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Limiting Factors of Extenuating Circumstances Using Neutrosophic 2-Tuple

Diego Fabricio Tixi Torres[1], Carlos Gilberto Rosero Martinez[2], Ned Vito Quevedo Arnaiz[3], and Jorge Gabriel Del Pozo Carrasco[4]

[1] Universidad Regional Autónoma de Los Andes, Sede Riobamba. Ecuador. E-mail: ur.diegotixi@uniandes.edu.ec
[2] Universidad Regional Autónoma de Los Andes, Sede Tulcán, Ecuador. E-mail: ut.carlosrosero@uniandes.edu.ec
[3] Universidad Regional Autónoma de Los Andes, Sede Santo Domingo. Ecuador. E-mail: us.nedquevedo@uniandes.edu.ec
[4] Universidad Regional Autónoma de Los Andes, Extensión Quevedo. Ecuador. E-mail: uq.jorgedc77@uniandes.edu.ec

Abstract. Every court is responsible for applying the law under the principles of fairness, justice, ethical-legal, and human value because it cannot be forgotten that every criminal is a human being. The foregoing is the reason why the application of extenuating circumstances acquires a particular complexity. Currently, in Ecuador, certain situations cause mismanagement of justice due to the lack of understanding and assimilation of mitigating circumstances. This is adopted as a problem situation, while the main objective of the investigation is to analyze the limiting factors in the application of extenuating circumstances using the 2-Tuple model in its neutrosophic extension.

Keywords: Extenuating circumstances, limiting factors, neutrosophic 2-tuple model, Neutrosophy.

1 Introduction

Extenuating circumstances are those that reduce the penalty of the crime with attention to some requirements established in the law. In its application, the verification of the behavior of the aggressor after having committed the harmful action prevails [1]. Which is compatible with the provisions of article 45 of the Organic Integral Penal Code (OIPC) of the Republic of Ecuador [2]. It has been possible to verify that there have been cases where people are prosecuted for an infraction that they did not want to commit and without neglecting what is established by the OIPC, the mitigating circumstances must be evaluated. This allows a fairer sentence to be obtained and the individual to be rehabilitated and reintegrated into society [1, 3, 4].

According to article 54 of the OIPC, the judge must individualize the sentence for each person, even if there are several responsible for the same infraction. To do this, the following aspects must be observed or considered:

- The circumstances of the punishable act, extenuating and aggravating circumstances.
- The needs and special or conditions of the victim.
- The seriousness of the violation of their rights.
- The degree of participation and all the circumstances that limit criminal responsibility (article 54 of the OIPC).

The preceding implies the adequacy of the sentence to the personality of the offender to whom it is applied, this is how the need to apply the sanction according to the actor and his personality can be evidenced. What considers the circumstances that serve as support to set the penalty within the framework of Criminal Law. In such a way that the factors taken into account in the phase of individualization of the sentence are multiple, thus: the conduct or precedent of the crime, the surrounding circumstances under which the crime was committed, time, manner, place, etc., and even the same criminal record that in practice is put into consideration before the judge seeking to determine and identify the dangerousness of the offender, as well as economic, social, family factors, etc. [5-7].

As well as all the circumstances that limit criminal responsibility so that justice is applied in its maximum expression. To guarantee that all legal systems tend to justice and equity. Therefore, every court is responsible for applying the law under the principles of fairness, justice, ethical-legal, and human value, because it cannot be forgotten that every criminal is a human being. The foregoing is the reason why the application of mitigating circumstances acquires a particular complexity [3, 8].

According to [3], it is important to verify the nature of the crime. It establishes a certain number of typologies for which it is necessary to consider several circumstances. However, it is important to mention that typicity refers to the type that in this case would be the crime that according to [3] has a triple function:

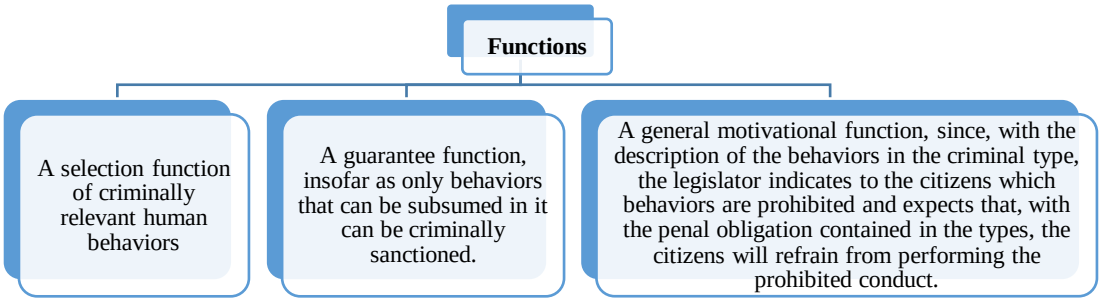

Figure 1: Triple role of mitigating circumstances. Adapted from [3].

