Pestel based on neutrosophic cognitive maps to characterize the factors that influence the consolidation of the neo constitutionalism in Ecuador

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Abstract. This paper analyzes the main contradictions existing in Ecuador for the consolidation of neo-constitutionalism, which is considered as; the new legal theory, which seeks to transform the rule of law into the constitutional rule of law, proposing for it; greater state intervention and creation of egalitarian democratic spaces and respect for human rights among state agencies and institutions. For this reason, the objective of this work is to characterize the factors that influence the consolidation of neo-constitutionalism in Ecuador, as an ideological and methodological theory of law. In order to characterize the factors that influence the consolidation of neo-constitutionalism in Ecuador, the PESTEL methodology based on neutrosophic cognitive maps is used, which constitutes a tool for the analysis of the environment that analyzes political, economic, social, technological, ecological and legal factors. A documentary analysis is carried out that deals with the pretentious materials of the institutionalization of neo-constitutionalism in Ecuador, from its contextualization.

Keywords: Neo constitutionalism, Rule of Law, Constitutional Rule of Law, State intervention, egalitarian democratic spaces, PESTEL, neutrosophic cognitive map.

1 Introduction

Neo-constitutionalism alludes to a new vision of the rule of law that starts from postmodern constitutionalism, its main characteristic is the primacy of the constitution over other legal norms and that constitute a distinction between rules as legal norms and principles as institutional norms. From the historical point of view, neo-constitutionalism has its starting point in the responses to the fascist legal-political regimes of 20th century Europe, especially Germany, Italy and Spain. Countries that were characterized by having three traditional models that have to their credit serious violations of human rights and the construction of a legal state of authoritarian rights[1] .

For[2] the fundamental feature that this constitutional tendency shares with the new Latin American constitutionalism or transformative constitutionalism is the strengthening of judges and in particular of constitutional judges and courts. It states that neo-constitutionalism arises in connection with the development of the process of constitutionalization of law and its intention is to overcome and replace juridical positivism.

According to the affirmation of the referred author, it is to emphasize that, for the neo-constitutionalism, the constitutionalization of the right once reached by a country, has as objective, that of dethroning to the classic positivism, as theory of the right. However, there are other aspects that constitute characteristic and important characteristics of the new Latin American constitutionalism, highlighting the strengthening of political participation, concern for equality and diversity, social and collective rights, constitutional regulation of the economy, openness to international law and secularism, as it refers[3].

In Ecuador, this system is reflected in the drafting of the 2008 Constitution, a state that guarantees rights and whose demands are made individually or collectively. In addition, the following categories of fundamental rights are established: good living, rights of individuals and priority groups, rights of communities, peoples and nationalities, rights of participation, rights of freedom, rights of nature, and rights of protection.

Refers [6], conducts a critical analysis of the system, referring to the categories of rights in the 2008 Constitution and points out that civil rights, considered as rights of freedom and social rights, are called rights of good living; political rights and are currently known as rights of participation. Five characteristics define the consolidation of neo-constitutionalism; in Ecuador, it defines[4].

a) Predominance of principles over rules
(b) Frequent use of the weighting technique to the detriment of subsumption
(c) Relevant and active presence of judges over legislators
(d) Recognition of evaluative pluralism as opposed to ideological homogeneity
(e) Invasive constitutionalism that permeates all areas of law

For Ecuador, the aforementioned characteristics emphasize the inclusion in the constitutional texts of principles such as the plurinational state, community democracy, the rights of nature and good living, which can be summarized in a broad and radical conception of democracy, understood beyond elections, in its political, cultural and economic dimensions as referred to [8]. With respect to the mediated conditions, the new Latin American constitutionalism, and particularly in Ecuador, has its own roots in the juridical currents of radical democracy, which developed in the continent in different historical periods.

Based on the above-mentioned characteristics, the PESTEL methodology is used, which, by its acronym, describes the Political, Economic, Social, Technological, Ecological and Legal factors, to analyze the factors that influence the consolidation of neo-constitutionalism in Ecuador. The PESTEL methodology offers a unilateral and temporary approach to the multipresentiality of the conditioning factors in a given system.[5]

The analysis through the PESTEL model, according to [9], without claiming the invention of the acronym "PESTEL". In this article, the PESTEL model integrates the factors shown in Figure 1 [5].

