Insertion and use of multicriteria methods for neutrosophic judicial evaluation

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Abstract. This study addresses the growing need to integrate multicriteria methods into judicial evaluation, specifically through a neutrosophic approach, to improve the accuracy and reliability of legal decision-making. Today, the judicial system faces critical challenges related to the interpretation of evidence, the consideration of multiple factors, and the uncertainty inherent in complex cases. Although various approaches have been used in judicial evaluation, few effectively address the ambiguity and indeterminacy present in the opinions of judges and experts, leading to fragmented or biased analysis. This study seeks to close that gap by applying neutrosophic multicriteria methods, which allow for a more balanced and comprehensive evaluation, incorporating all dimensions of the judicial process, from evidence to contextual factors. The methodological approach adopted is based on the use of neutrosophic multicriteria tools, which allow for the integration and analysis of various criteria through a flexible and robust framework. The results obtained reveal that this method not only improves the accuracy of judicial assessments but also provides a clearer view of the uncertainty associated with legal decisions. The main theoretical implications of this study lie in the possibility of applying a neutrosophic framework to judicial assessment, providing a tool capable of capturing the complexity of disputed cases. On a practical level, the findings are crucial for the development of judicial decision support systems, suggesting that the implementation of this approach could contribute to greater objectivity and consistency in judicial decisions, as well as to an improvement in the transparency of the judicial process.

Keywords: Multicriteria methods, judicial evaluation, neutrosophy, judicial decision-making, uncertainty, evidence analysis, support systems.

1. Introduction

The principle of immediacy is a fundamental concept within the criminal justice system of many countries. It refers to the direct proximity of the judge or court to the parties involved in a trial, which implies that the judge must directly witness the presentation of evidence and testimony to form an impartial opinion on the case. In other words, the judge must be physically present during the trial to observe first-hand the evidence and arguments presented by both parties [1] .

In white-collar crimes, which are usually financial, corruption, or high-profile crimes committed by people with power or influence, there may be a situation where the accused is not physically present during the trial. This can happen for a variety of reasons, such as the accused being in another country

and unable to be extradited or having delicate health conditions that prevent him from attending the trial [2] .

The absence of the accused at the trial may raise problems in relation to the principle of immediacy, since the judge will not be able to directly observe the reactions and expressions of the accused, which could affect his ability to assess the credibility of the testimonies, and the strength of the evidence presented. In addition, the absence of the accused may hinder the conduct of a fair trial, since it deprives the defense of the opportunity to question witnesses or present arguments in real time [3] .

However, it is important to note that the absence of the accused does not necessarily automatically imply a violation of the principle of immediacy. In some judicial systems, mechanisms may be established to ensure that the trial is conducted fairly and transparently, even in the absence of the accused. This may include allowing the defense to be represented by a lawyer or allowing communications and participation by the accused through technological means such as videoconferencing [2] .

In any event, the absence of the accused in economic or any other type of crime is a complex issue that must be carefully addressed to ensure that the fundamental rights of the accused are respected, and that a fair and equitable trial is conducted. Judicial systems must strive to strike a balance between the need for justice and respect for the fundamental principles of due process of law [4] .

The principle of immediacy is guaranteed through a series of procedural rules, such as the obligation of the judge to be present at all stages of the proceedings, the prohibition of submitting written evidence and the obligation of witnesses to appear before the court and testify. This is a fundamental principle of the Ecuadorian judicial system. It is essential to ensure that trials are fair and equitable and that judges have the necessary information to issue fair sentences [5] .

Below are some examples of how the principle of immediacy allows the judge to assess first-hand the evidence and testimony presented:

- ✓ The judge can observe the body language of witnesses and determine whether they are being truthful or not.
- ✓ The judge may ask witnesses questions to clarify their testimony.
- ✓ The judge may compare the testimonies of different witnesses to determine who is more credible.
- ✓ The judge may examine the evidence to determine if it is relevant to the case.

These crimes are often committed in the business or professional sphere and can have a significant impact on society. Some characteristics of white-collar crimes are [2]:

- ✓ They are committed by individuals with power and position.
- ✓ They occur in the business or professional sphere.
- ✓ They can have a significant impact on society.
- ✓ They are often difficult to research and prove.