Today certain situations cause mismanagement of justice due to a lack of understanding and assimilation of extenuating circumstances. Mostly it can be verified that this is due to [1, 3-5]:

a) its non-application exists by failing to observe evidence considered as mitigating circumstances,

b) misuse them, as a means to reduce the sentence of a dangerous person, even though sufficient elements are exposed for conviction.

According to the above, it can be said that the present investigation adopts the above as a problem situation. For this reason, the main objective of the investigation is to analyze the limiting factors in its application. For its resolution, it is proposed to apply the 2-Tuple model in its neutrosophic extension. It is chosen for the way of modeling the uncertainty of this problem by incorporating other modern approaches such as CWW (Computing With Words) for the treatment of imprecision and uncertainty.

The CWW deals with the words and propositions of a natural language as its main objects of computation, for example: "small", "big", "expensive", "very possible" or even more complex phrases such as "tomorrow will be sunny, but not very cold". The main inspiration of the CWW is the human ability to perform several different tasks such as (walking in the street, playing soccer, riding a bicycle, understanding a conversation, making decisions, etc.) without the need for the explicit use of measurements or calculations [9, 10].

Hence it is explicit why this method was selected over a statistical one because many of the direct opinions that could be collected are not reliable since they depend on the subjective opinion of the respondents. That is why the help of experts is essential because they are specialists in the subject and have wide access to opinions, which allows them to determine the true state of the opinion of those surveyed more accurately.

2 Materials and Methods

2.1 CWW

The CWW is a methodology that allows calculation and reasoning processes to be carried out using linguistic terms instead of numbers exclusively. This methodology allows creating and enriching decision models in which vague and imprecise information is represented through linguistic variables using linguistic terms. This makes it more natural for people to communicate. These processes have been carried out in fuzzy decision-making using different models, which are the following:

- Semantic Model: operations are performed using fuzzy arithmetic.
- Symbolic Model: the operations are carried out on the indices of the linguistic labels.
- Linguistic 2-tuple-based Model: it operates in a domain of linguistic expression, but treats it as a continuous universe, gaining precision in the results. The use of the 2-tuple-based model has made it possible to address decision-making problems defined in complex contexts that classical models cannot deal with, due to their limitations.

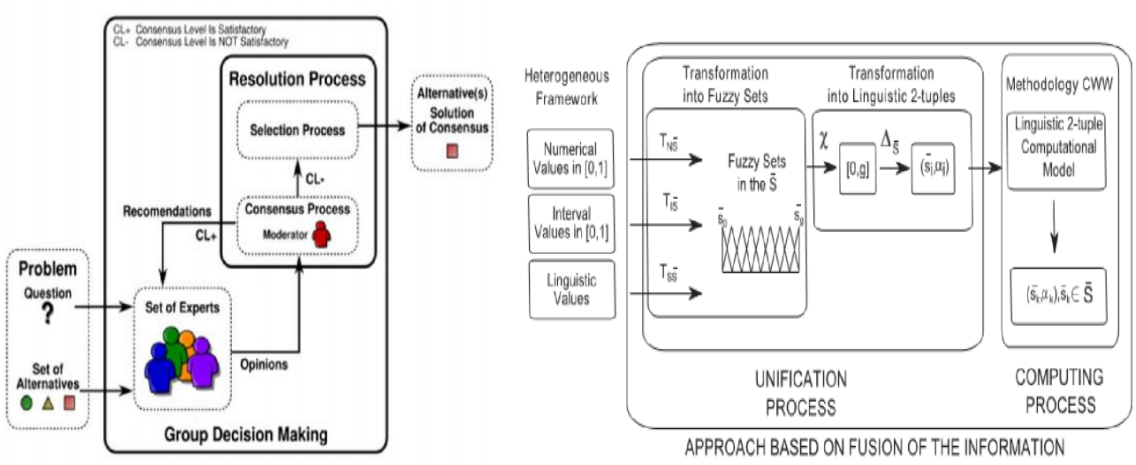

Figure 2: General scheme of a consensus-based group decision-making process and an approach based on the fusion of information into linguistic values [11-13].

