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Analysis of an strategic plan to increase the sales level of the company "TIENS" of Babahoyo using neutrosophic methods

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Abstract. In the world, natural medicine is increasingly appreciated as a complement to conventional medicine that treats diseases with industrially produced drugs. Natural medicine is cheaper, more accessible than the other one; it usually has fewer contraindications and also carries empirical and traditional knowledge. In Ecuador it is a very popular alternative for the population. "TIENS" Company produces natural medicines, which has been facing the difficulty that its sales are appreciably decreasing. That is why the company performs an analysis to increase the sale levels of produced medicines. To perform the evaluation of the alternatives, the neutrosophic AHP-SWOT method is used. This method allows studying the Strengths, Weaknesses, Opportunities, and Threats of the company, which in its original form does not allow quantifications, that is why the AHP technique is incorporated to evaluate pair-wise comparisons of criteria. In the neutrosophic framework, AHP-SWOT takes into account the indeterminacy that exists in decision making processes.

Keywords: Analytic Hierarchy Process (AHP), SWOT analysis, naturopathy, sale strategies.

1 Introduction

At the moment in which conventional medicine fails to achieve results in spite of a certain disease, some patients and their families resort to the help of natural medicines. All Ecuadorians of any condition or social class have the right to have quality medical care, either with traditional or alternative medicine, with natural medicines that benefit them in the improvement and total recovery of their health.

Similarly, there is space for researchers and entrepreneurs to open the possibilities of bio-knowledge, bio-economics and biotechnology. This is to sponsor all the initiative that, based on the responsible use of biodiversity, allows generating new jobs and expanding the offer to promote healthy eating, sustainable real estate construction, a cosmetic and beverage industry with alternative products, among others. Access to information and environmental education are the basis for an informed, committed and co-responsible citizenship in the processes of changing patterns of consumption and habitat management. The understanding of eco-dependence, in addition, extends to the care and protection of wildlife, confirming the importance of life and dignity in its broad ethical sense, so it is necessary to protect animal welfare with regulations, public policy and express jurisprudence, clear and direct cultural and strengthen sovereignty, see [1].

Around the world, natural medicine moves billions of dollars. In Ecuador every year 40% of patients have first come to a naturopathic physician, who gives them the treatment based on natural medicines, so patients end up trying natural medicine, see [1]. In this country many of the companies that sell natural medicine use a very good promotion which attracts more consumers.

Natural medicine is increasingly placed in a better position among drug-based medicine, which generates many gains and prestige for many countries and entrepreneurs who enjoy these varieties of vegetables and plants. This has resulted in several individuals and private companies devoting themselves to the manufacture and sale of natural medicines that can be profitable in terms of the market. Several of the companies indicate that naturopathic medicine drives to prevent cancer, prevent aging, wrinkles, cellulite, hair loss and male sexual dysfunction problems.

Natural or Alternative Medicine has been regularized by the Ministry of Public Health (MSP), which makes it gaining an important part of the Ecuadorian market, which is why it has already been implemented and will

continue to be done in all health centers. Natural or Alternative Medicine is classified into two groups: Natural or Alternative Medicine that is exercised by physicians who have a fourth level degree with specialization in Acupuncture, Homeopathy, and Neural Therapy; and alternative therapies, which are made up of Naturopathy, Phytotherapy, and Floral Therapy, among other techniques, see [2-4][1].

The Company "TIENS" is located in the city of Babahoyo, its commercial activity aims to produce and distribute products made from natural medicine with the purpose of taking care of the health and integrity of society in general, see[2].

The main difficulty that the company is currently going through is the decrease in the sale of its products, which is why its profits have declined over the months. Among the main causes is the increase in competitors that is growing more and more in the market, with similar products or with the same benefits at the lowest price. The entry of new competitors affects their profitability and puts their sustainability at risk.

Another cause detected is that the person in charge of the company has limited sales knowledge, which results in many of the processes being carried out empirically without a strategic horizon. Bad promotion has also been detected and that there are no marketing strategies within the company. The purpose of this paper is to carry out an analysis and evaluation of the possible alternatives of strategies to increase the level of sales of the products of the company "TIENS".

