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# A Neutrosophic N-Alectic Approach to Identifying the Causes of Tax Conflicts in Textile SMEs

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**Abstract.** This study analyzes the multidimensional causes of tax conflicts in textile SMEs in Metropolitan Lima using the neutrosophic n-alectic framework. Traditional binary models—compliance vs. non-compliance—fail to capture the interplay of factors such as tax illiteracy, legal ambiguity, and perceptions of injustice. By applying a refined neutrosophic approach that integrates multiple components of truth (T), indeterminacy (I), and falsity (F), the study models tax behavior as a vector and calculates the distance from an ideal compliance profile. Results show that SMEs with structured accounting systems (Profile A) have a significantly lower neutrosophic distance (0.135) than informally managed ones (Profile B, 0.515), confirming the benefits of formalization. Key contributors to conflict include low tax literacy (T<sub>1</sub>), high regulatory uncertainty (I), and perceived inequity (F<sub>3</sub>). Recommendations include tax training programs, regulatory simplification, neutrosophic self-diagnosis tools, transition support for informal SMEs, and incentive schemes. Additionally, the study draws connections between neutrosophic logic and the plural, relational worldviews of Andean and Amazonian cultures, underscoring the intercultural relevance of the n-alectic approach in designing inclusive and context-sensitive tax policy.

Keywords: Tax conflicts, Textile SMEs, Neutrosophic n-alectics, Formalization, Intercultural logic.

## 1. Introduction

Small and medium-sized enterprises (SMEs) in the Peruvian textile sector are vital to the country's economy, generating approximately 80% of formal employment [1]. Despite their importance, these businesses face persistent tax conflicts that threaten their sustainability. Disputes with the National Superintendence of Customs and Tax Administration (SUNAT) often arise from errors in tax declarations, a lack of tax knowledge, or prolonged administrative procedures [2]. These conflicts not only burden SMEs with fines and interest but also diminish their competitiveness in an increasingly globalized economy. Historically, the Peruvian tax system has evolved through efforts to formalize economic activity, yet regulatory complexity and administrative inefficiencies have continued to disproportionately affect textile SMEs [3, 4].

The 2020 pandemic exacerbated this scenario, increasing tax debts as operations were disrupted [5,6]. Many SMEs, prioritizing survival, failed to meet their tax obligations, leading to audits, sanctions, and a growing sense of mistrust toward the tax authority [7]. Furthermore, slow dispute resolution processes aggravate these conflicts, often leaving SMEs with mounting interest and limited capacity for legal defense . Although arbitration presents a potentially faster and fairer solution, its implementation remains scarce [. Added to this is the ambiguity in tax regulations, which can lead to interpretive discrepancies and reinforce perceptions of injustice . Thus, tax conflicts in this sector are not merely legal issues—they are socio-economic phenomena requiring multidimensional análisis[8,9].

To address this complexity, the present study adopts a neutrosophic n-alectic approach [10]. This methodology, derived from the refined logic developed by Florentin Smarandache, enables the integration of truth (T), indeterminacy (I), and falsity (F) components in modeling the causes of tax disputes. Unlike binary models that classify behavior as either compliant or non-compliant, neutrosophic n-alectics allows for the representation of contradictory and ambiguous realities [11]. This is particularly relevant in the Peruvian textile context, where overlapping factors—such as regulatory ignorance, fluctuating policies, financial instability, and mistrust in public institutions—interact in complex ways [12].

The research is guided by the following central question: What are the main factors that generate tax conflicts in textile SMEs in Metropolitan Lima, and how can they be modeled considering the uncertainty and contradictions inherent in stakeholder perceptions? To answer this, the study is structured as follows: Section 2 introduces the theoretical framework of neutrosophic n-alectics and contextualizes it within Andean and Amazonian worldviews. Section 3 presents a formal n-alectic formulation of the tax conflict problem. Section 4 describes the materials and methods used, including the construction of an ideal tax behavior profile and the application of a weighted Hamming distance. Section 5 analyzes the results obtained from two SME profiles and identifies key differentiating factors. Finally, Section 6 offers conclusions and policy recommendations based on the multidimensional diagnostic enabled by the n-alectic model.