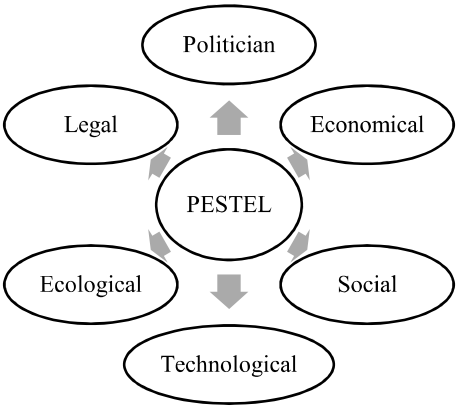

Figure 1: Factors that integrate the PESTEL analysis to characterize the most frequent contradictions and limitations on the consolidation of neo-constitutionalism in Ecuador. Source: Prepared by the authors.

In order to identify the variables corresponding to the most frequent contradictions and limitations on neo-constitutionalism in Ecuador, the environmental factors are grouped into the dimensions specified in Figure 1 using the PESTEL model, as referred to[6]. Once the main incident factors in the consolidation of neo-constitutionalism in Ecuador have been identified, PESTEL is analyzed with neutrosophic cognitive maps (NCM), in order to facilitate a greater interpretability of the results obtained.[7, 8]

NCMs are tools based on Neutrosophy, which was proposed for the treatment of neutrality. It has formed the basis for a series of mathematical theories that generalize classical and diffuse theories such as neutrosophic sets and neutrosophic logic.

The original definition of truth value in neutrosophic logic is shown as referring[6] as N = {(T,I,F): T,I,F ⊆ [0,1]} n, which represents a neutrosophic valuation, considered as a mapping of a group of propositional formulas to N, and for each sentence p to obtain the result through equation 1.

$$v(p) = (T, I, F) \quad (1)$$

Neutrosophic logic is a generalization of fuzzy logic, based on the concept of Neutrosophy according to [14, 15], where a neutrosophic matrix is a matrix where the elements $a = (a_{ij})$ are replaced by elements at $\langle R \cup I \rangle$, where $\langle R \cup I \rangle$ is an entire neutrosophic ring [9]. On the other hand, a neutrosophic graph is a graph in which at least one arc is a neutrosophic arc [10].

In a neutrosophic adjacency matrix[11, 12] the arcs that are equal to 0, mean that they do not have connection between nodes, if they are equal to 1, it means that they have connection between nodes, and if they are equal to I, it means that the connection is indeterminate (unknown if it is or not). Such notions are not used in diffuse theory.

On the other hand, if indeterminacy is introduced into a cognitive map as referred to [13], then that cognitive map is called a neutrosophic cognitive map, which is especially useful in the representation of causal knowledge .

3 Materials and Methods

In the present study, an analysis of PESTEL with neutrosophic cognitive maps is carried out to characterize the factors that influence the consolidation of neo-constitutionalism in Ecuador, from a descriptive methodology with quantitative method. The result obtained when using the descriptive methodology is feasible to define the characteristics of the factors that intervene in the PESTEL model related to the consolidation of neo-constitutionalism in Ecuador.

In accordance with the objective proposed in the present work, a framework is developed that facilitates the analysis of PESTEL based on neutrosophic cognitive maps [9]. The proposed framework is shown in Figure 2.

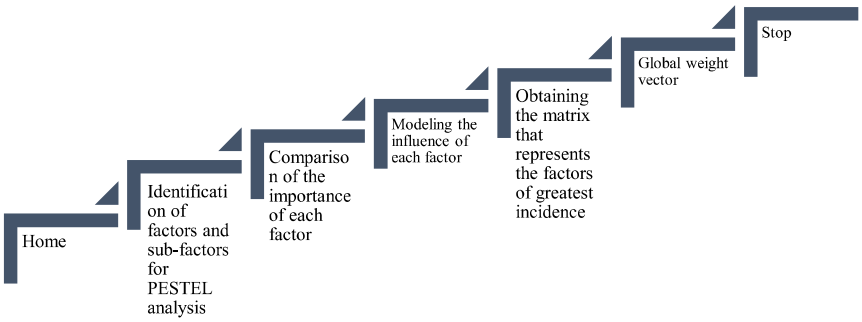

Figure 2: Framework for obtaining the characteristics to analyze in each factor of the PESTEL model based on neutrosophic cognitive maps. Source: Own elaboration.

