THE MANAGERIAL IMPLICATIONS OF FUZZY LOGIC IN THE TRIAGE PROCESS OF CHILD AND JUNIOR PLAYERS WITHIN A FOOTBALL CLUB

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Abstract: Even though most studies from the specialized economic literature approach various problematic aspects linked to corporations, production or service-providing companies worldwide, a phenomenon that deserves to be researched is the management of sport organizations because, especially in the contemporary world, sport has become both a means to preserve health and to spend one's leisure time, but it is also a field in which a significant amount of money is made and invested. In light of this, sport organizations in general and especially football clubs must find the best tools and methodologies of management with the aim of ensuring organizational sustainability. A very important aspect of this undertaking stems from the phase of sorting or selecting and training child and junior players; they represent both the cheapest and most valuable human resource that can efficiently and effectively ensure both a level of performance, as well as financial income within a football club. This is an integrating part of a chain of sustainable value within a sport organization. In this context, the decision-maker responsible for these aspects are sometimes confronted with situations of uncertainty or ambiguity ultimately due to subjective reasoning, especially in the case of evaluating children or juniors; thus, the implementation of a qualitative mathematical instrument represented by fuzzy logic in the sorting and selection process of this human resource that would catalyse the delineation of a chain of value that can be sustained throughout the years within a football club represents a direction towards which any sport entity should aim, not necessarily those concerned with football.

Key words: fuzzy logic, triage process, child and junior players, football club.

JEL Classification: C52, M12, Z19.

INTRODUCTION

Lately, taking into account the increasing complexity and particular dynamics that characterize the contemporary economic and business sector, researchers have sought to scientifically approach the planning and the application of the best methods and techniques with the aim of turning the decision-making process into a reliable and flexible one, given the activities of organizations in the context of postmodern management. This framework involves a certain quantity of vagueness and ambiguity that tends to surround the managerial decision-making process, taking into account the conditions and the circumstances in which organizations evolve, but also the increasing expectations and pretentions from the part of various stakeholders that gravitate around these organizations. Moreover, the lack of certainty in this circumstance is doubled by the subjectivity of the reasoning on the part of the decision-making human factor, which manifests itself many times through vague linguistic means of expression or words, seen as a specific human trait of being and relating. In this context, the adoption of a modern qualitative mathematical methodology based on fuzzy logic may create the perfect framework for taking reliable and sound decisions in the shortest amount of time possible.

Given all of these statements, we feel that the world of sports and especially the organizations that evolve in this area should not be exempted from taking into consideration these aspects. We mention this from the perspective of an increasing degree of professionalization in sports, at least in the last three to four decades, especially with regard to football, when this phenomenon started to become an industry in the real sense of the term, significantly due to the fact that huge sums of money gravitate around this sport, as well as varied interests and expectations.

Just as in the case of a company that conducts its activity within a certain production industry of in the services area, the management of sports entities must professionalize itself as much as possible. Given the transition of the contemporary world of business from Porter's industrial approach to more modern managerial approaches, the traits of the current period of postmodern management, such as resource-based management or knowledge management, sports organizations must base their strategies so that their chain of values would become a sustainable one, something ultimately provided by the sustainability of the elements associated to it. In this context, especially within sports entities in general of football clubs in particular, their management must concentrate efforts and undertakings towards performance, not just at the level of senior players, but also at the level of child or junior players, following the model provided by the big European clubs such as F.C. Barcelona or F.C. Ajax Amsterdam, which continually produce young talents, thus ensuring the sustainability of performance, in the realm of finance and sports. In other words, an appropriate management of child and junior centres that would emphasize the selection process and later on the training and professional education of young talents must be a priority for all professional football teams worldwide, given the fact that they do not aim to survive exclusively from selling tickets, television rights or advertising, but from training young professional players that would either remain within the club for a period of time after they are no longer juniors or they would be sold with a higher financial potential.

