EXERCISE OF INTERNAL AUDIT OF COMPLIANCE REGARDING HUMAN RESOURCES MANAGEMENT OF AN ENTITY IN TERMS OF FUZZY LOGIC

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Abstract:
This article aims to develop from the theoretical and practical point of view a methodology for the exercise of internal audit of compliance concerning the management of human resources of an entity from the fuzzy logic perspective. The reason for addressing this subject emerges from the great importance that human resource has it within an entity, regardless of its legal form, because its good evolution depends primarily on the quality of human resources employed within concerned entity. More than that, taking into account that the auditor's reasoning related to the way of assessing the proper management of human resources cannot often be deprived of subjectivity – aspect revealed by herself abstract thinking of human being, we consider necessary and effectively the approach of an instrument based on fuzzy logic in conducting the internal audit of compliance related to the management of human resources, which otherwise could be used by the auditor as within other organizational aspects related to internal audit.

Key words: fuzzy logic, internal audit, compliance audit, human resources.

JEL classification: C53, D81, M42.

Introduction

Human resources are probably the most important intangible resources of an entity, which can be considered the key to achieving success, especially when trying to refer to the human resources involved in the organization of an autonomous administration in forestry domain. This is because, the efficiency with which all the other forestry entities' resources are managed depends on the capacity and skills of human resources. Therefore, the management of a forest entity should make arrangements to have specialized human resources who have professional training appropriate to its duties to which there should be added permanent completing specialization to the staff's knowledge based on a program according to the needs of each autonomous administration.

Specialized literature addresses, on a large scale, the problem of internal audit and the use of expert innovative systems for effective internal audit activity, in this regard study of some papers that have helped us shape the present article being useful (Soyer et al., 2007; Azadeh et al., 2008; Omoteso, 2012; Wang et al., 2010; Ghiţă et al., 2009; Morariu, 2008; Renard, 2002).

Research methodology

The main objective considered in the preparation of this paper is to develop and implement a methodology for the exercise of internal audit of compliance in terms of fuzzy logic for the human resources management of a forestry entity. Detailing this objective into specific objectives, we may include: emphasizing the importance of exercising internal audit activity in the autonomous administration of forestry; conceptualization, role and place of fuzzy logic in developing a methodology that could

be applied in conducting internal audit of compliance, with specific applicability in auditing the management method of human resources in the forestry entities.

Given some ambiguous situations encountered in the performance of evaluation in the mission of internal audit of compliance, often evidenced by subjective opinions of the auditors, we consider necessary to address a methodology or a qualitative mathematical tool based on fuzzy logic, developed by Serbian researchers Pešić A. et al. (2012), providing reliable results in the perspective of accurately diagnose the condition of the entity in terms of human resource management. Implementation of such methodologies in achieving the missions of internal audit of compliance regarding human resources management, aims, besides emphasizing reliability, accuracy of the results they provide and enabling comparative analysis the internal auditor's possibility to comparatively analyze the achieved results recorded in the audit report prepared at the end of the audit mission whose objectives were subjected in fuzzy methodology.

Current state of knowledge regarding internal audit

The role of internal audit in the forestry entities and not only, is clearly and concretely outlined in defining this task by the Chamber of Auditors Decision no. 88/19 April 2007 concerning the approval of internal audit standards: "Internal audit is an independent and objective activity that gives an entity an insurance in terms of control degree over the operations, guides it to improve its operations and contributes to adding extra value. Internal audit helps this organization to achieve its objectives, assessing, through a systematic and methodical approach, its processes of risk management, control and governance of the organization and making proposals to strengthen their effectiveness "(Chamber of Financial Auditors Decision No. 88/19 April 2007 concerning the approval of internal audit standards).