The framework proposed in Figure 2 guides the process of obtaining the characteristics of each factor analyzed in the consolidation of neo-constitutionalism in Ecuador with the PESTEL model. The integrated structure of the factors that correspond to perform a PESTEL analysis and their characteristics are modeled through the use of a neutrosophic cognitive map, which contributes to obtaining a quantitative analysis of the characteristics that correspond to the analysis factors[10]. The following is a summary of the characteristics of each factor analyzed in the consolidation of neo-constitutionalism in Ecuador with the PESTEL model.

Neutrosophic cognitive maps are a generalization of fuzzy cognitive maps[14] . Fuzzy cognitive maps are introduced by Axelrod [15] where nodes represent concepts or variables in a given study area and arcs indicate positive or negative influences, which are considered causal relationships. They have been applied in several areas, especially in decision support and in the analysis of complex systems as referred to [16].

3 Results

The factors and characteristics of the PESTEL model obtained for the characterization of neo-constitutionalism in Ecuador are shown in Figure 3. The characteristics obtained and related to the factors of the PESTEL model are based on the framework proposed in Figure 2.

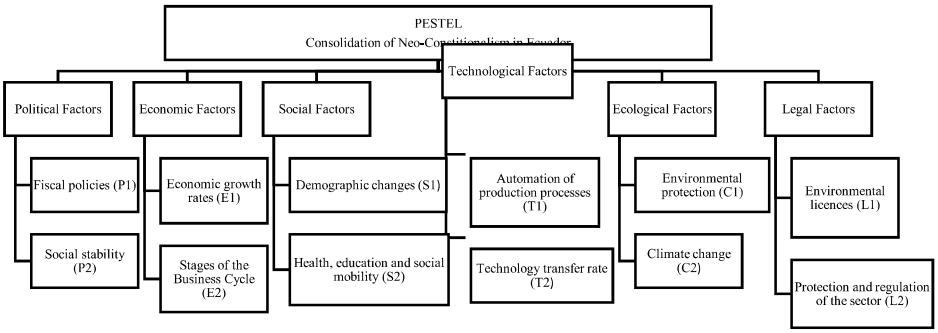

Figure 3: PESTEL hierarchical model for the characterization of neo-constitutionalism in Ecuador. Source: Prepared by the authors

Once the characteristics corresponding to the factors of the PESTEL model have been obtained, they are analyzed, through the characteristics of the PESTEL model, as a strategic analysis technique to define the context of a given area through the analysis of a series of external factors, as referred by [17]. The PESTEL analysis incorporates Ecological and Legal factors into the PEST analysis, for which reason a PEST analysis was previously carried out in this research to measure the impact of macro-environmental factors in terms of the characteristics present in the consolidation of neo-constitutionalism in Ecuador. The factors analyzed with the PEST technique were:

- Political factors; these factors are those related to the impact of any political or legislative change that may affect the consolidation of neo-constitutionalism in Ecuador.
- Economic factors; these factors are those referred to the economic affectations that institutions have, in the national, international or global order. The purchasing power related to the period of boom, recession, stagnation or recovery that the economy of the region under study is highlighted.
- Social factors; these factors focus on the forces that act within society and affect the attitudes, interests and opinions of those who influence decision-making.
- Technological factors; related to the use of technology, since it constitutes the driving force that contributes to an improvement in quality and entry barriers are reduced.

