A QUALITATIVE APPROACH IN TERMS OF FUZZY LOGIC RELATED TO THE EXCELLENCE ACHIEVING WITHIN MANAGERIAL PROCESS OF PERSONNEL SELECTION

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Abstract: The present article aims to design and develop a qualitative methodology using fuzzy logic in order to be a real tool for the managerial decisional factor in solving the multicriteria decisional problems related to the proper selection of the personnel and to the achievement of excellence in this field within a company. In our days, the economical environment characterized by globalization and by a continuous change, offers many times to the decisional factors some situations which are surrounded by uncertainty and ambiguity, fact that in its turn leads to a subjectivism of their reasoning, which is in fact a feature of the abstract thinking of human being itself. This aspects are manifesting also in the field of personnel selection, where the evaluations related to this process are often subjectives, materialized through qualitative linguistic values. In this context, using the proposed fuzzy methodology, embedded in a fuzzy software tool developed in the Java programming language, can offer significantly opportunities and chances to achieve the excellence in this field of research, because the future and performance of any organization depend by the human resources that are working within it.

Key words: fuzzy logic, decisional process, personnel, Java programming language.

Introduction

The companies in the contemporary period are facing with more and more challenges in the perspective to survive and progress, due to changing environment, globalization, technological changes and increased competitiveness of market. The decisional problems such as the selection of personnel and others like this one represent primordial aspects that properly managed can contribute in ensuring the perenniality of organizations in an effective and efficient manner, in the conditions of a high uncertainty of external environment doubled by the subjectivity of reasoning of the decisional factors from organization. Moreover, selecting the right person for the right place becomes a much more sophisticated process since that the internal changes in organizations have a direct impact on the methods for selecting human resources, whose complexity grows in accordance with organizational career management systems, of which the selection is an integral part. Therefore, the innovative selection systems which seeks to identify persons with the ability to learn and to adapt to new situations under the conditions of an internal and external environment of the company surrounded by uncertainty

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and risk, can provide to firm an important competitive advantage in fight with the competition.

Literature review related to the use of fuzzy logic in personnel selection issues

The evaluation of potential employees and its related selection system represent some important issues which can significantly affect the performance and the future competitiveness of an organization, that's why many organizations are spending frequently considerable resources in the hiring process of the most appropriate persons on the positions that must be occupied [1]. The traditional methods for human resource selection are based largely on statistical analyzes of test results that are considered as accurate reflections of reality [2], while the modern approaches recognize that the selection is a complex process involving a significant amount of vagueness and subjectivity [3]. Polychroniou and Giannikos [2] mention also that although many studies have reported a positive association between different human resource practices and the perceptual objectives and measures of human resources selection, some authors have shown concern that the results may be subjective due to methodological problems [4], fact for which are making appeal to the implementation of fuzzy logic in the perspective of modeling this subjectivity.
The specialty literature is very reach in approaches in terms of fuzzy logic related to the management of the company's personnel, especially in the case of those related to the process of selection regarding hiring the most suitable or best human resources, regardless of the organizational position targeted. Thus, Kelemenis et al. [5] address an extension of fuzzy TOPSIS in supporting the selection of managers, Canos and Liern [6] are using some soft computing-based aggregation methods for human resources management, while Otero and Otero [7] developed a fuzzy expert system architecture for capability assessments in skill-based environments.
In this article, I will implement within the designed proposed methodology the process of fuzzy multicriteria decision making approach (FMCDMA), which contains a finit set of alternatives, in which the decision makers must choose, assess and prioritize them taking into account the weights of a finite set of criteria or atributes [8]. In literature there are several ways to solve the problems that requires multicriteria decision making, of which the best known are represented by the technique of choosing the order of preference by similarity to ideal solution (TOPSIS) and by the analytical hierarchy process (AHP). According to Szopa and Marczyk [9], the multicriteria decisional problems concerns the performance of the following conditions: objectives are defined through the determination of a common set of acceptable solutions; each objective has a priority of achievement, which affects the degree of achievement of other objectives; a particular problem has a limited number of objectives planned to be achieved; choice of a decision variant is determined by a group of criteria defined for each objective.
The proposed fuzzy methodology designed in next chapter is a multidisciplinary one, addressing issues from areas such as management, mathematics or

psychology. Its design described in this article in a personal manner allows selecting the most suitable personnel in any kind of situation involved in this regard, taking into account the subjectivity of assessing the weight of importance of some selection criteria and of assessing the degree of potential performance in which the candidates satisfy the requirements of these criteria, all these aspects modeled under the spectrum of fuzzy logic.