According to the information found in specialized literature and in the legislation in force in the industry, internal audit activity conducted by auditors can be such as: audit of regularity or compliance which aims to ensure that all provisions implemented for applying the entity's internal rules for a function are applied and work properly; audit of effectiveness which aims to ensure that all devices implemented to achieve a good control on a function are appropriate, effective and should not be modified, removed or added; audit of management aims at ensuring that the policy concerning a function corresponds to the unit strategy; and not the least, activity such audit of strategy that aims to ensure that development strategy of a function corresponds in terms of consistency to the strategy of the other entity's or organization's functions (Tatiana Dănescu, university course, 2010, Doctoral School, p.3).

If we bring into question the importance of auditing the method of organization, ensuring and developing of the activity of human resources management within an autonomous administration of the forestry, the importance of this activity is all the more necessary to be highlighted, where information on human resources provided by accounting are brief and insufficient for making decisions substantiated by management regarding the management of these resources.

Conceptualization of fuzzy logic and description of related methodology

To determine the degree of conformity of the human resources management of an entity in terms of fuzzy logic, we resort to the use of original method from specialized literature designed by Pešić et al. (2012), which is a systematic approach incorporating fuzzy logic for a better description of the actual situation of an entity. The reason we refer to this methodology is related to the fact the both the assessments of importance of these criteria considered during the audit, and the way in which the enterprise meets the performance requirements of these criteria, can be made most of

the time from a qualitative perspective through linguistic values. Therefore, fuzzy logic supports the modeling of these qualitative assessments, which often expresses uncertainty, vagueness and subjectivity specific to human reasoning, which is manifested through language expressions, through words.

Fuzzy set theory has been developed since the '60s, in response to the insufficient consistency of deterministic reasoning of "yes" or "no" type, trying to formalize some reasoning such as "more or less". In classical logic, propositions can be true or false, without the possibility of intermediate values. If concrete models area approached, in the real world, some delicate situations occurred: not all real systems are clear and deterministic, as such they cannot be accurately described based on classical logic, and complete description of a real system requires a series of information which is not completely known or provided and which, it is often not exactly understood. Thus, it appeared necessary to use fuzzy sets and logic resulting from their use instead of conventional sets, crisp.

Fuzzy set theory was developed by Zadeh (1965, 1999), who noted that the mathematical models and various classical methods in decision-making process foundation have flaws and are difficult to apply to complex reality of economic factors. As the complexity of an economic process increases, a critical point can be reached from where precision and significance of the statements referring to process behavior are incompatible. Incompatibility principle defined by Zadeh converges to vague statements (fuzzy), and fuzzy logic tries to create a formalism for uncertainty and ambiguity specific to natural language which could shape it. Fuzzy logic is operated with fuzzy sets, materialized in two types of fuzzy numbers, triangular and trapezoidal, but in what follows we will work with triangular fuzzy numbers or sets. A triangular fuzzy number denoted $A = (a_1, a_2, a_3)$ can be graphically represented as in Figure 1, where it is noted that basically it is framed by 3 values, respectively a_1 which is the lowest and represents the lower boundary of the number, a_2 which is almost the maximum membership function - $\mu_A(x) = 1$ and a_3 which is the upper boundary of the number.
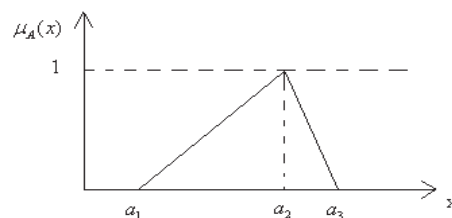

Figure no. 1 - Representation of triangular fuzzy number or set $A = (a_1, a_2, a_3)$

Source: Authors contribution

Basically, these fuzzy numbers include qualitative assessments of the various policy makers, and in our case, qualitative evaluations of the auditor or audit team conducting an audit of compliance. Therefore, the steps outlining the proposed methodology in this article from the perspective of fuzzy logic are as follows (Pešić et al., 2012):

1) Determination of the actual objectives or the criteria or the factors considered in conducting the findings of the mission of internal audit of compliance;

2) Assessment is done through the use of interval [0,5].