This analysis is performed based on the neutrosophic AHP-SWOT analysis ([5]), which combines the AHP technique with the representation of the SWOT matrix (Strengths, Weaknesses, Opportunities, and Threads). The Analytical Hierarchy Process (AHP) technique is a structured technique for dealing with complex decisions, it helps decision makers to find the solution that best suits their needs and their understanding of the problem, see [6-8]. This is a tool based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined, since then, see [9]. When the hierarchy is built, decision makers systematically evaluate their elements to compare them with each other; only two elements are compared at a time. When comparisons are made, decision makers can use concrete data about the elements, or they can use their judgments about the importance and relative meaning of the elements. It is essential for the AHP that human judgments, and not only the underlying information, can be used to conduct evaluations.

AHP converts these assessments to numerical values or priorities. A numerical weight or priority is derived from each element of a hierarchy, allowing diverse and often immeasurable elements to be compared with each other in a rational and consistent manner. This facility distinguishes AHP from other decision-making techniques. In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the relative ability of the alternatives to achieve the objective of the decision, so as to allow a direct consideration of the different courses of action.

Conversely, the SWOT analysis ([10-13]) is a methodology for studying the situation of a company or a project, analyzing its internal characteristics (Weaknesses and Strengths) and its external situation (Threats and Opportunities) in a square matrix. This methodology presents as a limitation that by itself it does not offer a quantitative evaluation on the situation of the organization, which is why it can be found associated with other techniques, including AHP, see[3, 4] [14-17].

The neutrosophic AHP-SWOT combines the AHP with the SWOT in a neutrosophic framework, which allows quantitative calculations of Strengths, Weaknesses, Opportunities, and Threats, where the typical indeterminacies of decision-making are taken into account, as developed by Abdel-Basset et al. in [5][5].

This paper is divided according to the following structure, below is a section of preliminary concepts, describing the neutrosophic AHP-SWOT method, with all of its elements. Next, a section is devoted to analyze strategies of the company “TIENS” based on neutrosophic AHP-SWOT. We culminate with a final section dedicated to giving conclusions.

2 Preliminaries

This section describes the main concepts and methods used in neutrosophic AHP-SWOT, in particular, the SWOT technique, the AHP methodology, and the neutrosophic AHP.

2.1 AHP method

This subsection describes the main elements of the Neutrosophic AHP method.

Definition 1: ([18-19]) The *Neutrosophic set* N is characterized by three membership functions, which are the truth-membership function T_A, indeterminacy-membership function I_A, and falsity-membership function F_A, where U is the Universe of Discourse and $\forall x \in U$, $T_A(x)$, $I_A(x)$,$F_A(x) \subseteq]^-0, 1^+[$, and $^-0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$.

See that according to the definition, $T_A(x)$, $I_A(x)$ and $F_A(x)$ are real standard or non-standard subsets of $]^-0, 1^+[$ and hence, $T_A(x)$, $I_A(x)$ and $F_A(x)$ can be subintervals of [0, 1].

Definition 2: ([18-19]) The *Single-Valued Neutrosophic Set* (SVNS) N over U is $A = \{\langle x; T_A(x), I_A(x), F_A(x)\rangle : x \in U\}$, where $T_A: U \to [0, 1]$, $I_A: U \to [0, 1]$, and $F_A: U \to [0, 1]$, $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

The *Single-Valued Neutrosophic number* (SVNN) is symbolized by N = (t, i, f), such that 0 ≤t, i, f ≤ 1 and 0 ≤t + i + f≤ 3.

Definition 3: ([18-19]) The *single-valued trapezoidal neutrosophic number*,

$\tilde{a} = \langle (a_1, a_2. a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, is a neutrosophic set on $\mathbb{R}$, whose truth, indeterminacy and falsity membership functions are defined as follows, respectively:

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}}\left(\frac{x-a_1}{a_2-a_1}\right), & a_1 \le x \le a_2 \\ \alpha_{\tilde{a}}, & a_2 \le x \le a_3 \\ \alpha_{\tilde{a}}\left(\frac{a_4-x}{a_4-a_3}\right), & a_3 \le x \le a_4 \\ 0, \text{ otherwise} \end{cases} \quad (1)$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\beta_{\tilde{a}}(x-a_1))}{a_2-a_1}, & a_1 \le x \le a_2 \\ \beta_{\tilde{a}}, & a_2 \le x \le a_3 \\ \frac{(x-a_2+\beta_{\tilde{a}}(a_4-x))}{a_4-a_3}, & a_3 \le x \le a_4 \\ 1, & \text{otherwise} \end{cases} \quad (2)$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{(a_2-x+\gamma_{\tilde{a}}(x-a_1))}{a_2-a_1}, & a_1 \le x \le a_2 \\ \gamma_{\tilde{a}}, & a_2 \le x \le a_3 \\ \frac{(x-a_3+\gamma_{\tilde{a}}(a_4-x))}{a_4-a_3}, & a_3 \le x \le a_4 \\ 1, & \text{otherwise} \end{cases} \quad (3)$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0,1]$, $a_1, a_2, a_3, a_4 \in \mathbb{R}$ and $a_1 \le a_2 \le a_3 \le a_4$.