Proposed fuzzy methodology within selection process of personnel

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 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 alternative for selection. These fuzzy scores are then converted into fixed values by the defuzzification process and the alternative with the highest score in the rankings is selected for implementation, in accordance with the evaluation of weight of the selection criteria importance and of the degree in which each alternative satisfy the performance requirements with respect to these criteria. Thus, the methods of fuzzy multicriteria decision-making have been developed due to the imprecision in assessing the relative importance of selection criteria and in estimating the potential performance of alternatives with respect to each of these criteria. The imprecision may derive from several respects: unquantifiable informations, incomplete informations, impossible obtainable informations and partly from ignorance. To overcome this obstacle, the fuzzy sets theory was developed to improve the reliability of decision making process under uncertainty [10]. 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 [11], [12], 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. The fuzzy logic reflects what people think and is proposing to shape the meaning of terms used in a context or another, the way how decisions are taken and the use of knowledge related to good sense or to the common sense. In the abstract of his masterpiece article in this field of fuzzy logic, entitled “Fuzzy sets”, which was practically the starter of new research, development and approach directions regarding the fuzzy logic, Zadeh [11] defines the fuzzy sets as follows (p. 338): “A fuzzy set is a class of objects with continuous degrees of membership. Such a set is characterized by a membership function (characteristic) that assigns to each object a degree of membership which varies between *0* and *1*. The notions of inclusion, union, intersection, complement, relation, convexity and others are extended to

such sets and different properties of this notions are established in the context of fuzzy sets. Particularly, a separation theorem for the convex fuzzy sets is proven without the necessity that the fuzzy sets to be separated".

In the perspective of diminishing spending of significant resources in the selection process of personnel likely to be employed in a company on a certain targeted position, here referring to both money as well as time and under the conditions of taking some selection decisions in uncertain environments or in fuzzy environments, I propose the implementation of the steps within the below fuzzy methodology, that otherwise stands behind the informatical software designed in next chapter in Java programming language, as follows:

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

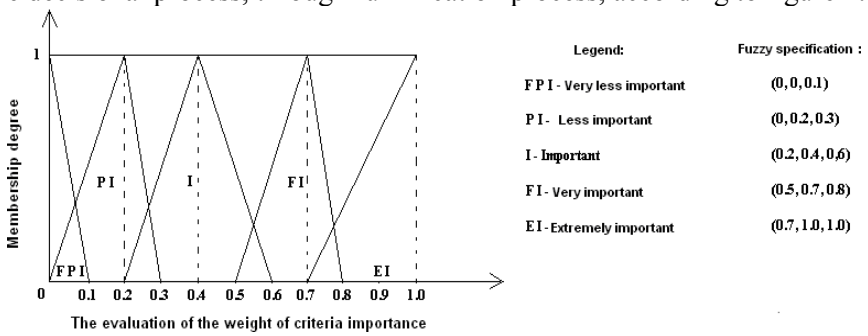

Figure 1. The fuzzy sets related to the importance of criteria

Source: Author's elaboration

2) Defining the fuzzy sets related to the evaluation of performance of each alternative (potential candidate) with respect to each selection criterion through the fuzzification process, according to figure 2.

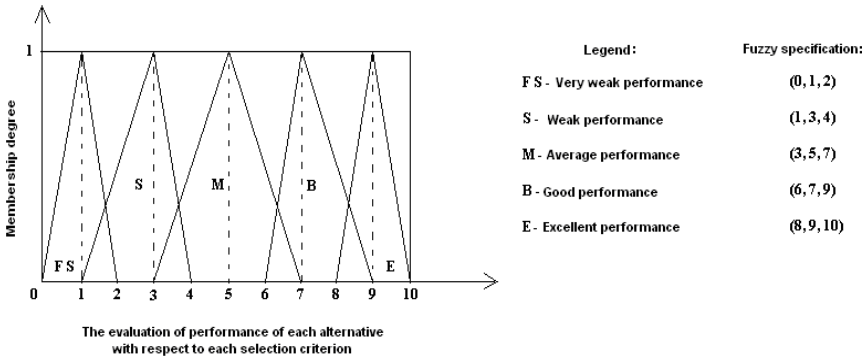

Figure 2. The evaluation of performance of each alternative (candidate) with respect to each selection criterion

Source: Author's elaboration

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

4) Establishing the number of decisional alternatives or potential candidates in our case (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:

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

6) Assessing the potential performance of each alternative (candidate) 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 decisional alternative (candidate) with respect to each selection criterion, so:

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

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 alternative (candidate) susceptible to be selected within decisional-making process of selection.

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

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

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

9) After comparing the real scores coresponding to each decisional alternative (potential candidate) from the every j row ($j = 1,...,m$) of matrix S, the alternative or the candidate in our concerned case with the highest score will be the final decisional option selected for implementation.