## 2. Preliminaries.

#### 2.1. Neutrosophic N-alectics as a Theoretical Framework.

Refined neutrosophic logic considers that each component of knowledge can be broken down into more detailed subcomponents[ 12, 13, 14].:

(*T*1,*T*2, ..., *Tp*; *I*1,*I*2, ..., *Ir*; *F*1,*F*2, ..., *Fs*) Where:

(1)

- p: number of true subcomponents
- r: number of subcomponents of uncertainty
- s: number of falsehood subcomponents
- n = p + r + s: total number of n- alectic elements

These subcomponents may represent different degrees, types, or contexts of truth, falsity, or indeterminacy.

N-alectic theory is a progressive generalization of dialectical and tri-alectic thinking, based on refined neutrosophic logic, which incorporates not only the classical elements of truth (T) and falsity (F), but also indeterminism (I) and its multiple subtypes. This proposal, developed by Florentin Smarandache, represents a dynamic expansion of logical thinking that allows the modeling of complex realities, where multiple components interact in a complementary, contradictory, or indeterminate way [10].

Traditional dialectics is based on a binary interaction between opposites (T, F). Tri-alectics, proposed by neutrosophy, introduces a third component: indeterminacy **(I)**, reflecting a more realistic perspective on human and social thought[11].

N-alectics is then presented as the most general theoretical framework[10]:

A dynamic between *n* refined subcomponents of knowledge, which may include several truths (T), several falsehoods (F), and multiple forms of indeterminacy (I).

A refined 4-component logic can be represented as follows[10]:  $(T, I_1 1, I_2, F)$ Where:

- T: True (e.g. man)
- F: Falsehood (e.g. woman)
- I 1: Complementary relationship (cooperation)
- I<sub>2</sub>: Contradictory relationship (conflict)

The n-alectic approach offers several key advantages that make it particularly suitable for analyzing complex, real-world scenarios. First, its multidimensional nature allows for the integration of multiple perspectives and evaluative criteria, moving beyond binary judgments. It also promotes ethical balance, fostering decisions that respect the principles of complementarity and relationality, which are essential in plural and participatory contexts. Moreover, it excels in uncertainty management, enabling the analysis of ambiguous, contradictory, or incomplete information without forcing premature closure. Finally, its intercultural applicability makes it especially valuable in environments shaped by diverse worldviews, such as those found in indigenous knowledge systems, where truth is often relational, layered, and dynamic.

#### 2.2 N-Alectic Worldviews in Andean and Amazonian Cosmologies

In contrast to classical neutrosophic logic which typically employs a single triplet (T, I, F), the Andean cosmovision exemplifies what we might term an n-alectic system, incorporating multiple truth, indeterminacy, and falsity components [15]. This can be formalized fro example as:

$$N_A = \langle \{T_1, T_2, \dots, T_n\}, \{I_1, I_2, \dots, I_m\}, \{F_1, F_2, \dots, F_p\} \rangle$$

Where the cosmological structure includes:

Hanan Pacha ( $T_1$ ): The upper world, associated with celestial and divine elements Kay Pacha ( $I_1$ ): The present or earthly world where forces coexist Uku Pacha ( $F_1$ ): The inner or underground world, the place of ancestors

**Figure 1.** Andean Chakana – Neutrosophic Structure. The Chakana (Andean Cross), is a sacred symbol representing the tripartite structure of the universe – Hanan Pacha, Kay Pacha, and Uku Pacha – with a central opening symbolizing Chaupi, the portal of transition. A visual representation of the n-alectic neutrosophic model.

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(2)

(3)

This n-alectic approach allows for more nuanced representations of complex systems where multiple dimensions of truth, indeterminacy, and falsity interact simultaneously. In the Andean cosmology, these components are not mutually exclusive but rather complementary under the principle of "yanantin."

