A proposed SWOT analysis method for integrating indeterminate Likert scale with the neutrosophic AHP

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Abstract

In the fast-paced world of business decision-making, where clarity and precision are vital, an integrated approach that combines the indeterminate Likert scale with the neutrosophic Analytical Hierarchy Process (AHP) offers a fresh and enriching perspective for SWOT analysis. This innovative methodology not only allows us to capture the ambiguity inherent in human evaluations, but also enhances analytical depth by incorporating neutrosophic thinking, which considers elements of truth, falsehood and indeterminacy. Instead of traditional methods that often oversimplify complexities, this integrated approach facilitates a more nuanced and holistic assessment of strengths, weaknesses, opportunities and threats, thus providing a more robust and reliable basis for formulating business strategies. Additionally, the adoption of the indeterminate Likert scale, fused with the neutrosophic AHP, introduces conceptual flexibility that is particularly useful in contexts of uncertainty and changing market dynamics. This approach not only allows decision makers to better capture the subjective and often contradictory perceptions of experts, but also facilitates the weighing of multiple criteria in a coherent and logical manner. Doing so ensures that the strategies developed are not only thoughtful and detailed, but also adaptable to the fluctuating realities of the modern business environment. In short, this integrated approach is presented as a powerful and versatile tool for strategic planning, capable of transforming complex challenges into tangible opportunities through a deep and balanced understanding of organizational reality.

Keywords: Indeterminate Likert Scale; Neutrosophic AHP; SWOT; Analytical Hierarchy Process

1. Introduction

In the field of business management, precision in decision making is a determining factor for the success of any organization. In this context, SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) has been a widely used tool to evaluate and develop effective strategies. However, the complexity and dynamics of the modern business environment require more sophisticated and adaptive approaches that can handle the ambiguity and uncertainty inherent in strategic evaluation [1]. Traditionally, SWOT analysis has been based on methods that, although effective, may be insufficient by not fully capturing the subjectivity and indeterminacy of human perceptions. This is where an integrated approach combining the indeterminate Likert scale and the neutrosophic Analytical Hierarchy Process (AHP) emerges as an innovative and robust solution. This approach allows for a more nuanced and accurate assessment of the internal and external factors affecting an organization, thus providing a stronger basis for strategic decision making [2].

The indeterminate Likert scale, unlike its traditional version, introduces a layer of flexibility and complexity by allowing the inclusion of indeterminate values. This is crucial in situations where responses are not clearly

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definable or where significant levels of uncertainty exist. By integrating this scale with the neutrosophic AHP, a synthesis of qualitative and quantitative evaluations is achieved, which facilitates a more coherent and logical ranking of strategic criteria [3]. The neutrosophic AHP, for its part, is an extension of the traditional AHP that incorporates neutrosophic thought, which considers not only the elements of truth and falsehood, but also those of indeterminacy. This framework allows for better handling of the complexity and ambiguity of strategic problems, providing a richer and more detailed assessment of the available options. By applying this approach to SWOT analysis, a more complete and balanced view of strengths, opportunities, weaknesses and threats is achieved [4].

The combination of the indeterminate Likert scale and the neutrosophic AHP not only improves the accuracy of the SWOT analysis, but also facilitates greater adaptability to changing conditions in the business environment. This integrated approach allows decision makers to more effectively capture the subjective and often contradictory perceptions of experts, which is crucial for developing strategies that are both thoughtful and dynamic. Furthermore, this approach provides a powerful tool for strategic planning, capable of transforming complex challenges into tangible opportunities through a deep and balanced understanding of organizational reality [5]. By allowing for a more detailed and nuanced evaluation of internal and external factors, it ensures that the strategies developed are more robust and effective. The use of the indeterminate Likert scale in combination with the neutrosophic AHP also introduces a methodology that is particularly useful in contexts of high uncertainty and volatility. This is especially relevant in the modern business environment, where conditions can change rapidly and organizations must be able to adapt with agility and precision. In summary, the adoption of an integrated approach using the indeterminate Likert scale and the neutrosophic AHP for SWOT analysis represents a significant evolution in strategic evaluation methodology. This approach not only improves the accuracy and adaptability of business strategies, but also provides a stronger and more reliable basis for decision making in an increasingly complex and dynamic business environment [6].

This article therefore explores in detail the benefits and applications of this integrated approach, demonstrating how it can transform the strategic analysis process and significantly improve the effectiveness of planning and decision making in organizations. Through a series of examples and case studies, it is illustrated how the combination of the indeterminate Likert scale and the neutrosophic AHP can provide a richer and more detailed understanding of strategic challenges and opportunities.

2. Related work

2.1. Neutrosophic sets

Several key explanations of neutrosophic sets are presented in this segment.