Practical case. Embedding the fuzzy methodology within a Java software tool

In the conditions of computing the human society, the operational management activities can be improved by using artificial intelligence and expert systems, which according to Dima et al. (2010) represent a software that uses all knowledge specific to the various activity domains during the process of elaborating a resolution for each problem that may intervene within a well defined domain. Therefore, in this framework related to expert systems and their related fuzzy logic, I embedded the fuzzy methodology described in previously chapter into an informatical software tool developed in Java programming language, whose interfaces related to the steps of fuzzy methodology described above can be seen in the figures 3, 4 and 5, in order to be provided some accurate, reliable and timely results, for solving the multicriteria decisional problems related to the selection of the most suitable or best personnel in an excellent, performant, elastic and flexible manner. In this context, as a practical example, I mention that I hypothetically used a fuzzy multicriterial decision example containing eight selection criteria and five decisional alternatives (potential candidates), from these following to be chosen the most suitable decisional alternative or candidate, depending on the fuzzy scores granted by decisional factor and manipulated using the fuzzy software, which compiles the data according to the fuzzy methodology described in previous chapter, after the qualitative linguistic assessments of decisional factor.

Table 1. Linguistic evaluation of the selection criteria weight of importance

Criteria	Weight of criteria importance
(1) Personality profile	FI
(2) Leadership ability	PI
(3) Communication skills	I
(4) Experince in the field	EI
(5) Age	FPI
(6) Knowledge of foreign languages	FI
(7) Salary request	I
(8) Educational background	EI

Source: Author's elaboration

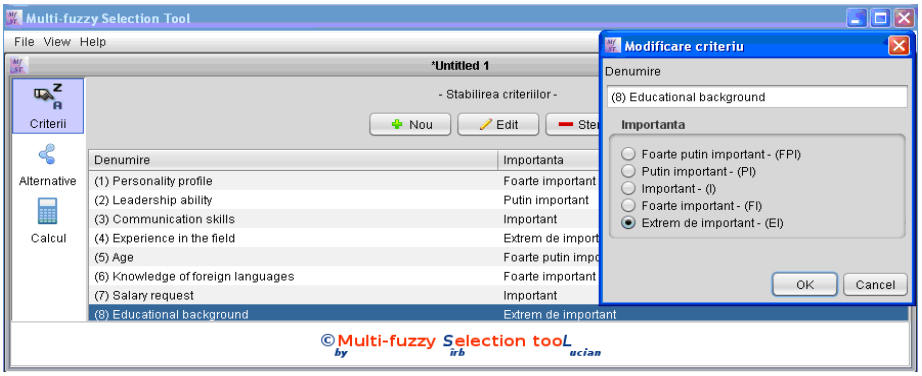

Figure 3. The fuzzy software interface related to the linguistic evaluation of weight of selection criteria importance
Source: Author's elaboration

Table 2. Linguistic evaluation of the potential performance of each decisional alternative (candidate) with respect to each selection criterion

Potential candidates	Selection criteria							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Smith	S	B	E	M	B	FS	E	S
Clint	M	B	E	S	M	B	FS	E
Dixon	FS	E	M	S	B	E	S	B
Garrett	E	B	S	FS	FS	B	M	E
Harrison	M	FS	B	B	M	E	FS	M

Source: Author's elaboration

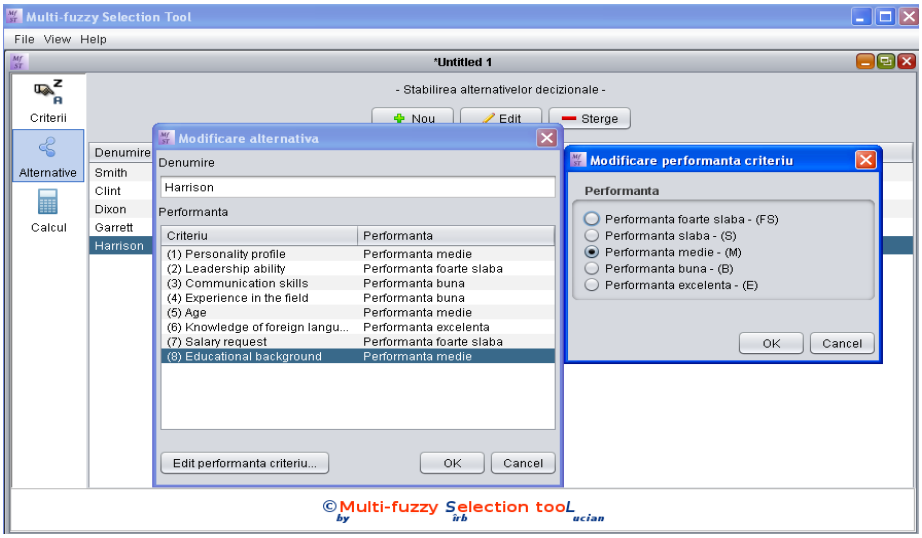

Figure 4. The software interface related to the linguistic evaluation of the potential performance of each potential candidate with respect to each selection criteria
Source: Author's elaboration

After carrying out steps 7, 8 and 9 of the fuzzy methodology presented in the previous chapter, the fuzzy software tool designed in the Java programming language will provide the most suitable solution regarding the selection of the best decisional alternative or of the most suitable candidate in our case, as it can be seen in figure 5 below.