In the context of the current research paper, we aim to use the method of fuzzy multiple-criteria decision-making; as a practical study, we will apply the fuzzy methodology described in the next chapter in the case of a football club named "F.C. Raris Timisoara", with the aim of optimally selecting a group of 18 players to form a competitive team of juniors, within a selection stage in which a number of thirty players took part.

As regards the theoretical framework in the field in which this analysis unfolds, we must mention the papers by Meng et al. (2014) that bring into discussion as a concept a new class of fuzzy sets named hesitant fuzzy linguistic term sets that could model both the qualitative and sometimes hesitant preferences on the part of experts in the context of multiple-criteria decision-making and also reveal their uncertainty and inconsistency. Furthermore, the study by Minin et al. (2014), approached in the context of football, tries to approach the problem of balancing divergent strategic objectives, with the aim of reaching a high level of performance, both in the field of sports and in the one of finance; with this framework in mind, Minin et al. (2014) argue that these objectives can be truly placed in balance over time through strategic agility.

From another perspective, that of scouting, Papic et al. (2009) present in their paper a fuzzy expert system for scouting and the evaluation of young talent in sports. In this sense, Papic et al. (2009) support the claim that numerous sports clubs, as well as parents or athletes, seek the answer to the questions: how does one recognize a talented child and which sport is the most appropriate one for that child? With this framework in mind, methodologies and various items of knowledge can be implemented with the aim of predicting future results of adult athletes; however, a distinction should be made because a reliable prediction in the case of children or junior players is much more difficult. The changes brought upon by puberty can significantly influence the

perspective of a future in sports. Other authors, such as Tavana et al. (2013), use a system of fuzzy inference that applies in the selection of players and in the formation of teams in team sports, while Darcy et al. (2014) investigate the development of social capital in a sports organization by making reference especially to the human capital.

MATERIALS AND METHODS

A methodology that allows to decisional making factor to express his preferences in linguistics terms and which to model this uncertainty and subjectivity of human reasoning within the process of triage or selection of the children and juniors football players is based on the use of fuzzy logic and of its associated fuzzy sets. The fuzzy sets theory is a powerful tool for solving many problems in different areas, which involve certain degrees of uncertainty and ambiguity. Using the triangular fuzzy numbers and the fuzzy math operators, it is determined a fuzzy score for each player for selection. These fuzzy scores are then converted into fixed values by the defuzzification process and the first eighteen players with the highest scores in the rankings are selected to be part from the new formed team of football, in accordance with the evaluation of weight of the selection criteria importance and of the degree in which each player satisfies the performance requirements with respect to these criteria. Thus, the method of fuzzy multicriteria decision-making have been developed due to the imprecision and subjectivity of the coach reasoning in assessing the relative importance of selection criteria and in estimating the potential performance of players with respect to each of these criteria. To overcome this obstacle, the fuzzy sets theory was developed to improve the reliability of decision making process under uncertainty (Bellman and Zadeh, 1970). The fuzzy logic is a special tool used in dealing with the vague character of data, in which precision and their significance sometimes become incompatible. The principle of incompatibility, defined by Zadeh (1965, 1999), considered "the father of fuzzy logic", converges towards vague (fuzzy) sentences and fuzzy logic tries to create a formalism for the imprecision and ambiguity that are specific to the natural language. Through fuzzification, the linguistic values can be converted into fuzzy sets, which allow an elastic and flexible mathematical modelation.

In this context, in the purpose of achieving the process of triage or selection of the best eighteen players within "F.C. Raris Timişoara" football club, I will propose the implementation of the following steps within the below fuzzy methodology, as follows:

1) Defining the triangular fuzzy sets related to the importance of criteria considered for the triage process, through fuzzification process, according to Figure 1.