Definition 4: ([6][18-19]) Given $\tilde{a} = \langle (a_1, a_2, a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$ and $\tilde{b} = \langle (b_1, b_2, b_3, b_4); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$ two single-valued trapezoidal neutrosophic numbers and λ any non null number in the real line. Then, the following operations are defined:

7. Addition: $\tilde{a} + \tilde{b} = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$
8. Subtraction: $\tilde{a} - \tilde{b} = \langle (a_1 - b_4, a_2 - b_3, a_3 - b_2, a_4 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$
9. Inversion: $\tilde{a}^{-1} = \langle ({a_4}^{-1}, {a_3}^{-1}, {a_2}^{-1}, {a_1}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, where $a_1, a_2, a_3, a_4 \neq 0$.
10. Multiplication by a scalar number:
$$\lambda\tilde{a} = \begin{cases} \langle (\lambda a_1, \lambda a_2, \lambda a_3, \lambda a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda > 0 \\ \langle (\lambda a_4, \lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda < 0 \end{cases}$$
11. Division of two triangular neutrosophic numbers:
$$\frac{\tilde{a}}{\tilde{b}} = \begin{cases} \langle \left(\frac{a_1}{b_4}, \frac{a_2}{b_3}, \frac{a_3}{b_2}, \frac{a_4}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_4 > 0 \; and \; b_4 > 0 \\ \langle \left(\frac{a_4}{b_4}, \frac{a_3}{b_3}, \frac{a_2}{b_2}, \frac{a_1}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_4 < 0 \; and \; b_4 > 0 \\ \langle \left(\frac{a_4}{b_1}, \frac{a_3}{b_2}, \frac{a_2}{b_3}, \frac{a_1}{b_4}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, a_4 < 0 \; and \; b_4 < 0 \end{cases}$$
12. Multiplication of two triangular neutrosophic numbers:
$$\tilde{a}\tilde{b} = \begin{cases} \langle (a_1 b_1, a_2 b_2, a_3 b_3, a_4 b_4); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, & a_4 > 0 \; and \; b_4 > 0 \\ \langle (a_1 b_4, a_2 b_3, a_3 b_2, a_4 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, & a_4 < 0 \; and \; b_4 > 0 \\ \langle (a_4 b_4, a_3 b_3, a_2 b_2, a_1 b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle, & a_4 < 0 \; and \; b_4 < 0 \end{cases}$$

Where, $\wedge$ is a t-norm and $\vee$ is a t-conorm.

Let us observe that when we set $a_2 = a_3$ in Definitions 3 and 4, then the single-valued trapezoidal neutrosophic number is called a *single-valued triangular neutrosophic number*, see [20].

Next, for the modeling we have to apply the NAHP. We propose a linguistic scale by using triangular neutrosophic numbers as can be seen in Table 1, see also the scale defined in [5].

In [5, 8] there is a combination of AHP with neutrosophic set theory. This combination permits to model the indeterminacy typical of every decision-making process.

See Equation 4 for appreciating the neutrosophic pair-wise comparison matrix.

$$\tilde{A} = \begin{bmatrix} \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & \tilde{1} \end{bmatrix} \quad (4)$$

Matrix $\tilde{A}$ satisfies the condition $\tilde{a}_{ji} = \tilde{a}_{ij}^{-1}$, based on the inversion operator of Definition 4.