The 2-tuple linguistic representation model allows computing processes with words without loss of information, based on the concept of symbolic translation. In this article, this method is used within the framework of neutrosophic sets. This combination enriches the result of decision-making, this concept is known as the Set of 2-tuple Linguistic Neutrosophic Numbers. The advantage of such a combination is that the falsehood and indeterminacy criteria can be included independently.

2.2 Neutrosophy applied to the 2-tuple CWW model

Definition 1. Let X be a universe of discourse. A *Neutrosophic Set* (NS) is characterized by three membership functions, $u_A(x), r_A(x), v_A(x): X \to]-0,1^+[$, that satisfy the condition: $-0 \leq \inf u_A(x) + inf r_A(x) + inf v_A(x) \leq sup u_A(x) + \sup r_A(x) + sup v_A(x) \leq 3^+ \; para \; todo \; x \in X$, where $u_A(x), r_A(x) \; and \; v_A(x)$ denote the true, indeterminate, and false membership functions of x in A, respectively, and their images are standard or nonstandard subsets of $]-0,1^+[$.

Definition 2. Let X be a universe of discourse. A Single Value Neutrosophic Set (SVNS) A on X is an object of the form:

$$A = \{\langle x, u_A(x), r_A(x), v_A(x)\rangle : x \in X\} \quad (1)$$

Where $u_A, r_A, v_A: X \to [0,1]$ satisfy the condition $0 \leq u_A(x) + r_A(x) + v_A(x) \leq 3 \; for \; all \; x \in X. u_A(x), r_A(x), v_A(x)$ denote the true, indeterminate, and false membership functions of x in A, respectively. For convenience, a *Single Value Neutrosophic Number* (SVNN) will be expressed as A = (a, b, c), where a, b, c ∈ [0,1] and satisfies 0 ≤ a + b + c ≤ 3.

Definition 3. Let $S = \{s_0, s_1, \dots, s_t\}$ be a set of linguistic terms and a value in the granularity interval of S. The *Symbolic Translation* of a linguistic term s_i, is a number in the interval [−0.5; 0.5) that expresses the difference of information between a quantity of information expressed by the value $\beta \in [0,t]$, obtained in a symbolic operation and the closest integer value $i \in \{0, \dots, t\}$, which indicates the index of the closest linguistic label s_i in S.

Definition 4. Let $S = \{s_0, s_1, \dots, s_t\}$ be a set of linguistic terms and a value that represents the result of a symbolic operation, then the *linguistic 2-tuple* (2TL) that expresses the information equivalent to β, is obtained using the following function:

$$\Delta: [0,t] \to S * [-0.5;0.5)$$

$$\Delta(\beta) = (s_i, \alpha), con \begin{cases} s_i, i = round(\beta) \\ \alpha = \beta - 1, \alpha \in [-0.5;0.5) \end{cases} \quad (2)$$

Where *round* is the usual rounding operator, s_i is the label with the index closest to β and α is the value of the symbolic translation. It should be noted that $\Delta^{-1}: \langle S\rangle \to [0,t]$ is defined as $\Delta^{-1}: \langle s_i, \alpha\rangle = i + a$. In this way, a linguistic 2-tuple $\langle S\rangle$ is identified with its numerical value in $[0,t]$.

Definition 5. Suppose $S = \{s_0, s_1, \dots, s_t\}$ is a 2TL with odd cardinality t + 1. $(s_T, a), (s_I, b), (s_F, c) \in L \; and \; a, b, c \in [0,t]$ are defined where $(s_T, a), (s_I, b), (s_F, c) \in L$ express independently the degree of truth, degree of indeterminacy, and degree of falsehood by 2TL, respectively, then a *2-tuple Neutrosophic Linguistic Numbers Set* (NLNS2T) is defined as follows:

$$l_j = \left\{\left(s_{T_j}, a\right), \left(s_{I_j}, b\right), \left(s_{F_j}, c\right)\right\} \quad (3)$$

Where $0 \leq \Delta^{-1}\left(s_{T_j}, a\right) \leq t, 0 \leq \Delta^{-1}\left(s_{I_j}, b\right) \leq t, 0 \leq \Delta^{-1}\left(s_{F_j}, a\right) \leq t \; y \; 0 \leq \Delta^{-1}\left(s_{T_j}, a\right) +$