Once the macro-environmental factors have been established through the PEST technique, the external factors that influence the consolidation of neo-constitutionalism in Ecuador are defined, using the PESTEL technique. Factors obtained for the purpose of defining the context in which neo-constitutionalism is framed in Ecuador and measuring its consolidation. The factors that are analyzed through the PESTEL technique are, according to them:

1. Ecological factors
2. Legal Factors

The ecological factors analyzed in the consolidation of neo-constitutionalism in Ecuador correspond to the characteristics related to environmental protection and climate change. On the other hand, and with regard to legal factors, the characteristics related to environmental licenses and the protection and regulation of the sectors with the greatest impact on the consolidation of neo-constitutionalism are analyzed.

The results obtained with the analysis of PEST and PESTEL, where the characteristics that represent the factors under study are obtained, are presented in linguistic terms, so that in order to obtain a greater interpretability of them it is necessary to treat them in order to be able to quantify them. For this reason, in the present study, neutrosophic cognitive maps are used as a tool for the modeling of the characteristics related to the factors that influence the consolidation of neo-constitutionalism in Ecuador.

The neutrosophic cognitive map (NCM) is composed of a neutrosophic graph, in which at least one arc is a neutrosophic arc and this represents the present indetermination [12]. It is useful in the re-presentation of causal knowledge, as it allows the representation and analysis of indetermination [11].

Static analysis in a neutrosophic cognitive map [18]focuses on the selection of the most important concepts, characteristics or factors in the modeled system. The static analysis, referred to, is performed from the adjacency matrix, and is considered the absolute value of the weights.

A static analysis in MCN gives as initial result, a neutrosophic number of the form (a+bI, where I = indetermination). For its interpretation, a de-neutrosification process is required, as proposed by Salmerón and Smarandache.

In the De-Neutrosification process indetermination ($I \in [0,1]$) is replaced by its maximum and minimum values. Essentially, to perform a static analysis on a neutrosophic cognitive map the steps shown in Figure 4 must be followed.

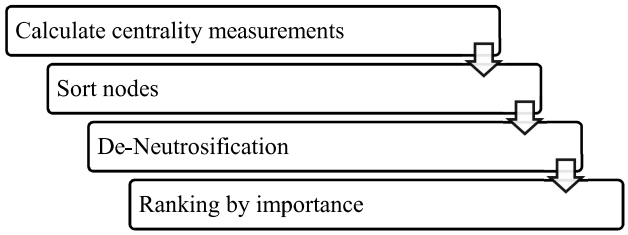

Figure 4: Steps to follow for static analysis in a neutrosophic cognitive map. Source: [5]

The measures described below are used in the proposed model; they are based on the absolute values of the

adjacency matrix:

Outdegree od(vi) is the sum of the rows in the neutrosophic adjacency matrix. It reflects the strength of the outgoing relations (cij) of the variable.

$$od(vi) = \sum_{i=1}^{n} c_{ij} \quad (2)$$

Indegree id(vi) is the sum of the columns, it reflects the strength of the outgoing relations (cij) of the variable.

$$id(vi) = \sum_{i=1}^{n} c_{ij} \quad (3)$$

Total degree (td(vi)), is the sum of the indegree and the outdegree of the variable.

$$td(vi) = od(vi) + id(vi) \quad (4)$$

For the evaluation of PESTEL factors with a neutrosophic cognitive map, the factors obtained with the PESTEL technique and the characteristics related to each factor that were represented hierarchically in Figure 3 are taken into account. In the present study, the MCN is developed by capturing knowledge. The generated neutrosophic adjacency matrix is shown in Table 1.

Nodes	P1	P2	E1	E2	S1	S2	T1	T2	C1	C2	L1	L2
P1	0	0	0	-0.3	0	0	0	0	0	0	0	0
P2	0	0	0	0	0	0	0.25	0	0	0	0	0
E1	0	0	0	0	0	0	0	0	0	0	0	0
E2	0	0	0	0	0	0	0	0.3	0	0	0	0
S1	0.4	I	0	0	0	0	0	0	0	0	0	0
S2	0	0	0	0	0	0	0	0	0	0	0	0
T1	0	0	0	0	0	0	0	0	0	0	0	0
T2	0	0	0	0.35	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0	0.25	0	0	0
C2	0	0	0	0	0	0	0	0	0	0	0	0
L1	0	0	0	0	0	0	0	0	0	0.30	0	0
L2	0	0	0	0	0	0	0	0	0	0	0	0.20

Table 1: Neutrosophic adjacency matrix. Source: Own elaboration.