Mathematically, we can express the relationship between these components as[19]:

 $0 \leq \sum (T_i) + \sum (I_j) + \sum (F_k) \leq n + m + p$ 

(4)

(5)

where  $i \in \{1, 2, ..., n\}, j \in \{1, 2, ..., m\}$ , and  $k \in \{1, 2, ..., p\}$ 

This formulation extends neutrosophic logic to accommodate the multilayered nature of ancient cosmological systems, providing a bridge between ancestral wisdom and modern mathematical approaches to uncertainty and complementarity.

Building on this framework, the Amazonian cultures of Peru, especially those in the Loreto región, offer equally complex and relational understandings of the world. In these worldviews, knowledge is not seen as linear or dichotomous but emerges from the interweaving of ecological knowledge, spiritual communication, and communal experience. This dynamic and pluralistic epistemology aligns naturally with the n-alectic paradigm, making Amazonian cosmologies fertile ground for applying and extending refined neutrosophic logic to contexts of intercultural dialogue, sustainability, and epistemic diversity [20, 21].

# 2.3. N-Alectic Formulation of the Problem: Tax Conflicts in Textile SMEs

Tax conflicts represent a multidimensional and persistent challenge for small and medium-sized enterprises (SMEs) in Peru's textile sector [22]. These disputes, often stemming from errors in tax returns, lack of regulatory understanding, or administrative delays, have significant financial and social consequences [23]. In Metropolitan Lima—where most of these SMEs are concentrated—such conflicts not only increase debt burdens through fines and interest but also hinder competitiveness in a globalized market. The issue arises from a complex interplay of limited tax literacy, ambiguous legal frameworks, and administrative inefficiencies[24].

The tax conflict experienced by textile SMEs in Metropolitan Lima cannot be adequately captured through binary logics such as compliance/non-compliance or legality/illegality. Instead, it demands a logic system capable of simultaneously expressing degrees of truth (T), falsity (F), and indeterminacy (I), and their subtypes. From the perspective of neutrosophic n-alectics, the conflict can be represented as a structured configuration of knowledge components that interact dynamically:

 $C_{tax} = (T_1, T_2, T_3, I_1, I_2, I_3, F_1, F_2, F_3)$ Where:

 $T_i$ : represent compliance-oriented elements (e.g., regulatory knowledge, financial capacity, and organizational commitment).

*I<sub>j</sub>*: reflect areas of indeterminacy or ambiguity (e.g., frequent legal changes, interpretative gray zones, procedural uncertainty).

 $F_k$ : denote dimensions of non-compliance (e.g., tax ignorance, financial barriers, perception of injustice).

This formulation not only captures the complexity of tax behavior in SMEs but also enables its mathematical modeling under neutrosophic logic. It provides a flexible structure for evaluating real-world profiles, detecting causality patterns, and designing interventions. By formally integrating multiple dimensions of truth, indeterminacy, and falsity, this n-alectic vector allows for context-sensitive diagnosis and the construction of neutrosophic distances to an ideal profile, as developed in the methodological section [10].

## 3. Materials and Methods

This study adopts a neutrosophic n-alectic approach to analyze tax conflicts in small and mediumsized enterprises (SMEs) within the textile sector. The methodology is structured to capture the multidimensional and uncertain nature of tax compliance behavior, moving beyond traditional binary logic.

## 3.1. Neutrosophic Modeling Framework

This study adopts a neutrosophic n-alectic approach to analyze tax conflicts in small and medium-sized enterprises (SMEs) within the textile sector. The methodology is structured to capture the multidimensional and uncertain nature of tax compliance behavior, moving beyond traditional binary logic.