$\Delta^{-1}\left(s_{I_j}, b\right) + \Delta^{-1}\left(s_{F_j}, a\right) \leq 3.$

The score and precision function allow to classify the NLNS2T as shown below:

Let $l_j = \left\{\left(s_{T_j}, a\right), \left(s_{I_j}, b\right), \left(s_{F_j}, c\right)\right\}$ be a NLNS2T on L, the score and precision function on l_1 is defined as follows:

$$S(l_1) = \left\{\frac{2t + \Delta^{-1}\left(s_{T_1}, a\right) - \Delta^{-1}\left(s_{I_1}, b\right) - \Delta^{-1}\left(s_{F_1}, c\right)}{3}\right\}, \Delta^{-1}(S(l_1)) \in [0, t] \quad (4)$$

$$H(l_1) = \Delta\left\{\frac{t + \Delta^{-1}\left(s_{T_1}, a\right) - \Delta^{-1}\left(s_{F_1}, c\right)}{2}\right\}, \Delta^{-1}(H(l_1)) \in [0, t] \quad (5)$$

$$MAP(l_1, l_2, \ldots, l_n) = \sum_{j=1}^{n} w_j l_j = \begin{cases} \Delta\left(t\left(1 - \prod_{j=1}^{n}\left(1 - \frac{\Delta^{-1}(s_{T_J}, a_j)}{t}\right)^{w_j}\right)\right), \\ \Delta\left(t\prod_{j=1}^{n}\left(\frac{\Delta^{-1}(s_{I_J}, b_j)}{t}\right)^{w_j}\right), \Delta\left(t\prod_{j=1}^{n}\left(\frac{\Delta^{-1}(s_{F_J}, c_j)}{t}\right)^{w_j}\right) \end{cases} \quad (6)$$

$$MGP(l_1, l_2, \ldots, l_n) =$$

$$\sum_{j=1}^{n} l_j^{w_j} \begin{Bmatrix} \Delta\left(t\prod_{j=1}^{n}\left(\frac{\Delta^{-1}\left(s_{T_J}, a_j\right)}{t}\right)^{w_j}\right), \Delta\left(t\left(1 - \prod_{j=1}^{n}\left(1 - \frac{\Delta^{-1}\left(s_{I_J}, b_j\right)}{t}\right)^{w_j}\right)\right), \\ \Delta\left(t\left(1 - \prod_{j=1}^{n}\left(1 - \frac{\Delta^{-1}(s_{F_J}, c_j)}{t}\right)^{w_j}\right)\right) \end{Bmatrix} \quad (7)$$

Definition 6. Given a set of NLNS2T, $l_j = \left\{\left(s_{T_j}, a\right), \left(s_{I_j}, b\right), \left(s_{F_j}, c\right)\right\}$, (j = 1, 2,…, n) with a vector of weights that satisfies the conditions y = 1, then we have the following two aggregation operators, which are the *Weighted Arithmetic Mean of Linguistic Neutrosophic Numbers of 2-tuple* (WAMLNN2T) and the *Weighted Geometric Mean of 2-tuple Linguistic Neutrosophic Numbers* (WGMLNN2T).

2.3 Procedure to resolve the objective

a) Select
   1) Experts: experts with more than 3 years of experience in the courts of the Republic will be chosen so that the following condition is met: $K = \{k_1, k_2, \ldots, k_n\}(n \geq 2)$. Each one will be assigned a weight such that $w_i \in [0,1]$ y $\sum_{j=1}^{n} w_i = 1$. Provided that the will to participate in the exercise voluntarily is expressed.
   2) Decision criteria such that $C = \{c_1, c_2, \ldots, c_m\}(m \geq 2)$.

b) Assign linguistic scale

c) Evaluate by criteria assigning, through equation 6, the result of the evaluation of each of the criteria by each expert consulted. To then perform the total aggregation with a weight ratio such that $w_i = \frac{1}{m}$ on the results of each criterion.

d) Apply the score function or the precision function to assess the results from a numerical value from equations 4 and 5.