Figure 5. The software interface related to the fuzzy calculation according to the implementation of the methodology presented in previous chapter
Source: Author's elaboration

As it can be seen in the figure above, the candidate whose name is "Garrett" is the most suitable or the best from the given five ones in order to be employed, taking into account the subjective and qualitative assessments of the weight of selection criteria importance and of the potential performance of each of five candidates with respect to each selection criteria.

Summary

Through this paper I proposed myself to develop an effective and a powerful tool under the spectrum of fuzzy logic in order to model the uncertainty and subjectivity which surrounding the human decision factors regarding to the personnel selection and which most often are manifesting by linguistic expressions specifics to human factor reasoning. Choosing the right man for the right place, into a company that activates in an increasingly competitive environment and subjected to globalization, represents the key towards the achieving of organization's overall performance and towards survival and continuity of its activities in conditions of performance and excellence. The methodology used in selecting the most suitable human resource, described in chapter 3, represents an extremely effective and efficient tool in the perspective of ensuring of some high quality decisions regarding the personnel selection and his subsequent hiring on any organizational position targeted. This decisions are among the most important ones wihin an entity, because by their quality depend all the related economical, social or ecological benefits on long term and also the perenniality of organization after all,

in the increasingly complex and changing economic reality of our contemporary period.

The proposed methodology can be also successfully applied in other areas of decisional process surrounded by uncertainty and ambiguity, given the circumstances and the degree of its applicability and compatibility with the different situations concerned. Moreover, in this context, in which the decisional factors reasoning often tends to be a subjective one, materialized through qualitative linguistic assessments, fact revealed by the abstract thinking itself of human being, the use of fuzzy methodology proposed in this article really proves its utility, even more so as its algorithm steps are implemented and compiled within an informatical software tool developed in Java programming language, in order to provide to decisional factors more reliable, pertinent and relevant results, in an accurate and timely manner.

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PODEJŚCIE JAKOŚCIOWE W WARUNKACH LOGIKI ROZMYTEJ W RELACJI DO OSIĄGNIĘCIA DOSKONAŁOŚCI W KIEROWNICZYM PROCESIE WYBORU PERSONELU

Streszczenie: Celem niniejszego artykułu jest zaprojektowanie i opracowanie metodologii, wykorzystującej logikę rozmytą, w celu utworzenia prawdziwego narzędzia czynnika decyzyjnego w rozwiązywaniu wielokryterialnych problemów decyzyjnych związanych z właściwym wyborem personelu. W dzisiejszych czasach, środowisko rynkowe charakteryzuje się globalizacją i ciągłymi zmianiami, powodując bardzo często konieczność podejmowania decyzji w sytuacjach niepewnych i wieloznacznych, co z kolei prowadzi do zjawiska subiektywności przy ich podejmowaniu, co w rzeczywistości jest cechą abstrakcyjnego rozumowania u człowieka. Te aspekty bardzo często występują w zakresue doboru personelu, gdzie oceny związane z tym procesem, bardzo często mają charakter subiektywny, uwidacznianie przez jakościowe wartości językowe. W tym kontekście, stosując rozmytą metodologię, istniejące narzędzia, opracowane w języku programowania Java, oferują znaczące korzyści i szanse na osiągnięcie doskonałości w tej dziedzinie badań, ponieważ przyszłość i efektywność każdej organizacji uzależnione jest od zasobów ludzkich które w niej pracują.

Słowa kluczowe: logika rozmyta, proces decyzyjny, personel, język programowania Java

模糊邏輯與定性方法的優越性，實現在管理過程的人才選拔

摘要：本文章的目的是為了成為一個真正的工具，在解決多目標決策問題有關人員的正確選擇，並在這個卓越的成就，為管理決策因素的定性方法，採用模糊邏輯設計和開發領域內的公司。在我們這個時代，經濟全球化和連續變化的環境，提供了許多倍某些情況下，不確定性和模糊性所包圍，其實，反過來導致他們的推理，這實際上是一個主觀決策因素人類自身的抽象思維的一個特點。這方面也表現在該領域的人才選拔，評價有關這個過程的往往subjectives的，物化通過定性語言值。在這種情況下，使用模糊方法，嵌入式一個模糊軟件工具，在Java編程語言開發的，可以提供顯著的機遇和機會，這一領域的研究，實現了卓越的，因為任何一個組織的未來和性能取決於由內工作的人力資源