Some examples of white-collar crimes are:

These are the most common types of white-collar crimes:

- ✓ Fraud
- ✓ Bribery
- ✓ Corruption
- ✓ Money laundering
- ✓ Abuse of power
- ✓ Abuse of confidence
- ✓ Tax evasion

White-collar crime is a serious problem in Ecuador, as it can cause economic, social and political damage. Ecuadorian authorities must take measures to prevent and combat these crimes. The research aims to develop a judicial management system that maximizes the application of the principle of immediacy while ensuring procedural efficiency, optimal use of resources and accessibility to justice.

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1. Methodology.

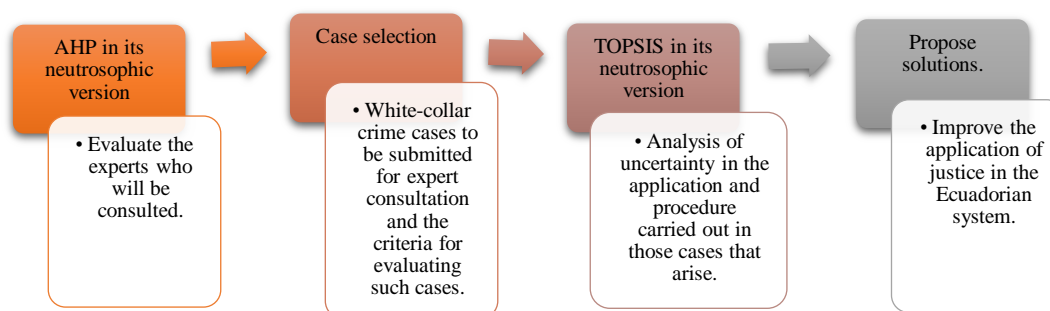To carry out the investigation, the steps are as follows:

Figure 1. Prosed method

Analytic Hierarchy Process (AHP): This method models the problem resulting in the creation of a representative hierarchy of the decision-making scheme in question [6] . The importance levels or weights of the criteria are estimated by making pairwise comparisons between them. The theory of the AHP technique within a neutrosophic framework can be found in [7] . For this method triangular neutrosophic numbers will be used, see [8-10] .

TOPSIS: In the case of TOPSIS, the selection is based on identifying the alternative that is closest to the ideal solution and farthest from the worst solution [9 , 11 , 12] . This method has evolved into Neutrosophy, so in this paper linguistic terms will be linked to Single Valued Neutrosophic Numbers (SVNN). This allows experts to make their evaluations in linguistic terms, which is more natural. For more details, see [13,14].

2. Application and results

A. **Experts:** A judge, a prosecutor and two lawyers were selected for the consultation.

Vectors of importance were determined based on the specific responsibilities and roles of these actors within the criminal justice system. While the judge acts as an impartial arbiter making decisions based on the law and evidence presented during the trial, and the lawyer defends the interests of his or her client (whether the accused or the plaintiff), the prosecutor is the driving force behind the prosecution, playing an active role in combating white-collar crime from the initial investigation to the eventual conviction. This combination of prosecutorial responsibility, specialized knowledge, authority to decide on prosecution, and the duty to protect the public interest justifies the higher level of importance assigned to the prosecutor in the process of evaluating a white-collar crime case.

Expert weights: Lawyer 1 = (0.19444,0.17307,0.17); Lawyer 2 = (0.08333,0.09230,0.01); Prosecutor = (0.41667,0.48076,0.49); Judge = (0.30556,0.32692,0.33)

B. **Alternatives**

Table 1. Alternatives

Alternative 1	Alternative 2	Alternative 3
Odebrecht: In 2017, the Brazilian company Odebrecht pleaded guilty to bribery of public officials in several countries, including Ecuador. The bribes were paid to obtain government contracts and the total amount of the bribes is estimated to be over $788 million.	**National Assembly:** In 2018, it was revealed that several Ecuadorian legislators had received bribes to vote in favor of certain laws. The bribes were paid in exchange for votes to approve laws that benefited private companies. The case involving the National	**Panama Papers:** In 2016, a journalistic investigation revealed that several Ecuadorian politicians and businessmen had used companies in Panama to evade taxes. The Panama Papers case has damaged Ecuador's image and led

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Alternative 1	Alternative 2	Alternative 3
The Odebrecht case has had a significant impact in Ecuador, as it has led to the dismissal of several public officials and the investigation of others.	Assembly has damaged the image of Ecuadorian democracy and led to the dismissal of several legislators.	to the investigation of several public officials.