Based on the refined neutrosophic logic proposed by Florentin Smarandache, the n-alectic framework incorporates multiple truth (T), indeterminacy (I), and falsity (F) components to reflect the complex interactions between regulatory knowledge, financial capacity, ambiguity, and perceived fairness. The general structure of the neutrosophic vector for each SME profile is defined as:

$$N = (T_1, T_2, T_3; I_T, I, I_F; F_1, F_2, F_3)$$

(6)

- Truth components (T): represent tax compliance factors
- $\circ$   $T_1$ : knowledge of tax regulations
- $\circ$   $T_2$ : financial capacity to meet obligations
- $\circ$   $T_3$ : compliance-oriented organizational culture
- Indeterminacy components (I): represent tax-related ambiguities
- $\circ$  *I<sub>T</sub>*: favorable but ambiguous interpretations
- *I*: frequent regulatory changes
- $\circ$   $I_F$ : gray area between legal avoidance and illegal evasion
- Falsity components (F): represent non-compliance drivers
- $\circ$   $F_1$ : ignorance of obligations
- $F_2$ : financial obstacles
- $F_3$ : perception of unfair taxation

## 3.2. Weight Assignment

To reflect the relative influence of each dimension on tax conflict scenarios, normalized weights were assigned to all nine components, as follows (Table 1.)

	Table 1.	. Weight Distribution	for Neutrosophic	Vector Components
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Component	Weight
$W_{T1}$	0.15
W <sub>T2</sub>	0.15
W <sub>T3</sub>	0.10
w <sub>IT</sub>	0.10
w <sub>I</sub>	0.10
W <sub>IF</sub>	0.10
W <sub>F1</sub>	0.10
W <sub>F2</sub>	0.10
W <sub>F3</sub>	0.10

The total weight sum is normalized to 1.0 to ensure comparability.

# 4.3. Ideal Solution Construction

The **ideal SME profile** is conceptualized as one that maximizes compliance (T) while minimizing indeterminacy (I) and non-compliance (F). Mathematically, the ideal profile is defined as:

$$x^* = (\max(T), \max(I_T), \min(I), \min(I_F), \min(F))$$
(7)

## 4.4. Neutrosophic Distance Calculation

To evaluate the proximity of each SME profile to the ideal solution, we applied the weighted Hamming distance metric ( $\lambda = 1$ ), which aggregates the absolute deviations of each component, weighted accordingly:

$$D(x, x^*) = \sum_{i=1}^{n} (w_i * |x_i - x_i^*|^{\lambda})$$
(8)

Where:

- *x* is the observed profile,
- *x*<sup>\*</sup> is the ideal profile,
- *w<sub>i</sub>* is the weight for component i,
- $\lambda = 1$  (Hamming distance).

The profile with the n-alectic distance is considered closer to the ideal tax behavior

#### 5. Case Study

Tax disputes remain one of the most pressing challenges for small and medium-sized enterprises (SMEs) in the textile industry. These firms operate in highly dynamic environments where legal, economic, and operational variables intersect, often generating conditions of partial compliance, regulatory ambiguity, and perceived inequity. Conventional binary classifications—such as compliant versus non-compliant—fail to account for this complexity.

To address this gap, the present study employs a neutrosophic n-alectic model, derived from the refined logic proposed by Florentin Smarandache. This model allows for the simultaneous representation of truth (T), indeterminacy (I), and falsity (F) components, distributed across multiple dimensions. In this framework, each SME profile is described by a 9-dimensional vector:

$$N = (T_1, T_2, T_3; I_T, I, I_F; F_1, F_2, F_3)$$

- $T_1$ : Knowledge of tax regulations
- *T*<sub>2</sub>: Financial capacity to meet obligations
- T<sub>3</sub>: Compliance-oriented organizational culture
- $I_T$ : Ambiguous but favorable interpretations
- *I*: Regulatory uncertainty
- *I<sub>F</sub>*: Confusion between legal avoidance and evasion
- $F_1$ : Ignorance of obligations
- F<sub>2</sub>: Financial hardship
- $F_3$ : Perception of excessive or unfair tax burden

Each component is assigned a normalized weight to reflect its relative contribution to tax conflict scenarios, as detailed in the methodology section.