3) Let F_i, $i = 1,...,n$ be the factors that are determined to be relevant factors for an organization O. Their estimated value is v_i, $i = 1,...,n$. This value belongs to the

interval $[0,5]$. Four fuzzy sets[243] are defined: $\overline{SMA}$ - "Major weakness"; $\overline{SMI}$ - "Minor weakness"; $\overline{FMI}$ - "Minor strength" and - "Major strength".

Depending on the values of the factors, the degree of membership of each factor to each of the four fuzzy sets is calculated.

The graphical presentation of defined fuzzy sets can be noticed in figure no. 2 where it can be seen that a factor can be simultaneously both a minor weakness factor and a minor strength factor (in varying degrees), these ratings being obtained from fuzzy scores awarded by the internal auditor. The factor F_i in Figure 1 belongs to the set $\overline{SMA}$ with the degree of membership $\mu_{1\,i}$, while belonging to the set $\overline{SMI}$ with the degree of membership $\mu_{2\,i}$.
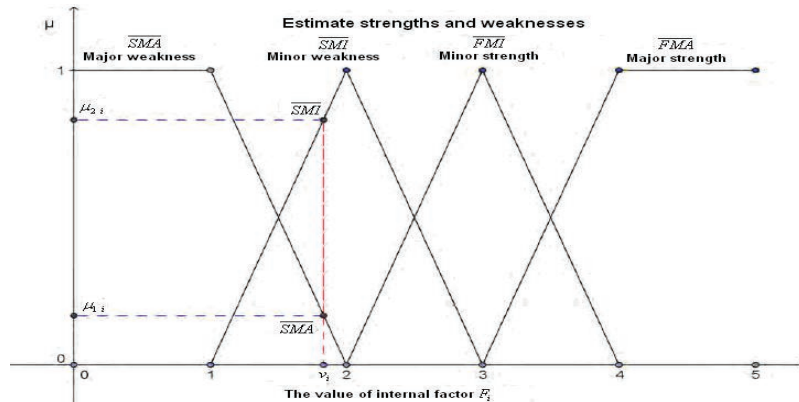

Figure no. 2 – Estimating the strength and weakness of the factors considered in the exercise of internal audit of compliance
Source: Authors contribution

Theorem 1. The sum of all degrees of membership obtained for each factor must be equal to 1. For each factor F_i

$$\sum_{k=1}^{4} \mu_{k\,i} = 1 \tag{1}$$

Proof: Since we use triangular fuzzy sets, for a factor F_i with a value x, membership function $\mu_{1\,i}$ is equal to 1 for x belonging to the interval $[0,1]$. Further, $\mu_{1\,i}(x) = -x+2$ is valid for $x \in [1,2]$ and is equal to 0 in the interval $[2,4]$. Similarly, $\mu_{2\,i}(x) = x-1$ is valid for $x \in [1,2]$ and also for $\mu_{2\,i}(x) = -x+3$ for $x \in [2,3]$. Also, $\mu_{2\,i}(x) = 0$ for $x \notin [1,3]$.

Similarly we obtain formulas for the other membership functions.

If the factor value is from 0 to 1, the degree of membership to fuzzy set $\overline{SMA}$ is equal to 1, and for all other fuzzy sets is equal to 0. If the value belongs to the interval $[1,2]$, then by the symmetry of the graphs of functions that are fuzzy sets $\overline{SMI}$ on the line $\mu = 0.5$, the degree of membership to the set $\overline{SMA}$ is equal to 1 minus the degree of membership to the set $\overline{SMI}$ and the degree on the other two remaining sets is equal to 0. We can demonstrate this also using the formulas above for the fuzzy sets represented by $\overline{SMA}$ and $\overline{SMI}$. For example, for a factor F_i with the value $x \in [1,2]$, we get:

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[243] A fuzzy set is a mapping from a set of real numbers in the interval [0,1]. A function value represents the degree of membership of an element to the fuzzy set.

$$\mu_{1\ i}(x)+\mu_{2\ i}(x)=(-x+2)+(x-1)=1 \qquad (2)$$

Similarly, we notice that in the interval $[2,3]$, only two degrees of membership are different from 0 ($\overline{SMI}$ and $\overline{FMI}$) and their sum is equal to 1. In the interval $[3,4]$, the graphs of the functions $\overline{FMI}$ and $\overline{FMA}$ are symmetric on the line $\mu=0.5$, therefore the amount of corresponding degrees of membership is equal to 1 and the other two degrees are equal to 0. We can prove the last assertions also using the formulas for triangular fuzzy sets. Finally, in the interval $[4,5]$ only the membership degree of $\overline{FMA}$ is equal to 1, and the others are equal to 0. Therefore, throughout the field, the sum of membership degrees is equal to 1.

The same procedure is applied to all relevant factors F_i, $i=1,...,n$. Each of the factors belongs to a certain degree of membership to fuzzy sets $\overline{SMA}$, $\overline{SMI}$, $\overline{FMI}$ and $\overline{FMA}$.

The importance of relevant factors is also considered. In this context, Pešić et al. (2012) suggest that weight is taken from the interval $[0,2]$, resulting in the weight which increases or decreases the influence of some factors on the global level of the internal environment state of the organization. The influence of a factor is decreased if the weight is in the interval $[0,1)$ and is increased if the weight is in the interval $(1,2]$. If the weight is 1, it has no impact on the value of the factor. The obtained data are presented in Table no. 1.

Table no. 1 – Degrees of membership of internal factors to fuzzy sets

Internal factor	SMA	SMI	FMI	FMA	Weight
F_1	$\mu_{1\ 1}$	$\mu_{2\ 1}$	$\mu_{3\ 1}$	$\mu_{4\ 1}$	α_1
F_2	$\mu_{1\ 2}$	$\mu_{2\ 2}$	$\mu_{3\ 2}$	$\mu_{4\ 2}$	α_2
F_3	$\mu_{1\ 3}$	$\mu_{2\ 3}$	$\mu_{3\ 3}$	$\mu_{4\ 3}$	α_3
…	…	…	…	…	…
F_n	$\mu_{1\ n}$	$\mu_{2\ n}$	$\mu_{3\ n}$	$\mu_{4\ n}$	α_n

Multiplying the degrees of membership of factors F_i, corresponding to fuzzy sets observable by the weights of these factors, we obtain the weighted fuzzy membership degrees (Table no. 2).

Table no. 2 – Weighted fuzzy membership degree

Internal factor	$\overline{SMA}$	$\overline{SMI}$	$\overline{FMI}$	$\overline{FMA}$
F_1	$\alpha_1\ \mu_{1\ 1}$	$\alpha_1\ \mu_{2\ 1}$	$\alpha_1\ \mu_{3\ 1}$	$\alpha_1\ \mu_{4\ 1}$
F_2	$\alpha_2\ \mu_{1\ 2}$	$\alpha_2\ \mu_{2\ 2}$	$\alpha_2\ \mu_{3\ 2}$	$\alpha_2\ \mu_{4\ 2}$
F_3	$\alpha_3\ \mu_{1\ 3}$	$\alpha_3\ \mu_{2\ 3}$	$\alpha_3\ \mu_{3\ 3}$	$\alpha_3\ \mu_{4\ 3}$
…	…	…	…	…
F_n	$\alpha_n\ \mu_{1\ n}$	$\alpha_n\ \mu_{2\ n}$	$\alpha_n\ \mu_{3\ n}$	$\alpha_n\ \mu_{4\ n}$