These white-collar crime cases in Ecuador were selected for neutrosophic analysis because the principle of immediacy in these cases is particularly illustrative due to the complexity and covert nature of these crimes. These crimes, often perpetrated in corporate or financial contexts by high-status individuals, require a detailed understanding of personal transactions and interactions for detection and prosecution.

C. Criteria

1. Maximizing Immediacy: Ensuring that the judge has maximum direct contact with the parties, witnesses and evidence for a better understanding and assessment of the facts.
2. Procedural Efficiency: Reduce case resolution times, minimizing delays without compromising the quality of justice.
3. Resource optimization: Efficient use of available human and material resources, including courtrooms, information technologies and judicial staff.
4. Accessibility: Ensure that all parties have equal access to the justice system, regardless of their geographic location, socioeconomic status or physical capabilities.
5. Adaptability and resilience: The ability of the system to adapt to unforeseen changes, such as increased demand for judicial services or crises.

Table 2. TOPSIS method according to expert 1 evaluation.

	Maximizing immediacy	Procedural efficiency	Resource optimization	Accessibility	Adaptability and resilience
Odebrecht	(0.70, 0.25, 0.30)	(0.90, 0.10, 0.10)	(0.50, 0.50, 0.50)	(0.60, 0.35, 0.40)	(0.30, 0.75, 0.70)
National Assembly	(0.50, 0.50, 0.50)	(0.80, 0.15, 0.20)	(0.20, 0.85, 0.80)	(0.70, 0.25, 0.30)	(0.10, 0.90, 0.90)
Panama Papers	(0.60, 0.35, 0.40)	(0.40, 0.65, 0.60)	(0.90, 0.10, 0.10)	(0.50, 0.50, 0.50)	(0.80, 0.15, 0.20)

Table 3. TOPSIS method according to expert evaluation 2.

	Maximizing immediacy	Procedural efficiency	Resource optimization	Accessibility	Adaptability and resilience
Odebrecht	(0.53, 0.23, 0.33)	(0.89, 0.12, 0.16)	(0.62, 0.52, 0.50)	(0.66, 0.38, 0.38)	(0.29, 0.77, 0.80)
National Assembly	(0.48, 0.51, 0.52)	(0.75, 0.11, 0.11)	(0.21, 0.85, 0.86)	(0.73, 0.30, 0.13)	(0.08, 0.92, 0.86)
Panama Papers	(0.58, 0.34, 0.41)	(0.37, 0.68, 0.67)	(0.87, 0.17, 0.03)	(0.57, 0.47, 0.52)	(0.75, 0.22, 0.26)

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Table 4. TOPSIS method according to expert evaluation 3.

	Maximizing immediacy	Procedural efficiency	Resource optimization	Accessibility	Adaptability and resilience
Odebrecht	(0.64, 0.24, 0.27)	(0.93, 0.10, 0.12)	(0.41, 0.45, 0.50)	(0.54, 0.49, 0.41)	(0.27, 0.80, 0.73)
National Assembly	(0.49, 0.48, 0.54)	(0.77, 0.16, 0.19)	(0.15, 0.99, 0.68)	(0.71, 0.23, 0.38)	(0.08, 0.87, 0.81)
Panama Papers	(0.59, 0.37, 0.51)	(0.38, 0.64, 0.59)	(0.86, 0.03, 0.13)	(0.53, 0.47, 0.48)	(0.70, 0.09, 0.15)

Table 5. TOPSIS method according to expert evaluation 4.