Two indices to convert neutrosophic triangular numbers in crisp numbers are defined in [5]. These are the score and accuracy Equations, respectively, see Equations 5 and 6:

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \quad (5)$$

$$\mathbf{A}(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (6)$$

Saaty scale	Definition	Neutrosophic Triangular Scale
1	Equally influential	$\tilde{1} = \langle(1,1,1); 0.50, 0.50, 0.50\rangle$
3	Slightly influential	$\tilde{3} = \langle(2,3,4); 0.30, 0.75, 0.70\rangle$
5	Strongly influential	$\tilde{5} = \langle(4,5,6); 0.80, 0.15, 0.20\rangle$
7	Very strongly influential	$\tilde{7} = \langle(6,7,8); 0.90, 0.10, 0.10\rangle$
9	Absolutely influential	$\tilde{9} = \langle(9,9,9); 1.00, 1.00, 1.00\rangle$
2, 4, 6, 8	Sporadic values between two close scales	$\tilde{2} = \langle(1,2,3); 0.40, 0.65, 0.60\rangle$
		$\tilde{4} = \langle(3,4,5); 0.60, 0.35, 0.40\rangle$
		$\tilde{6} = \langle(5,6,7); 0.70, 0.25, 0.30\rangle$
		$\tilde{8} = \langle(7,8,9); 0.85, 0.10, 0.15\rangle$

Table 1: Saaty's scale translated to a neutrosophic triangular scale.

2.2 The Neutrosophic AHP-SWOT

This subsection is dedicated to explain the algorithm of Neutrosophic AHP-SWOT, introduced in [5]. In the following we describe the algorithm used by Abdel-Basset et al.

Step 1 Select a group of experts at performing SWOT analysis.

In this step, experts identify the internal and the external factors of the SWOT analysis by employing questionnaires/interviews. Figure 1 presents the SWOT analysis diagram:

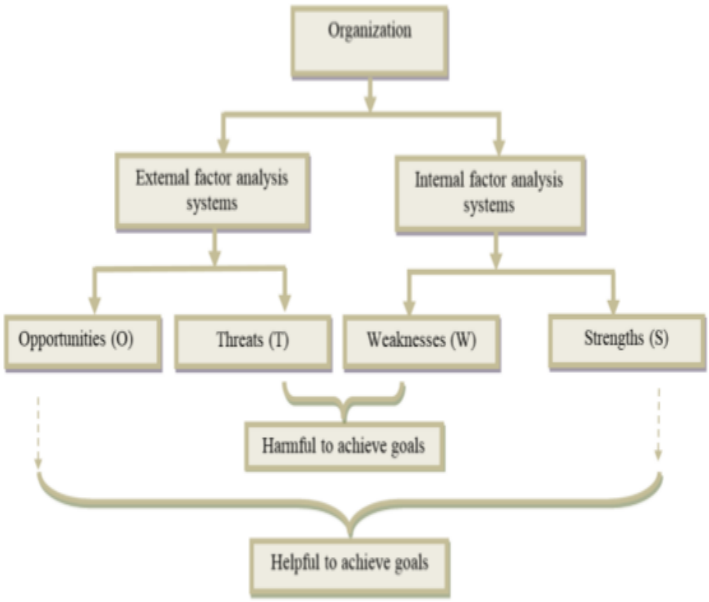

Figure 1: Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis diagram. Source [5].

Step 2 Structure the hierarchy of the problem.

The hierarchy of the problem has four levels:

- The first level is the goal the organization wants to achieve.
- The second level consists of the four strategic criteria that are defined by the SWOT analysis (i.e., criteria).

- The third level contains the factors that are included in each strategic factor of the previous level (i.e., sub-criteria).
- The final level includes the strategies that should be evaluated and compared. The general hierarchy is presented in Figure 2.

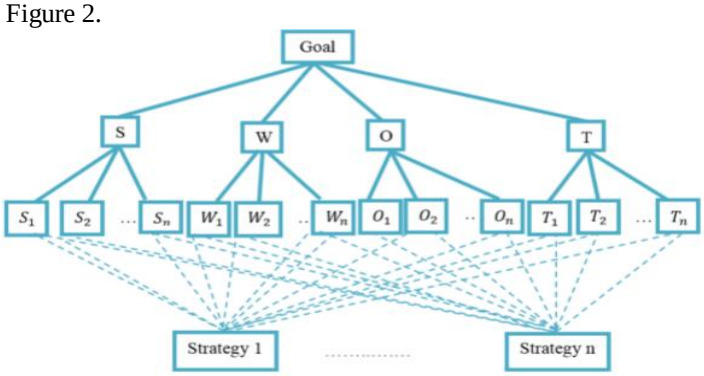

Figure 2: The hierarchy of a problem. Source [5].