Legend: | Fuzzy specification :
FPI - Very less important | $(0,0,0.1)$
PI - Less important | $(0,0.2,0.3)$
I - Important | $(0.2,0.4,0.6)$
FI - Very important | $(0.5,0.7,0.8)$
EI - Extremely important | $(0.7,1.0,1.0)$

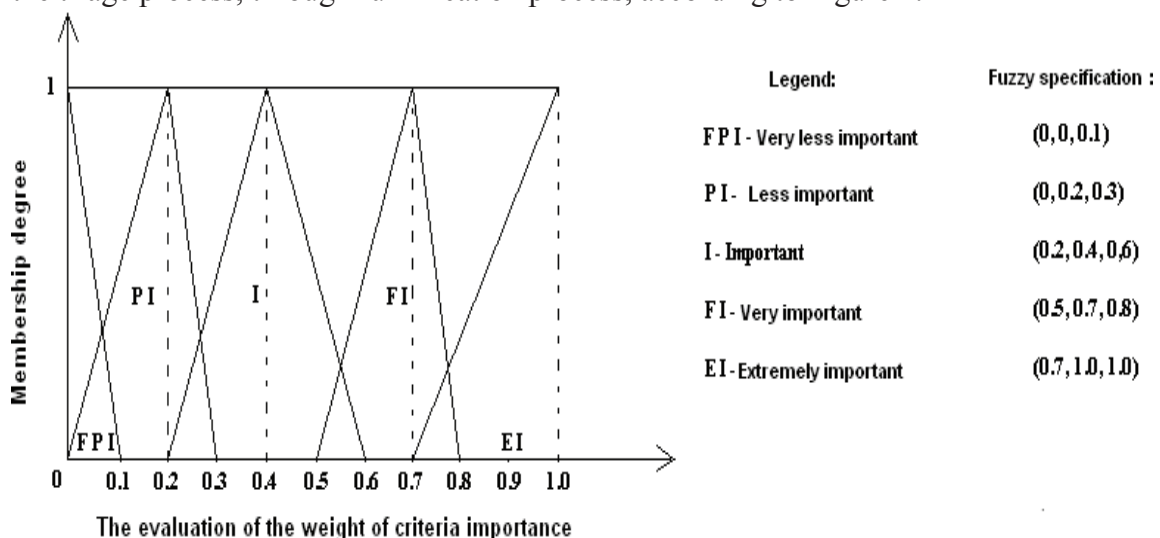The evaluation of the weight of criteria importance

Figure no 1. The fuzzy sets related to the importance of criteria

2) Defining the fuzzy sets related to the evaluation of performance of each player with respect to each selection criterion through the fuzzification process, according to Figure 2.
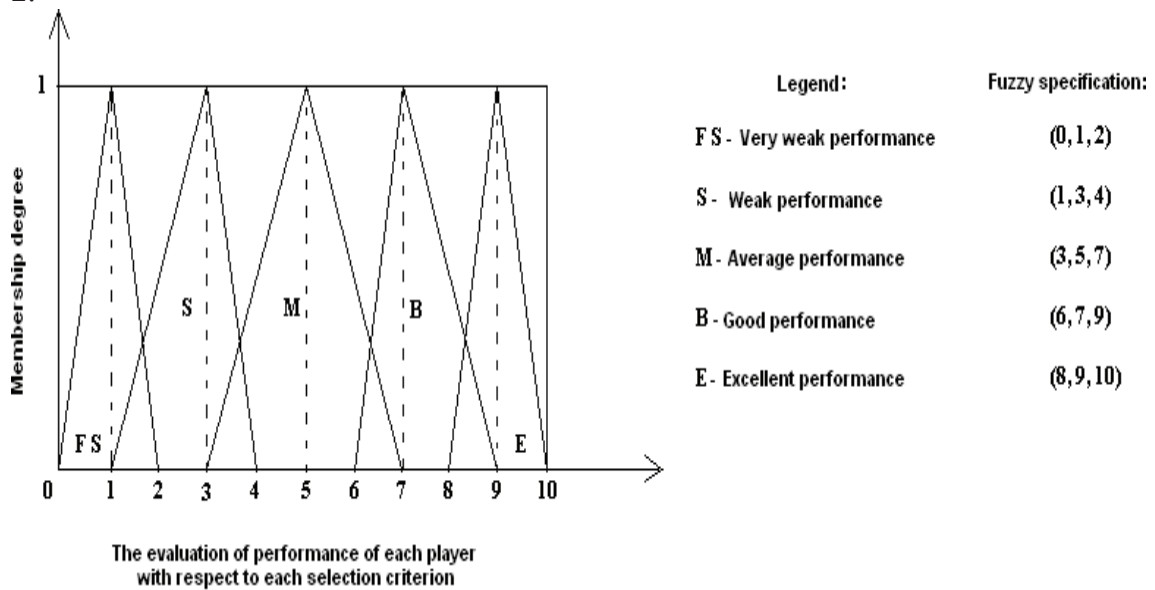