To assess the practical utility of this model, two distinct SME profiles were constructed:

(9)

- Profile A: An SME with a formal, structured accounting department.
- Profile B: An SME that manages its tax affairs informally, without institutionalized support.

The actual values for each profile are summarized below:

Component	Profile A	<b>Profile B</b>
$T_1$	0.8	0.3
<i>T</i> <sub>2</sub>	0.7	0.4
$T_3$	0.8	0.3
$I_T$	0.4	0.5
Ι	0.3	0.7
$I_F$	0.3	0.6
$F_1$	0.2	0.7
$F_2$	0.3	0.6
$F_3$	0.2	0.7

Table 2: Neutrosophic Component Values for SME Profiles A and B

The ideal SME profile is defined as the one that maximizes T components while minimizing I and F components. The ideal vector is expressed as:

$$x^* = (0.9, 0.9, 0.9; 0.3, 0.1, 0.2; 0.1, 0.1, 0.1)$$

To quantify the proximity of each profile to the ideal vector  $x^*$ , the weighted Hamming distance was applied(8).

For Profile A, the calculated distance is:

$$D_A = 0.015 + 0.030 + 0.010 + 0.010 + 0.020 + 0.010 + 0.010 + 0.020 + 0.010 = 0.135$$

For Profile B, the distance from the ideal is:

$$D_{B} = 0.090 + 0.075 + 0.060 + 0.020 + 0.060 + 0.040 + 0.060 + 0.050 + 0.060 = 0.515$$

These results highlight a significant divergence in tax compliance profiles. Profile A, characterized by stronger institutionalization, aligns much more closely with the neutrosophic ideal than Profile B. The largest discrepancies were found in regulatory knowledge ( $T_1$ ), regulatory uncertainty (I), and perceived injustice ( $F_3$ )—components where Profile B exhibits considerably lower performance.

This confirms that tax behavior in SMEs is not reducible to binary logic but is better understood through a multidimensional model where knowledge, ambiguity, and perceptions interact dynamically. The neutrosophic n-alectic approach thus provides both a diagnostic and strategic lens for designing targeted interventions in the fiscal governance of SMEs.

The main differences are observed in:

- Regulatory awareness (T<sub>1</sub>): The most notable gap is found in this component, where SMEs in Profile B show a value of just 0.3 compared to 0.8 in Profile A. This indicates that lack of regulatory awareness is one of the main factors generating tax conflicts.
- Regulatory uncertainty (I): SMEs in Profile B experience significantly higher levels of uncertainty (0.7) compared to those in Profile A (0.3), suggesting that a lack of resources to stay up-to-date on regulatory changes amplifies conflicts.

Rosalinda Jiménez Ávalos, María Josefa López Macedo, César Ulíses Marín Eléspuru, Américo Navor Gómez Barrera, Hugo Luis Zevallos Egoávil, Víctor Raúl Reátegui Paredes, Marcial Antonio Medina Vigo. A Neutrosophic N-Alectic Approach to Identifying the Causes of Tax Conflicts in Textile SMEs • Perception of injustice ( $F_3$ ): Profile B shows a high value (0.7) compared to Profile A (0.2), indicating that the subjective perception of the tax system is a relevant component in the generation of conflicts.

The n-alectic neutrosophic model used here allows us to go beyond simplistic binary classifications of compliance versus non-compliance. Instead, it reveals that tax conflicts in textile SMEs emerge from a multidimensional interplay of compliance factors (T), uncertainties (I), and non-compliance components (F), each with distinct causal weight.

From this analysis, the following main causes of tax conflicts can be identified:

- Regulatory ignorance: Lack of up-to-date and understandable information on specific tax obligations in the textile sector.
- Limited financial capacity: Difficulty maintaining adequate cash flow to meet tax obligations in a timely manner.
- Interpretative ambiguity: Gray areas in the interpretation of specific regulations, particularly regarding imports, input classification, and machinery treatment.
- Frequent regulatory changes: Volatility in tax frameworks, complicates long-term planning and increases perceived instability.
- Perception of inequity: The feeling that tax burdens are unfairly high compared to other sectors or informal competitors.