Step 3 Structure the neutrosophic pair-wise comparison matrix of factors, sub-factors and strategies, through the linguistic terms which are shown in Table 1.

The neutrosophic scale is attained according to expert opinions. The neutrosophic pair-wise comparison matrix of factors, sub-factors and strategies are as Equation 4.

Step 4 Check the consistency of experts' judgments.

If the pair-wise comparison matrix has a transitive relation, i.e., $a_{ik} = a_{ij}a_{jk}$ for all i,j and k, then the comparison matrix is consistent, focusing only on the lower, median and upper values of the triangular neutrosophic number of the comparison matrix.

Step 5 Calculate the weight of the factors (S, W, O, T), sub-factors $\{(S_1,...,S_n), (W_1,...,W_n), (O_1,...,O_n),(T_1,...,T_n)\}$ and strategies/alternatives (Alt_1, ... , Alt_n) from the neutrosophic pair-wise comparison matrix, by transforming it to a deterministic matrix using Equations 7 and 8.

To get the score and the accuracy degree of $\tilde{a}_{ji}$ the following equations are used:

$$S(\tilde{a}_{ji}) = {}^{1}\!/_{S(\tilde{a}_{ij})} \quad (7)$$

$$A(\tilde{a}_{ji}) = {}^{1}\!/_{A(\tilde{a}_{ij})} \quad (8)$$

With compensation by accuracy degree of each triangular neutrosophic number in the neutrosophic pair-wise comparison matrix, we derive the following deterministic matrix:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{bmatrix} \quad (9)$$

Determine the ranking of priorities, namely the Eigen Vector X, from the previous matrix as follows:

1. Normalize the column entries by dividing each entry by the sum of the column.
2. Take the total of the row averages.

Step 6 Calculate the total priority of each strategy (alternative) for the final ranking of all strategies using Equation 10.

The total weight value of the alternative j (j = 1,...,n) can be n as follows:

$$Tw_{Alt_j} = w_S * \sum_{i=1}^{n} w_{S_i} * w_{Alt_j} + w_W * \sum_{i=1}^{n} w_{W_i} * w_{Alt_j} + w_O * \sum_{i=1}^{n} w_{O_i} * w_{Alt_j} + w_T * \sum_{i=1}^{n} w_{T_i} * w_{Alt_j} \quad (10)$$

where (i = 1,...,n) and (w_S,w_W,w_O,w_T) are the weights of Strengths, Weaknesses, Opportunities and Threats; (w_{Si},w_{Wi},w_{Oi},w_{Ti}) are the sub-factor weights; and w_{Alt_j} is the weight of the alternative j, corresponding to its sub-factor.

See that Step 4 refers to consider when applying this technique, this is by using the calculus of the *Consistency Index* (CI), which is function depending on λ_{max}, the maximum eigenvalue of the matrix. Saaty establishes that consistency of the evaluations can be determined by equation $CI = \frac{\lambda_{max} - n}{n-1}$, where n is the order of the matrix. Also, the *Consistency Ratio* (CR) is defined by equation CR = CI/RI, where RI is given in Table 2.

Order (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Table 2: RI associated to every order.

If CR≤0.1 we can consider that experts' evaluation is sufficiently consistent and hence we can proceed to use AHP. We apply this procedure to matrix A in Equation 9.

3 Results

In the following we present the results obtained from applying the neutrosophic AHP-SWOT method to analyze the strategic plans that was designed to increase the sales of the company "TIENS". We will begin by showing the factors that constitute Strengths, Weaknesses, Opportunities, and Threats detected by the managers and specialists of the company, see [1][7].

Table 3 contains the obtained SWOT matrix.

STRENGTHS	WEAKNESSES
S_1: Value added to product	W_1: Little financial margin
S_2: Low prices, discounts and promotions	W_2: Lack of capacity to meet demand
S_3: High academic level of human talent	W_3: Lack of ability to compete with prices
S_4: High level of operating software	
OPPORTUNITIES	**THREATS**
O_1: Location in the downtown area of the City	T_1: New competitors
O_2: Strategic alliances with suppliers	T_2: Economic instability
O_3: Application of technology	T_3: Unfair Competition

Table 3: SWOT Matrix corresponding to the "TIENS" Company.