The evaluation of performance of each player
with respect to each selection criterion

Figure no 2. The evaluation of performance of each player with respect to each selection criterion

3) Establishing the number of selection criteria (denote by n, where $i = 1,...,n$).

4) Establishing the number of players that are participating at triage in order to select only eithteen of them (denote by m, where $j = 1,...,m$).

5) Assessing the weight of performance of each criterion according to figure 1, so that all the weights will be transposed as a matrix with one column and n rows, denoted by I, as follows:

$$I = \begin{pmatrix} weight\ of\ impor\tan ce->criterion\ 1 \\ weight\ of\ impor\tan ce->criterion\ 2 \\ . \\ . \\ . \\ weight\ of\ impor\tan ce->criterion\ n \end{pmatrix}, i = 1,...,n. \qquad (1)$$

6) Assessing the potential performance of player with respect to each criterion of selection according to figure 2, so that all the evaluations will be transposed in a matrix with m rows and n columns ($m \times n$), denoted by P, which has on each row the performance evaluation of each player with respect to each selection criterion, so:

$$P = \begin{pmatrix} P_{11} & P_{12} & ... & P_{1n} \\ P_{21} & P_{22} & ... & P_{2n} \\ . \\ . \\ . \\ P_{m1} & P_{m2} & ... & P_{mn} \end{pmatrix}, \text{ where } i = 1,...,n,\ j = 1,...,m. \qquad (2)$$

7) By multiplying matrices P and I above, it will result the aggregate fuzzy matrix denoted by S from "solution", with 1 column and m rows, which will contain on every row the fuzzy scores corresponding to each player susceptible to be selected within triage process.

239

$$S = P \times I = \begin{pmatrix} P_{11} & P_{12} & ... & P_{1n} \\ P_{21} & P_{22} & ... & P_{2n} \\ . \\ . \\ . \\ P_{m1} & P_{m2} & ... & P_{mn} \end{pmatrix} \times \begin{pmatrix} weight\ of\ impor\tan ce->criterion\ 1 \\ weight\ of\ impor\tan ce->criterion\ 2 \\ . \\ . \\ . \\ weight\ of\ impor\tan ce->criterion\ n \end{pmatrix} = \begin{pmatrix} S_1 \\ S_2 \\ . \\ . \\ . \\ S_m \end{pmatrix}, \qquad (3)$$

where $i = 1,...,n$, $j = 1,...,m$.

8) Because every row of matrix S contain a fuzzy score as the form of a triangular fuzzy number after multiplying the matrices P and I, these score will be converted into real, fixed numbers, through the process of defuzzification, by using a common, useful and easy to use method, namely the centroid method, as follows: let $S_j = (s_j^1, s_j^2, s_j^3)$ from matrix S above, then

$$D(S_j) = \frac{s_j^1 + s_j^2 + s_j^3}{3}, \text{ where } j = 1,...,m. \qquad (4)$$

9) After comparing the real scores coresponding to each player from the every j row ($j = 1,...,m$) of matrix S, the first eighteen players with the highest score will be selected in order to form the new team of football.