The application of neutrosophic n-alectics thus reveals the dynamic and layered nature of tax conflict causality in this sector. It highlights how knowledge, interpretation, resource constraints, and subjective perceptions co-exist in ambiguous and shifting regulatory terrains.

The analysis of neutrosophic distances supports the idea that SMEs with formalized tax management (Profile A) approximate the ideal neutrosophic tax profile more closely. However, even these enterprises are not exempt from challenges, particularly in managing evolving ambiguities and indeterminacies arising from complex legislation.

Based on these findings, the following actions are recommended:

- Sector-specific training programs: Tailored workshops and tax update sessions that address the unique realities of textile SMEs.
- Regulatory simplification: Streamlining of tax frameworks to reduce ambiguity and bureaucratic overload.
- Self-diagnosis tools: Implementation of instruments based on neutrosophic logic to help companies evaluate their tax compliance spectrum periodically.
- Gradual transition mechanisms: Support schemes to help informally managed SMEs evolve into structured, compliant entities.
- Positive reinforcement: Development of incentive-based programs that reward SMEs demonstrating alignment with the neutrosophic ideal of tax behavior.

This study demonstrates the analytical power of neutrosophic n-alectics as a conceptual and methodological framework. By formally integrating truth, indeterminacy, and falsity in a multidimensional space, it allows researchers and policymakers to detect patterns, gaps, and latent conflict drivers that conventional binary approaches overlook. Its application to the textile sector opens new possibilities for evidence-based tax policy design, rooted in contextualized and cognitively enriched understandings of enterprise behavior[25].

# 6. Conclusions

This study demonstrates the analytical power and practical relevance of neutrosophic n-alectics in modeling and understanding the causes of tax conflicts in textile SMEs. By extending classical binary and triadic frameworks, the n-alectic approach enabled the incorporation of multiple components of truth (T), indeterminacy (I), and falsity (F)—reflecting the real-world complexity of tax behavior and decision-making in this sector.

One of the central advantages of this methodology is its ability to simultaneously capture certainty, uncertainty, and contradiction across various factors, such as tax knowledge, financial capacity, regulatory ambiguity, and perceived injustice. This multidimensional representation goes far beyond traditional compliance vs. non-compliance categorizations, allowing for a more accurate diagnosis of the diverse causes and intensities of tax conflict.

The application of this framework revealed clear differentiation between structured and informal SME profiles, with Profile A (structured accounting) achieving a neutrosophic distance of 0.135 compared to 0.515 for Profile B (informal management). These findings indicate that formalization and institutional support significantly reduce the potential for tax disputes, though they do not eliminate the challenges posed by legal complexity and evolving norms.

The n-alectic approach also proved valuable for prioritizing policy interventions. Through the analysis, the most influential conflict-generating factors were identified: low tax literacy ( $T_1$ ), high regulatory uncertainty (I), and perceived inequity in tax enforcement ( $F_3$ ). These components not only affect compliance behavior but also shape SMEs' perceptions of the tax system and their willingness to formalize. In summary, neutrosophic n-alectics enabled:

- The systematic classification of causal factors into compliance, ambiguity, and non-compliance categories;
- A formal method to define and measure proximity to an ideal tax behavior profile;
- A flexible analytical structure capable of accommodating heterogeneous experiences, perceptions, and contexts;
- A tool for designing targeted policies, such as training programs, simplification of tax procedures, and differentiated support mechanisms for informal enterprises.

This study reaffirms the relevance of n-alectic thinking for the analysis of complex socio-economic problems, especially those involving regulatory friction and asymmetric access to institutional resources. Its application to the textile sector in Metropolitan Lima provides a template for further research and public policy design, not only in Peru but in other regions with similar challenges.

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