	Maximizing immediacy	Procedural efficiency	Resource optimization	Accessibility	Adaptability and resilience
Odebrecht	(0.73, 0.28, 0.34)	(0.93, 0.00, 0.12)	(0.49, 0.59, 0.52)	(0.66, 0.39, 0.36)	(0.26, 0.66, 0.65)
National Assembly	(0.48, 0.48, 0.48)	(0.83, 0.20, 0.13)	(0.14, 0.82, 0.83)	(0.65, 0.19, 0.38)	(0.04, 0.91, 0.92)
Panama Papers	(0.65, 0.42, 0.44)	(0.34, 0.70, 0.52)	(0.79, 0.19, 0.18)	(0.46, 0.59, 0.54)	(0.78, 0.22, 0.19)

Table 6. Distances between negative and positive solutions.

Alternative	s_i^+	s_i^-	$\widetilde{\rho_J}$	order
Odebrecht	1.141224	1.19552	0.511618	2
National Assembly	1.758339	0.881627	0.333954	3
Panama Papers	1.021049	1.725995	0.62831	1

Alternatives are ranked based on CP, with higher values being better. Based on this criterion, alternatives are ranked as follows:

1. **National Assembly** : It is considered the least preferable due to its lower CP in this aggregate analysis, indicating that this case had the least application of the proposed criteria.
2. **Panama Papers** : It has an intermediate CP, ranking second.
3. **Odebrecht** : Has the highest CP, indicating that it is the most preferable of the three according to the experts' aggregate evaluations.

This result shows how aggregate analysis can vary from individual assessments, highlighting the importance of considering multiple perspectives in decision-making.

3. Discussion.

The expert with the highest weighted value was the prosecutor, which is justified based on the following elements:

- ✓ Prosecutor's Responsibility: The prosecutor plays a central role in the investigation and prosecution of white-collar crimes. He or she is responsible for gathering and presenting the evidence necessary to prove the defendant's guilt beyond a reasonable doubt. This task involves a thorough understanding of the legal and financial complexities associated with these crimes, as well as the ability to build a compelling case that can withstand scrutiny in court.
- ✓ Specialized Knowledge: White collar crimes often involve sophisticated financial maneuvers, tax evasion, fraud, embezzlement, and other forms of corporate and government corruption.

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The prosecutor, because of his or her experience in prosecuting these types of crimes, possesses specialized knowledge that is crucial to identifying and understanding the tactics employed by criminals, giving him or her a unique position in the evaluation process.

✓ Prosecutor's decision: The prosecutor has the discretion to decide whether there is sufficient evidence to proceed with formal prosecution and to bring charges against the accused. This decision depends not only on the availability of evidence, but also on strategic considerations and the public interest, which requires an informed and experienced judgment about the strength of the case.

✓ Protecting the public interest: Prosecutors represent the State and the general public, seeking to administer justice and maintain confidence in financial and government institutions. Their role is essential to deter future economic crimes by effectively prosecuting offenders, thereby contributing to the integrity of the economic and government system.

The application of the TOPSIS neutrosophic method in the present analysis illustrates an approach to decision-making in contexts characterized by high levels of uncertainty and indeterminacy. In this scenario, the Odebrecht, National Assembly and Panama Papers alternatives (A1, A2 and A3 respectively) were evaluated under a set of weighted criteria, to determine the most suitable alternative based on the calculation of the positive neutrosophic proximity to the ideal solution (CP). The essence of this approach lies in its ability to effectively incorporate and manage the ambiguity inherent in expert preferences and judgments, offering a robust framework for multi-criteria analysis[14,15].

In the specific case of our analysis, alternative 1, Odebrecht, turned out to be the most preferable, having the highest CP value. This result indicates its optimal proximity to the ideal positive neutrosophic solution, highlighting its superiority across the spectrum of criteria considered. The attribution of this preference is not arbitrary, but rather reflects an aggregate consensus based on expert evaluations, mitigating the impact of subjectivity by applying neutrosophic logic.

On the other hand, the National Assembly was positioned as the least preferable alternative, attributable to its lower CP. This finding suggests that A2 deviates significantly from the neutrosophic ideal solution, reflecting deficiencies or areas for improvement in the context of the evaluated criteria. Panama Papers, with an intermediate CP, is located at an equilibrium point between Odebrecht and the National Assembly, denoting moderate compatibility with the positive ideal solution and, therefore, relative viability as a decision option.