To determine the internal environment state of the organization as a whole, Pešić et al. (2012) determined the weighted arithmetic mean of the degrees of membership of the factors to fuzzy sets $\overline{SMA}$, $\overline{SMI}$, $\overline{FMI}$ and $\overline{FMA}$. For the first two sets, the membership degree is taken with negative sign (because it represents the weakness of the organization), and for the other two fuzzy sets with positive sign (because it represents the strength of the organization). Furthermore, the degrees of membership to $\overline{SMA}$ and $\overline{FMA}$ are multiplied by 1.5, increasing their influence in the total amount,

because it expresses a great weakness and great strength (Table no. 3). The factor 1.5 is an empirical value that is chosen to emphasize the weakness and major strength of the factors.

Summing the values in the last column, we get a number I^O that indicates the current internal environment state of the organization O:

$$I^O = -(1.5)\sum_{i=1}^{n}\frac{\alpha_i\mu_{1\,i}}{n} - \sum_{i=1}^{n}\frac{\alpha_i\mu_{2\,i}}{n} + \sum_{i=1}^{n}\frac{\alpha_i\mu_{3\,i}}{n} + (1.5)\sum_{i=1}^{n}\frac{\alpha_i\mu_{4\,i}}{n} \qquad (3)$$

The value I^O is a real number in the interval $[-3,3]$. If the resulting number is positive, the organization has more strengths than weaknesses and the higher the number, the better the organization state is. If the resulted number is negative, the organization has more weaknesses than strengths, and a smaller number means that the organization state is worse.

Table no. 3 – Weighted arithmetic mean of membership degrees

Internal factor	$\overline{SMA}$	$\overline{SMI}$	$\overline{FMI}$	$\overline{FMA}$
F_1	$\alpha_1\,\mu_{1\,1}$	$\alpha_1\,\mu_{2\,1}$	$\alpha_1\,\mu_{3\,1}$	$\alpha_1\,\mu_{4\,1}$
F_2	$\alpha_2\,\mu_{1\,2}$	$\alpha_2\,\mu_{2\,2}$	$\alpha_2\,\mu_{3\,2}$	$\alpha_2\,\mu_{4\,2}$
F_3	$\alpha_3\,\mu_{1\,3}$	$\alpha_3\,\mu_{2\,3}$	$\alpha_3\,\mu_{3\,3}$	$\alpha_3\,\mu_{4\,3}$
…	…	…	…	…
F_n	$\alpha_n\,\mu_{1\,n}$	$\alpha_n\,\mu_{2\,n}$	$\alpha_n\,\mu_{3\,n}$	$\alpha_n\,\mu_{4\,n}$
	$-(1.5)\sum_{i=1}^{n}\frac{\alpha_i\mu_{1\,i}}{n}$	$-\sum_{i=1}^{n}\frac{\alpha_i\mu_{2\,i}}{n}$	$\sum_{i=1}^{n}\frac{\alpha_i\mu_{3\,i}}{n}$	$(1.5)\sum_{i=1}^{n}\frac{\alpha_i\mu_{4\,i}}{n}$

Case study on the application of proposed methodology in a forest entity

Regarding the specifically application of the methodology described in the previous paragraphs related to the exercise of internal audit of compliance mission, from the perspective of fuzzy logic, we considered the final report prepared by the internal auditor of the Forest Administration Forest R.A, drawn up on the occasion of internal audit of compliance mission regarding human resources management. Thus, the objectives pursued are:

1) Organizing staff recruitment;
2) Establishing the salary entitlements of the staff;
3) Emphasizing presence, leaves and holidays;
4) Career development of the staff;
5) Continuous professional training of the staff;
6) Management of professional files;
7) Management of work books;
8) Functionality of computer system used to manage human resources;
9) Calculation, declaration and payment of tax obligations on payroll and other similar or related income;
10) Archiving documents

At the same time, in this study, it can be comparatively searched and verified whether the internal auditor's work results, respectively the conclusions and recommendations of the final report, correspond to the results provided by the application of this methodology based on fuzzy logic. Why not, if the results correspond or are relatively similar, this methodology designed by Pešić et al. (2012) may also prove reliability in other economic situations where it might be applied.