In addition, managers and specialists determined to apply the following strategies to improve the company's sales level:

Alt_1. Cost leadership strategy: it is based on the company obtaining a competitive advantage in relation to costs, that is, the company produces its products using lower costs and at the same time is efficient in all areas of production, marketing and all those that have relationship with production.

Alt_2. Organizational Growth Strategy: This strategy has as main foundation that the company prospers when it increases the sales of its products, because it manages to expand.

Alt_3. Promotion and advertising strategies: The "TIENS" Company will carry out advertising and promoting strategies to publicize the variety of its products and at the same time motivate people to acquire them, and also let all the people know about the benefits for the health that possesses each of its products.

There was a team of 4 experts, who were asked to evaluate the criteria and sub-criteria. The group decision assessments were obtained by calculating the median of experts' individual evaluations over the same aspect. The calculations were supported on the software Octave 4.2.1, see [21].

Table 4 contains the neutrosophic pair-wise comparison matrix between Strengths, Weaknesses, Opportunities, and Threats.

Factors	**Strengths**	**Weaknesses**	**Opportunities**	**Threats**
Strengths	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$	$1/\tilde{2}$
Weaknesses	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$	$1/\tilde{3}$
Opportunities	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$	$1/\tilde{2}$
Threats	$\tilde{2}$	$\tilde{3}$	$\tilde{2}$	$\tilde{1}$

Table 4: The neutrosophic comparison matrix of Strengths, .Weaknesses, Opportunities, and Threats.

Table 5 contains the crisp values of Table 4, after applying Equation 6.

Factors	Strengths	Weaknesses	Opportunities	Threats
Strengths	1	1	1	0.56738
Weaknesses	1	1	1	0.39507
Opportunities	1	1	1	0.56738
Threats	1.7625	2.5312	1.7625	1

Table 5: The crisp comparison matrix of factors.

This matrix satisfies CR = 0.0061536≤0.1.
The following vector of the normalized matrix was obtained from Table 5:

$$X = \begin{bmatrix} 0.20625 \\ 0.18923 \\ 0.20625 \\ 0.39827 \end{bmatrix}$$

Table 6 contains the comparison matrix between the Strengths.

Strengths	S_1	S_2	S_3	S_4
S_1	$\tilde{1}$	$\tilde{3}$	$\tilde{1}$	$\tilde{5}$
S_2	$1/\tilde{3}$	$\tilde{1}$	$1/\tilde{5}$	$\tilde{2}$
S_3	$\tilde{1}$	$\tilde{5}$	$\tilde{1}$	$\tilde{5}$
S_4	$1/\tilde{5}$	$1/\tilde{2}$	$1/\tilde{5}$	$\tilde{1}$

Table 6: The neutrosophic comparison matrix of Strengths.

Table 7 contains the crisp values of Table 6, after applying Equation 6.

Strengths	S_1	S_2	S_3	S_4
S_1	1	2.5312	1	5.3438
S_2	0.39506	1	0.18713	1.7625
S_3	1	5.3438	1	5.3438
S_4	0.18713	0.56738	0.18713	1

Table 7: The crisp comparison matrix of Strengths.

This matrix satisfies CR = 0.021625≤0.1.
The following vector of the normalized matrix was obtained from Table 7:

$$X = \begin{bmatrix} 0.368447 \\ 0.117185 \\ 0.442914 \\ 0.071445 \end{bmatrix}$$

Table 8 contains the comparison matrix between the Weaknesses.

Weaknesses	W_1	W_2	W_3
W_1	$\tilde{1}$	$1/\tilde{2}$	$1/\tilde{4}$
W_2	$\tilde{2}$	$\tilde{1}$	$1/\tilde{3}$
W_3	$\tilde{4}$	$\tilde{3}$	$\tilde{1}$

Table 8: The neutrosophic comparison matrix of Weaknesses.

Table 9 contains the crisp values of Table 8, after applying Equation 6.

Weaknesses	W_1	W_2	W_3
W_1	1	0.56738	0.25157
W_2	1.7625	1	0.39506
W_3	3.9750	2.5312	1

Table 9: The crisp comparison matrix of Weaknesses.

This matrix satisfies CR = 0.0014135≤0.1.
The following vector of the normalized matrix from Table 9 was obtained:

$$X = \begin{bmatrix} 0.14655 \\ 0.24850 \\ 0.60496 \end{bmatrix}$$

Table 10 contains the comparison matrix between the Opportunities.