The case of Ecuador's National Assembly in 2018, where several legislators were implicated in receiving bribes in exchange for voting in favor of laws that benefited private companies, raises a number of critical considerations under the lens of specific criteria commonly associated with governance and effective institutional performance. The involvement of these legislators in acts of corruption not only undermines the integrity of democratic institutions but also violates fundamental principles that should guide the conduct of public servants. Below, we analyze how this case transgressed the following criteria:

✓ **Maximizing immediacy (C1):** This criterion, which emphasizes the importance of rapid and effective responses to society's needs and challenges, was clearly violated. The legislators involved prioritized personal and third-party interests over collective well-being, delaying or denying immediate responses to the needs of the population. Corruption in this context contributes to public distrust and cynicism, eroding faith in the ability of institutions to act quickly and effectively for the benefit of the population .

✓ **Procedural efficiency (C2):** Efficiency in legislative processes involves the enactment of laws and policies in a fair, transparent manner and in the public interest. In the case of the National Assembly, this principle was compromised, as legislative processes were manipulated to favour private interests. Procedural efficiency was not only violated in terms of the quality and impartiality of the legislation passed, but also in the public perception of the Assembly as an efficient and trustworthy institution.

- ✓ **Resource Optimization (C3):** Public resources, including time and legislative capacity, should be used as effectively as possible to promote the general welfare. However, this case illustrates a diversion of resources towards the pursuit of corrupt objectives, which affects the efficient allocation of those resources for legitimate purposes and undermines the integrity of legislative decisions .
- ✓ **Accessibility (C4):** Accessibility in this context refers to the ability of the population to influence the legislative process and access their representatives so that their voices are heard. Corruption undermines this principle by closing channels of communication and public participation, privileging instead those who are willing to pay bribes to obtain exclusive access and legislative favors .
- ✓ **Adaptability and resilience (C5):** An institution's adaptability and resilience are manifested in its ability to resist corruption and adapt to the changes necessary to preserve its integrity. In this case, the involvement of legislators in corrupt practices reveals a systemic failure in control, accountability and transparency measures, which calls into question the institution's ability to adapt and strengthen itself in the face of such challenges.

It is essential to address these challenges and seek solutions that ensure due process and justice in cases where the accused is absent. To do so, the regulations must be adapted and the technologies available in the Ecuadorian judicial system must be used. It is suggested that these criteria be considered for the selection and analysis of judicial proceedings in which the principle of immediacy will be applied. For example, the court could implement a hybrid system of hearings, combining in-person sessions for cases where immediacy is critical, with virtual hearings in situations where efficiency and accessibility are prioritized.

4. Conclusion

The principle of immediacy is a fundamental pillar of the Ecuadorian judicial system, which aims to guarantee a fair and equitable trial by allowing the judge to directly witness the evidence, testimony and expressions of the parties involved in the process. However, in cases of white-collar crimes, in which individuals with power, influence and resources are involved, the absence of the accused can pose challenges to the effective application of this principle. The absence of the accused in court affects the judge's ability to directly observe the reactions and expressions of the accused, which can make it difficult to assess his credibility and to properly evaluate the evidence presented. Additionally, the lack of direct participation of the accused can lead to biased judicial decisions or decisions based solely on the version presented by the accusing party.

Some possible solutions include allowing defendants to appear by videoconference, appointing a legal representative to defend defendants in their absence, and allowing the submission of evidence and testimony in writing. These measures can help ensure the effective participation of defendants in the trial and facilitate their defense, even if they are not physically present. The negative impact of the National Assembly case on the image of Ecuadorian democracy is a wake-up call on the urgent need to strengthen institutions, ensure accountability, and reinforce control mechanisms to prevent corruption. This analysis not only highlights violations of the fundamental principles of democratic governance, but also underlines the urgency of adopting structural reforms that promote a culture of integrity, transparency, and public service.

Conflicts of interest: "The authors declare that they have no conflict of interest."

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