3 Results and Discussion

It is exposed as a problem to analyze the incorrect inapplicability of the mitigating circumstances, so the limiting factors of this situation are understood as input variables. To determine these factors, a survey was conducted among the selected experts. [23, 24]

For the selection of the group of experts, a competency validation survey was applied through self-assessments, on an ascending scale from 1 to 10:

- Degree of knowledge that said potential expert possesses about the subject
- Degree of influence of each of the sources of argumentation

The processing of the form was based on the calculation of the rating factor of the experts through the following mathematical expression:

$$K = \frac{FA + GC}{2} = \frac{\frac{SI + EP + IR + FB}{4} + GC}{2} \quad (8)$$

Where:
Si= Intuition
PS= Practical experience
IR= Research conducted
BC= Consultation of bibliographic sources
DK: Degree of knowledge (1-10)

7 experts were consulted for the exercise and their skills were checked as described below using equation 8:
K Value and Classification
8-10 High
5-7 Medium
1-4 Low

Of the 10 interviewees, only a group of 3 experts composed of a judge, defense attorney, and prosecutor were selected for a total (k=3), therefore $w_i = \frac{1}{3}, for\ i = 3$.

From the surveys applied, it was possible to determine the limiting factors of the correct inapplicability of the mitigating circumstances. According to the criteria of the experts consulted, these are:

a) Corruption between the actors of the judicial system that favors non-observance or not at convenience.
b) Lack of knowledge about who should request its application.
c) No belief in their effectiveness due to their typification.
d) Need to streamline the process: they are usually downplayed and ignored due to violation of the principle of innocence since it is assumed that everyone is guilty of having committed a crime
e) Misidentification of the accused and/or the investigation of the fact prevents the visualization of the same within the process.

A linguistic scale consisting of the following was selected: $S = \{s_0 = Very\ Bad, s_1 = Bad, s_2 = Regular, s_3 = Good, s_4 = Very\ Good"\}$, which was processed in Octave 4.2.1. The following tables show the results of the application of the method.

Factors	Lawyer	Judge	Attorney
Corruption	<(s2, 0), (s1, 0), (s1, 0)>	<(s1, 0), (s2, 0), (s1, 0)>	<(s2, 0), (s1, 0), (s0, 0)>
Individualization	<(s1, 0), (s1, 0), (s1, 0)>	<(s0, 0), (s1, 0), (s3, 0)>	<(s1, 0), (s1, 0), (s2, 0)>
Effectiveness	<(s2, 0), (s1, 0), (s3, 0)>	<(s1, 0), (s1, 0), (s2, 0)>	<(s0, 0), (s1, 0), (s1, 0)>
Streamlining	<(s1, 0), (s1, 0), (s1, 0)>	<(s0, 0), (s1, 0), (s3, 0)>	<(s1, 0), (s1, 0), (s2, 0)>
Identification	<(s0, 0), (s1, 0), (s3, 0)>	<(s0, 0), (s1, 0), (s1, 0)>	<(s0, 0), (s0, 0), (s3, 0)>

Table 1: Evaluation. Source: own elaboration.

Factors	Added Criteria
Corruption	<(s2;0.42), (s1;0.23), (s2;0.07)>
Individualization	< (s1;-0.30), (s1; 0), (s3; 0)>
Effectiveness	< (s1; 0.12), (s1; 0), (s3; 0)>
Streamlining	<(s1;-0.31), (s1;0), (s3;-0.38)>
Identification	<(s0, 0), (s0, 0), (s3, 0)>

Table 2: Joint criteria of the experts. Source: Own elaboration.

Factors	Scoring Function
Corruption	(s2; 0.36)
Individualization	(s2; -0.42)
Effectiveness	(s2; -0.30)
Streamlining	(s2; -0.31)
Identification	(s1; -0.34)

Table 3: Scoring function. Source: own elaboration.

The factors can be sorted as follows:

