decisions taken by a single person are less correct than those made collectively with the difference between the two amounting to 26% (Surowiecki, 2004), or finding mathematically evaluated existing weighting factors, because there is no method able to effectively assess an optimal combination of the dynamic properties of the system. It seems to be clear that all player-rated indicators have different effects on their performance. However, there are no objective methods that allow weighing (evaluating) the factors affecting the efficiency of player activity. Nevertheless, the application of subjective methods (expert evaluation) based on objective indicators (testing data) can be considered an effective instrument.

To optimise the efficiency of the process for selecting basketball players, it is essential to search for the methods based on collective evaluation. The decisions taken on the basis of the wisdom-of-crowds theory will be efficient if strict selection and mathematical calculation methods are applied. If a judgement of a crowd comprises signal-plus noise, averaging judgments will cancel out the noise and extract the signal (Genre, Kenny, Meyler, & Timmermann, 2013). The decisions taken on the basis of wisdom-of-crowds require more complex mathematical methods for information processing (Dadelo, Turskis, Zavadskas, & Dadeliene, 2012, 2013). For this reason, multi-criteria decision making methods can be used. Decision makers play a central role within this process, which takes into account the perspective of each party involved. Therefore, it proves useful for dealing with conflicts and providing recommendations.

The decisions on sport management and development require more complex mathematical methods of information processing. The development of MCDM methods has been motivated not only by a variety of real-life problems requiring the consideration of multiple criteria, but also by the practitioners' desire to propose enhanced decision-making techniques using recent advancements in mathematical optimisation, scientific computing and computer technology. The selection of the strategy for sport development almost involves MCDM methods; whereas applicable, the original justification for the decision data is not based on objective tests and measurements. Up to now, no multi-criteria decision-making (MCDM) methods have been used for ranking athletes. There are a number of MCDM methods that could be used for solving the problems of sorting and ranking (Liou & Tzeng, 2012).

Tavana, Azizi, Azizi, and Behzadian (2013) employed a two-phase framework for selecting soccer players and forming teams. Some authors (González-Gómez & Picazo-Tadeo, 2010) focused on researches into the assessment of the sporting performance of professional teams at a competitive level. The problem was addressed using data envelopment analysis techniques and directional distance functions. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method is one of the most mathematically clearest and one of the most widely used well-known MCDM methods (Antucheviciene, Zakarevicius, & Zavadskas, 2011; Antucheviciene, Zavadskas, & Zakarevicius, 2012). TOPSIS was originally developed by Hwang and Yoon (1981). Cables, García-Cascales, and Lamata (2012) presented an alternative to the TOPSIS decision-making approach to linguistic variables (LTOPSIS). Choudhary and Shankar (2012) introduced a STEEP-fuzzy AHP-TOPSIS framework for the evaluation and selection of thermal power plant location. Mokhtarian and Hadi-Vencheh (2012) applied a new fuzzy TOPSIS method based on left and right scores for determining an industrial zone for the factory of dairy products. Rouhani, Ghazanfari, and Jafari (2012) adopted a fuzzy TOPSIS evaluation model of business intelligence for enterprise systems. Collan, Fedrizzi, and Luukka (2013) presented an approach based on fuzzy pay-off distributions and a TOPSIS–AHP framework for the multi-expert system of patent ranking. Lourenzutti and Krohling (2014) illustrated the applicability of Hellinger distance to TOPSIS and TODIM methods. Wang and Wang (2014) stated that the consideration of the correlation between indicators improved the evaluation results (in terms of sorting and closeness) to a certain extent compared to the traditional TOPSIS method. They provided the evaluation of the provincial competitiveness of Chinese high-tech industry using an improved TOPSIS method. Aloini, Dulmin, and Mininno (2014) proposed a peer-based modification in intuitionistic fuzzy multi-criteria group decision making with the TOPSIS method (peer IF-TOPSIS) and applied it to the problem of selecting an alternative. They stated that, among numerous MCDM methods, TOPSIS continued to work satisfactorily in different application areas. Behzadian, Otaghsara, Yazdani, and Ignatius (2012) presented a literature review on TOPSIS methods and related applications.

However, the TOPSIS method for solving the problems of sport science has not been applied.

2. Methods

This paper describes a novel framework for practical assessment and ranking of basketball players (Fig. 1).

2.1. Determining of criteria set for players' assessment

The investigation involved the key professional players of the Lithuanian Basketball League. The investigation aimed to assess physical and functional conditions of players. The information was necessary to plan individual training processes or adapt the training process to each individual athlete. The training process aims to achieve high standards set for the entire team. Physical conditions of players should meet team standards. One of the primary observations is that traditional methods of statistics used in

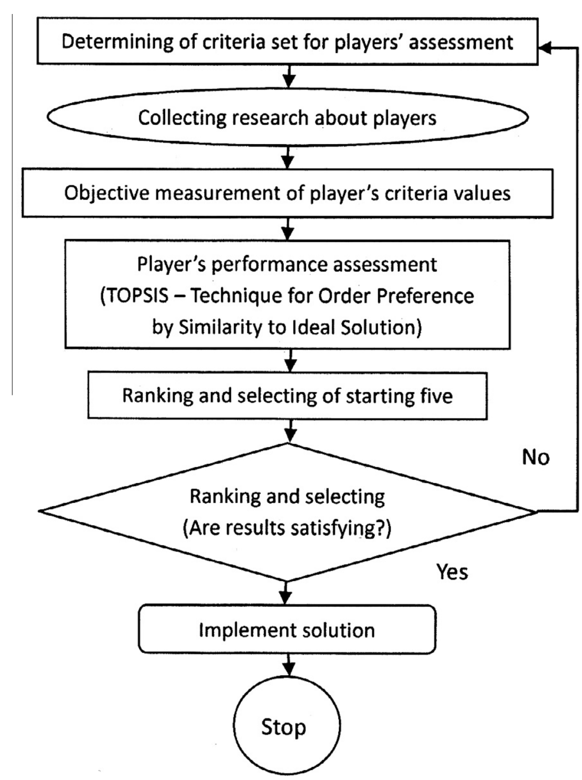

Fig. 1. Research progress.

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