Opportunities	**O₁**	**O₂**	**O₃**
O₁	$\tilde{1}$	$\tilde{1}$	$\tilde{3}$
O₂	$\tilde{1}$	$\tilde{1}$	$\tilde{3}$
O₃	$1/\tilde{3}$	$1/\tilde{3}$	$\tilde{1}$

Table 10: The neutrosophic comparison matrix of Opportunities.

Table 11 contains the crisp values of Table 10, after applying Equation 6.

Opportunities	**O₁**	**O₂**	**O₃**
O₁	1	1	2.5312
O₂	1	1	2.5312
O₃	0.39506	0.39506	1

Table 11: The crisp comparison matrix of Opportunities.

This matrix satisfies CR = 0≤0.1.
The following vector of the normalized matrix from Table 11 was obtained:

$$X = \begin{bmatrix} 0.41752 \\ 0.41752 \\ 0.16495 \end{bmatrix}$$

Table 12 contains the comparison matrix between the Threats.

Threats	**T₁**	**T₂**	**T₃**
T₁	$\tilde{1}$	$1/\tilde{5}$	$1/\tilde{3}$
T₂	$\tilde{5}$	$\tilde{1}$	$\tilde{3}$
T₃	$\tilde{3}$	$1/\tilde{3}$	$\tilde{1}$

Table 12: The neutrosophic comparison matrix of Threats.

Table 13 contains the crisp values of Table 12, after applying Equation 6.

Threats	**T₁**	**T₂**	**T₃**
T₁	1	0.18713	0.39506
T₂	5.3438	1	2.5312
T₃	2.5312	0.39506	1

Table 13: The crisp comparison matrix of Threats.

This matrix satisfies CR = 0.0035≤0.1.
The following vector of the normalized matrix from Table 13 was obtained:

$$X = \begin{bmatrix} 0.11052 \\ 0.62628 \\ 0.26320 \end{bmatrix}$$

Table 14 summarizes the comparison of each strategy from the point of view of each factor and sub-factor.

Factors/Sub-Factors	**Weight**	**Strategies**		
		Alt₁	**Alt₂**	**Alt₃**
Strengths	0.20625			
S₁	0.368447	0.38950	0.38950	0.22099

S_2	0.117185	0.33333	0.33333	0.33333
S_3	0.442914	0.33333	0.33333	0.33333
S_4	0.071445	0.26578	0.26578	0.46844
Weaknesses	0.18923			
W_1	0.14655	0.41753	0.41753	0.16495
W_2	0.24850	0.41753	0.41753	0.16495
W_3	0.60496	0.50568	0.30746	0.18687
Opportunities	0.20625			
O_1	0.41752	0.22069	0.22069	0.55862
O_2	0.41752	0.41753	0.41753	0.16495
O_3	0.16495	0.457219	0.457219	0.085561
Threats	0.39827			
T_1	0.11052	0.33333	0.33333	0.33333
T_2	0.62628	0.57675	0.30843	0.11482
T_3	0.26320	0.26578	0.26578	0.46844
Total		0.41803	0.32841	0.25356
Rank of Strategies		1	2	3

Table 14: Comparing strategies respect to SWOT factors and sub-factors and their ranking.

According to the results in Table 14, the strategies are ordered in the following order: $\mathrm{Alt}_1 \succ \mathrm{Alt}_2 \succ \mathrm{Alt}_3$.

Conclusion

This paper was dedicated to study and evaluate three strategies to increase the sales of natural medicines produced by the "TIENS" Company in the city of Babahoyo in Ecuador. For this end, the neutrosophic AHP-SWOT method was applied. This method has the advantages of each of the incorporated techniques, theories and methods. SWOT permits the representation of the four aspects that prejudice or benefit company performance, both internally and externally, however this representation alone does not permit the quantification of these advantages. Thus, AHP combined with SWOT allows the assessment of the company's situation quantitatively. For its part, neutrosophic theory lets the modeling of the imprecision contained in any decision-making process. Four experts carried out evaluations and it was concluded that the best strategy is the "Cost Leadership Strategy", followed by the "Organizational Growth Strategy" and finally the "Promotion and Advertising Strategies". Although in principle these three strategies are not mutually exclusive, if one of them had to be selected, the order of priority is given. Future works by the authors of this paper include the study of the impact of applying these strategies in the company.

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