The centrality measurements are calculated through the Outdegree and Indegree measurements, the results of which are shown in Table 2.

Nodes	Id	Od
P1	0.4	0.3
P2	I	0.25
E1	0	0.2
E2	1.05	0.3
S1	I	0.7+1
S2	0	I
T1	0.55	0.2
T2	0.3	0.35
C1	0.25	0
C2	0.30	0
L1	0	0.30
L2	0	0.20

Table 2: Measures of centrality, Outdegree, Indegree. Source: Prepared by the authors.

Once the measures of centrality have been calculated, the nodes of the neutrosophic cognitive map are classified, a classification shown in Table 3.

Nodes	Transmitte Node	Receiving Node	Ordinary
P1			X
P2			X
E1			X
E2	X		
S1			X

S2	X	
T1		X
T2		X
C1		X
C2		X
L1		X
L2		X

Table 3: Classification of the nodes. Source: Own elaboration.

According to the results shown in Table 3, the subsequent nodes are classified. In this case, E2 and S2 are the receiving nodes. The rest of the nodes are ordinary. The total degree td(vi) is calculated through equation 4, the results for our case study are shown in Table 4.

Nodes	td
P1	0.7
P2	0.25+I
E1	0.2
E2	1.35
S1	0.7+2I
S2	I
T1	0.75
T2	0.65
C1	0.25
C2	0.30
L1	0.30
L2	0.20

Table 4: Total centrality. Source: Prepared by the authors.

The next step is the process of De-Neutrosification as refer [10], where I ∈ [0,1], is replaced by maximum and minimum values. In Table 5, the values of the intervals are shown

Nodes	td
P1	0.7
P2	[0.25, 1.25]
E1	0.2
E2	1.35
S1	[0.7, 2.7]
S2	[0, 1]
T1	0.75
T2	0.65
C1	1.25
C2	1.30
L1	1.30
L2	1.20

Table 5: Neutrosification of the total centrality values. Source Own elaboration.

Finally, we work with the mean of the extreme values, which is calculated through equation 5, which is useful to obtain a single value according to [11]. Value that contributes to the identification of the characteristics according to the factors obtained with the PESTEL model, for our case study.

$$A > B \leftrightarrow {}^{(a_1 + a_2)}/_2 > {}^{(b_1 + b_2)}/_2 \qquad (5)$$

Then;

$$\lambda([a_1 + a_2]) = {}^{(a_1 + a_2)}/_2 \qquad (6)$$

Based on equation 5, we obtain the median of the extreme values to analyze the characteristics to attend according to the factors obtained through the PESTEL technique in this study. The results are shown in table 6.

Nodes	td
P1	0.7
P2	0.75
E1	0.2
E2	1.35
S1	1.7
S2	0.5
T1	0.75
T2	0.65
C1	1.25
C2	1.30
L1	1.30
L2	1.20

Table 6: Median of extreme values. Source Own elaboration.

From these numerical values the following order is obtained:

$$S_1 > E_2 > C2 > L1 > C1 > L2 > P_2 > T_1 > P_1 > T_2 > S_2 > E_1$$

The factors to consider for the consolidation of neo-constitutionalism in Ecuador are technological, political and economic.

Conclusion

This study characterizes the consolidation of neo-constitutionalism in Ecuador. The PESTEL technique is used, which contributed to the analysis of the environment and made it possible to identify the key factors that have a significant impact on neo-constitutionalism in Ecuador. The most influential characteristics of the consolidation of neo-constitutionalism in Ecuador are described for each identified factor.

The characteristics were modeled through the use of neutrosophic cognitive maps, with the interdependencies between the characteristics and the factors identified with the PESTEL technique, where from them a quantitative analysis was made, based on the static analysis provided by the use of neutrosophic cognitive maps.

It is demonstrated through the use of neutrosophic cognitive maps that for the consolidation of neo-constitutionalism in Ecuador, technological, political and economic factors must be taken into account.

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