After giving proper scoring in accordance with the assessment of the objectives in the internal audit of compliance report exercised by the internal auditor in this research study, the results are displayed in the tables no. 4, 5 and 6.

Table no. 4 – Evaluation of the objectives considered in the exercise of internal audit of compliance mission within the Forest Administration Forest R.A

Objectives	Value	$\overline{SMA}$	$\overline{SMI}$	$\overline{FMI}$	$\overline{FMA}$	Weight
1.	5	0	0	0	1	1,8
2.	4,2	0	0	0	1	1,5
3.	2,8	0	0,2	0,8	0	1
4.	3,4	0	0	0,6	0,4	0,5
5.	1,6	0,4	0,6	0	0	0,8
6.	2,9	0	0,1	0,9	0	1,2
7.	4,2	0	0	0	1	0,3
8.	3,8	0	0	0,2	0,8	1
9.	3	0	0	1	0	1,5
10	2,6	0	0,4	0,6	0	0,4

Applying the weights within FSIF model, the data in table no. 5 were obtained.

Table no. 5 – Weighted fuzzy membership degrees

Objectives	$\overline{SMA}$	$\overline{SMI}$	$\overline{FMI}$	$\overline{FMA}$
1.	0	0	0	1,8
2.	0	0	0	1,5
3.	0	0,2	0,8	0
4.	0	0	0,3	0,2
5.	0,32	0,48	0	0
6.	0	0,12	1,08	0
7.	0	0	0	0,3
8.	0	0	0,2	0,8
9.	0	0	1,5	0
10	0	0,16	0,24	0

The results from table no. 6 below are obtained by calculating the weighted arithmetic mean.

Table no. 6 – Weighted arithmetic mean after the calculations

$\overline{SMA}$	$\overline{SMI}$	$\overline{FMI}$	$\overline{FMA}$
-0,048	-0,096	0,412	0,69

Following the calculations according to formula (3), by adding the weighted arithmetic mean obtained in each fuzzy set in the previous table, we get:

$$I^O = 0,958.$$

Since the value is positive, we conclude that the overall result of the internal audit mission reveals that the objectives related to human resource management are achieved at reasonable standards, rules and other regulations in force for the forest entity Forest Administration. Of course, for a positive result, almost equal to 3, should be considered an improvement of objectives specific to human resource management reminded above and extracted from the studied internal audit report and implementation of the recommendations made in this case, as shown in the internal audit report developed at the end of internal audit mission on human resources management. Also, the hypothesis launched at the beginning of this paper to compare the results of internal auditor's work, respectively the conclusions and recommendations of the final report, to the results provided by the application of this methodology based on fuzzy logic, in the sense that both are relatively similar results, which was confirmed. Therefore, in general, the results correspond or are relatively similar to those drawn

from the audit report and this methodology designed by Pešić et al. (2012) and applied in the audited forest entity proves its reliability.

Conclusions

The methodology addressed in this article represents a challenge that would worth taking into consideration by internal audit practitioners because it offers the possibility of providing reliable results in the internal audit report, under an economic environment increasingly complex and enveloped in the dark, and due to the subjectivity internal auditors prove in some cases in the evaluations of different aspects and as a result of obtaining dissymmetrical (asymmetrical) information in the performed missions. The results of the case study in this paper confirm the reliability of fuzzy methodology used in this article, which fully demonstrates its relevant applicability degree to the practice of internal audit mission. As research perspectives, we notice subsequent attempts of application and innovation of the methodology designed by Pešić et al. (2012) in terms of fuzzy logic in other test cases of financial accounting fields and resorting to various software for easily handling the input data and to provide accurate results following arithmetic calculations.

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