RESULTS

The methodology proposed in the previous chapter, as I mentioned in chapter 2, will be implemented in a triage or selection process of children and juniors within "F.C. Raris Timişoara" football club performed in February month of 2014 year. Thus, after following the steps of the proposed fuzzy algorithm, we will obtain the next results, synthesized in Tables 1, 2, and 3.

For beginning, it should be stated that within the triage or selection process were presented thirty children born in the of the same ages everyone. The criteria considered for the triage or selection process are divided into four main categories, as it can be seen in Table 1 below, where it can be observed also the weight of importance of each specific criterion taked into account provided by the coach who make the selection, according to Figure no. 1.

Table no. 1
The criteria and their weight of importance within triage or selection process

Main criteria	Specific criteria	Weight of importance
I. Physical development	1. Segments developed	**I**
	2. Appropriate mobility	**F I**
	3. Cardiac and respiratory adaptability to effort	**E I**
	4. Height	**P I**
	5. Weight	**I**
	6. Age	**F P I**
II. Motion qualities	7. Skill in the specifics of technical execututions	**F I**
	8. Skill in various forms of running, jumping	**F I**
	9. Speed (with its forms of manifestation)	**F I**
	10. Resistance (with different forms of effort)	**E I**
	11. Force with the opponent	**F I**
	12. Jumping to the head (detente)	**F I**
	13. Use of legs – stops, returns	**F I**

III. Specifics eforts	14. Sprints in different positions	**F I**
	15. Repetition of some trails	**E I**
	16. Runs with ball handling	**E I**
IV. Psychic attributes	17. Orientation in space	**E I**
	18. Concentration	**F I**
	19. Anticipation	**F I**
	20. Mobilization capacity	**E I**
	21. The gift of self	**E I**

After establishing the criteria of selection and their related weight of importance in Table 1 above, in Table 2 below we will see the names of those thirty players who have participated within triage or selection process and the linguistic evaluation of their performance with respect to each of the selection criteria, according to figure 2.

Table no. 2

The evaluation of performance of each player with respect to each selection criterion

Crt. / Players	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
Albulescu	S	M	F S	B	E	E	S	M	B	M	E	B	E	S	E	B	S	E	M	M	E
Beca	S	B	M	M	M	M	S	B	S	M	E	M	M	E	S	B	M	M	S	M	S
Bisztriczky	S	M	E	M	M	M	M	F S	E	B	M	S	E	M	M	B	M	M	M	E	E
Budai	M	M	E	S	M	M	B	M	E	M	E	M	E	S	M	M	F S	E	M	S	M
Carpaci	M	M	M	E	B	S	S	M	E	B	S	E	M	M	M	B	S	B	S	S	M
Covaliu	B	M	S	E	B	S	M	B	M	M	M	S	M	M	S	B	E	M	M	M	M
Durnac	M	M	S	M	M	M	F S	M	S	M	B	M	M	B	M	M	B	S	M	S	M
Grigore	B	F S	M	M	B	E	M	M	M	M	S	B	S	M	B	S	E	M	B	M	B
Iovi	B	M	M	M	M	E	S	S	M	S	B	E	B	M	S	M	S	M	S	M	M
Lazar	M	B	S	M	M	M	M	B	S	M	S	M	E	M	F S	M	M	M	S	M	M
Lupascu	M	S	S	M	S	S	E	E	B	M	B	E	S	B	M	E	B	M	B	S	B
Macovei	M	E	M	M	M	F S	M	B	M	M	M	B	M	E	M	S	M	M	S	B	S
Mihai	M	S	M	M	E	M	M	M	S	B	M	S	M	M	M	F S	B	E	M	B	M
Petrescu	B	M	E	B	M	M	M	B	M	M	B	B	M	E	M	M	S	M	F S	M	S
Savu	B	S	M	F S	E	M	M	M	M	B	S	M	M	E	S	M	M	M	M	E	M
Trif	M	S	B	E	E	S	B	B	M	M	S	E	B	S	S	E	B	M	B	S	E
Tuducan	M	M	M	M	M	M	E	F S	M	M	B	M	B	M	M	M	M	M	S	B	M
Varga	M	S	B	S	E	B	B	S	E	M	M	E	B	S	E	S	B	M	E	M	M
Coserea	E	M	S	M	M	M	M	M	M	M	M	F S	M	M	S	E	M	M	M	M	M
Casian	M	M	E	B	E	S	M	E	B	B	S	E	S	E	S	S	B	S	M	M	S
David A.	M	M	M	B	M	S	B	S	M	F S	E	S	M	E	M	B	M	M	M	M	E
David D.	E	S	B	M	E	M	M	E	S	E	B	B	M	M	E	S	S	B	E	B	M
Tudor	S	S	B	M	B	B	E	S	B	S	S	M	M	M	B	S	E	S	M	M	M
Iovu	M	F S	M	M	M	M	S	M	M	M	M	E	S	M	M	M	E	M	M	S	B
Angeru	M	M	M	S	M	B	M	S	M	M	F S	M	B	M	M	B	M	M	M	M	S
Haba	M	B	E	E	S	B	M	E	S	B	S	M	M	M	M	B	S	M	S	M	S
Pruteanu	M	E	E	S	M	E	E	M	M	M	B	E	S	M	M	E	M	F S	M	M	B
Muscu	E	S	B	M	M	S	E	S	B	M	S	M	M	M	M	B	M	S	E	M	M
Reut	B	M	M	B	S	M	M	M	M	M	M	B	E	E	S	M	B	S	M	M	M
Bera	M	B	M	M	E	B	S	B	M	M	S	E	B	M	S	E	B	B	M	S	M