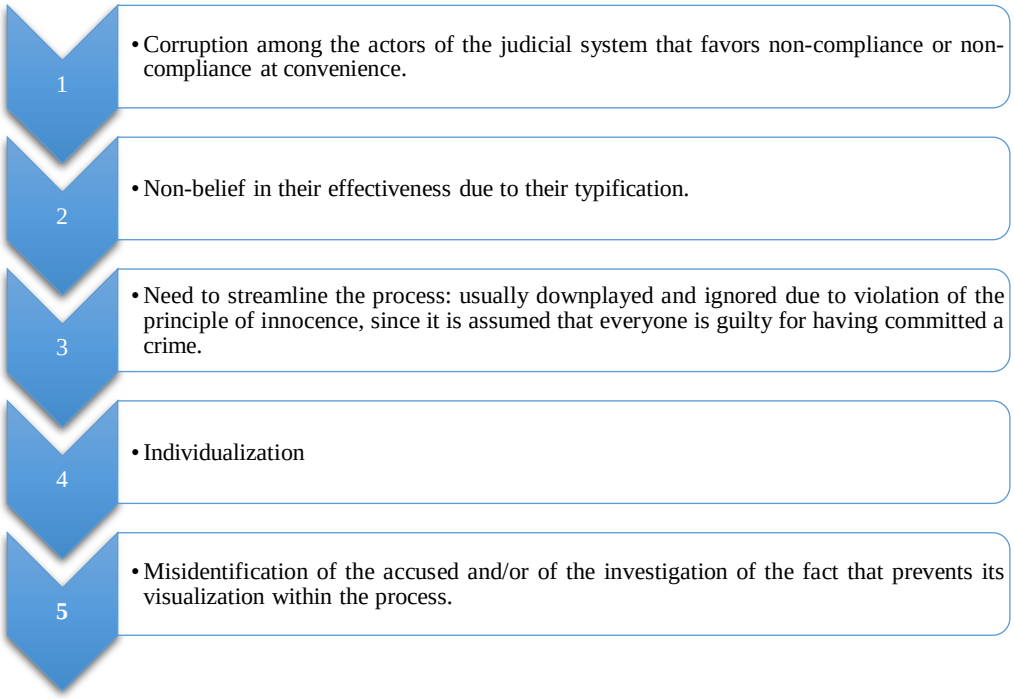

Figure 3. Order of importance of the factors according to the results. Source: own elaboration.

In accordance with the results, it can be said that for the experts consulted, the main reasons why the analyzed phenomenon is faced, are the presence of corruption and the lack of effectiveness in the typification. Therefore, the need to make improvements in eliminating these situations is essential. [14, 15, 16]

As can be seen in Table 3, in general, all the proposed factors are not favorably evaluated, most of them are exposed as regular. What offers a not very encouraging panorama for the implementation of Due Process. Although the correct attitude of those who impose justice is indeed the first step to guarantee due process, in such a way that there is the right to defense, presentation of evidence, and other actions that the defense attorney could present as an extenuating factor on the infraction committed; is the responsibility of all the correct application of the law.

The Ecuadorian State is characterized as a state of rights and justice, which is fully stated in the Constitution of the Republic, so that under no circumstances can a right be violated. Therefore, there is a need to improve both the training of students on this subject, as well as the postgraduate training of the actors of the justice system as corrective measures. All this is to achieve an equitable judicial system where justice is imposed in an egalitarian manner. [17, 18, 19, 20]

Regarding politics and corruption, the actions must come from the highest hierarchy, according to the criteria of the experts on the subject in question. The social, legal, technological, and ecological factors in that order have a much lower hierarchy, and are similar in values, in the analysis; but their strategies are pillars for the development of a long-term plan for the full recovery of due process in the closure of public service premises. [21, 22]

In addition, it is necessary to pay attention to individualization. It is a matter of adapting the penalty, provided for in the norm, to a specific case so that it is truly fair and effective. When applying the sentence, it is the judge who must consider a series of circumstances not explicitly provided for in the law, which affect the greater or lesser severity of the act, and which are susceptible to generalization. Although it is the defense attorney who proposes mitigating causes, the role of the judge is fundamental. Therefore, training activities are also needed in this area.

Conclusion

Fuzzy logic has grown rapidly due to its ability to solve problems related to the uncertainty of information or knowledge of experts. In addition, it provides a formal method for the expression of knowledge in a form understandable by humans. The variant presented to create a computational model allows decisions to be made in the definition of improvement actions. With the use of the CWW merged with Neutrosophy, an accurate mathematical tool is achieved in the treatment of qualitative information and the subjectivity of evaluation by experts. Its experimental evaluation through this case demonstrated a satisfactory performance of the system, exhibiting the advantage of using this intelligent system to speed up the work time of the evaluators in this area.

The management of extenuating circumstances requires a continuous analysis in the search for justice through the means available for it. Some of the factors that prevent a correct development of what is established in the case of mitigating circumstances were determined. It was found that the Ecuadorian State must work more deeply on this issue, both in training strategies and in the management of the authorities of the judicial system. Control mechanisms must be established for the processes to guarantee compliance with due process.

It is recommended to conduct an analysis of other legislation to determine points in common or other aspects of interest that may present themselves as opportunities for improvement. Legislations such as the Spanish, Colombian, and Argentine could be models of comparison, for which it is exhorted to research this subject.

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