241

After performing the calculations according to steps 5) to 9), the ranking of the players after conducting the trial or selection process from the fuzzy logic perspective looks like in the Table 3.

Table no. 3
The final ranking of the players after conducting the trial or selection process
from the fuzzy logic perspective

Position	Name of the player	Defuzzificated score
1.	David D.	90.2
2.	Bisztriczky	88.37
3.	Pruteanu	87.57
4.	Lupascu	86.73
5.	Trif	86.53
6.	Varga	86.47
7.	Albulescu	85.63
8.	Bera	82.2
9.	Budai	81.43
10.	Casian	81.3
11.	Muscu	79.7
12.	David A.	79.53
13.	Reut	79.17
14.	Petrescu	78.77
15.	Savu	78.37
16.	Grigore	78.33
17.	Macovei	78.17
18.	Covaliu	77.4
19.	Tuducan	77.27
20.	Carpaci	77
21.	Haba	76.23
22.	Mihai	75.67
23.	Tudor	74.93
24.	Beca	74.13
25.	Iovu	74.03
26.	Coserea	72.5
27.	Angeru	70.7
28.	Iovi	69.37
29.	Lazar	68.97
30.	Dumac	68.83

DISCUSSIONS AND CONCLUSIONS
Although that after the triage or selection process it has been pursued choosing the first best eighteen players, the other ones who were not choosed not must be disappointed, but to be more ambitious to improve their quality related to football approach and they could also receive attention for coach over time and to me monitorized for another future trial, depending on their wish to be through the best within any football team, not only as regarding the team from our study, respectively "F.C. Raris Timişoara". The methodology based on fuzzy logic proposed in this paper can also be applied in other fileds of sport's world, especially within team sports such as basketball, handball and so on, being so a powerfull qualitative mathematical tool in handling the uncertainty, ambiguity and especially the human factor resoning who often is subjective and it is expressed by linguistic values through words and not by fixed or real numbers. In the same time, the children and juniors sector deserve a more special attention by the management of professional football teams, because by its quality depends the

ensurance of sustainability of sport entity, this aspect being a balance between the sport and financial performance. In this sense, the football clubs from Romania should pay more attention over the centers of children and juniors and should benchmarck the best examples from the other football clubs from Europe or other places from the world in the perspective of improving their human capital since its childhood, from which an integral part refers to the effective and effectively triage or selection of the most promising talents so that these to not be losed.

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