Definition 1[7]: Within the framework of neutrosophic logic, a set N is delineated by a trio of membership functions: the truth membership function, T_A,the indeterminacy membership function I_A,, and the falsity membership function. F_A.Here, U represents the universal set, and for each element x within U , $T_{A(x)}, I_{A(x)}, and\ F_{A(x)}$there are subsets of the interval $]-0,1^{+}[$. It is established that the minimum$T_{A(x)}, I_{A(x)}, and\ F_{A(x)}$ cumulatively they are limited below 0 and their maximum cumulatively does not exceed 3. In particular, $T_{A(x)}, I_{A(x)}, and\ F_{A(x)}$ they could constitute subintervals within [0, 1]. [4,13]

Definition 2[8] : The construction of a single-valued neutrosophic set (SVNS) N within the universe U is articulated as $A = \{< x;\ T_{A(x)}, I_{A(x)}, F_{A(x)} > : x \in U\}$c, where $T_A: U \to [0, 1], I_A: U \to [0, 1]$,y $F_A: U \to [0, 1]$is such that the sum $T\_A(x) + I\_A(x) + F\_A(x)$ is restricted within the interval [0, 3].

The *single-valued neutrosophic number* (SVNN) is represented by N = (t, i, f), such that 0 ≤t, i, f ≤1 and 0 ≤t + i + f ≤3.

Definition 3: [9] The *single-valued trapezoidal neutrosophic number* represents $\tilde{a} = \langle (a_1, a_2. a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$a neutrosophic set over the real numbers ℝ, where its membership functions of truth, indeterminacy and falsity are defined respectively. This constructs a more nuanced representation of neutrosophic values, accommodating a broader interpretation within the spectrum of truth, indeterminacy and falsity: [8]

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

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

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

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

Definition 4[9]: Given $\tilde{a} = \langle(a_1, a_2, a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$two $\tilde{b} = \langle(b_1, b_2, b_3, b_4); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}}\rangle$trapezoidal neutrosophic numbers of a single value and λany non-zero number on the real line. Then, the following operations are defined: [7,14]

Addition: $\tilde{a} + \tilde{b} = \langle(a_1 + b_1, a_2 + b_2, a_3 + b_3, a_4 + b_4); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle$ (4)

Subtraction:$\tilde{a} - \tilde{b} = \langle(a_1 - b_4, a_2 - b_3, a_3 - b_2, a_4 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle$ (5)

Investment:, $\tilde{a}^{-1} = \langle(a_4{}^{-1}, a_3{}^{-1}, a_2{}^{-1}, a_1{}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$where $a_1, a_2, a_3, a_4 \neq 0$. (6)

Multiplication by a scalar number:$\lambda\tilde{a} = \begin{cases} \langle(\lambda a_1, \lambda a_2, \lambda a_3, \lambda a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle, & \lambda > 0 \\ \langle(\lambda a_4, \lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle, & \lambda < 0 \end{cases}$ (7)

Division by a scalar number: $\frac{\tilde{a}}{\lambda} = \begin{Bmatrix} \langle(\frac{a_1}{\lambda}, \frac{a_2}{\lambda}, \frac{a_3}{\gamma\lambda}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle \ if\ (\lambda > 0) \\ \langle(\frac{a_3}{\gamma\lambda}, \frac{a_2}{\lambda}, \frac{a_1}{\lambda}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \beta\gamma_{\tilde{a}}\rangle \ if\ (\lambda < 0) \end{Bmatrix}$ (8)

Division: $\frac{\tilde{a}}{\tilde{b}} = \begin{cases} \langle(\frac{a_1}{b_3}, \frac{a_2}{b_2}, \frac{a_3}{b_1}); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \theta\beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle \ if\ (a_3 > 0, b_3 > 0) \\ \langle(\frac{a_3}{b_3}, \frac{a_2}{b_2}, \frac{a_1}{b_1}); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle \ if\ (a_3 < 0, b_3 > 0) \\ \langle(\frac{a_3}{b_1}, \frac{a_2}{b_2}, \frac{a_1}{b_3}); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle \ if\ (a_3 < 0, b_3 < 0) \end{cases}$ (9)

2.2. Neutrosophic AHP (NAHP) in SWOT analysis

In the implementation of the Neutrosophic Analytic Hierarchy Process (AHP), a linguistic scale can be employed as an alternative to a numerical scale, offering a more intuitive means for experts to make evaluations [10,11,12] . The original numerical scale proposed by Saaty thus becomes a linguistic scale, as illustrated in Table 1. This adaptation facilitates the evaluation of ethical components within the supply chain through linguistic terms, which experts find more acceptable. . Compared to numerical evaluations.

Table 1: Saaty Scale translated into a Triangular Neutrosophic Scale. Source: [9]

saty 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 influential	$\tilde{7} = \langle(6,7,8); 0.90, 0.10, 0.10\rangle$
9	Absolutely influential	$\tilde{9} = \langle(9,9,9); 1.00, 1.00, 1.00\rangle$

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The SWOT-NAHP methodology involves the execution of the following steps [13]:

Step 1: Assemble a team made up of people trained in the SWOT analysis process. In this initial stage, the team uses questionnaires or interviews to outline crucial internal and external elements to perform the SWOT analysis.

To convert a complex theme into a simpler and more understandable framework, perform the following step:

Step 2: Develop a hierarchical structure for the problem at hand.

This hierarchical structure consists of four levels: The first level is related to the objective that the organization seeks to achieve. The second level includes the four strategic factors identified by the SWOT analysis, called "criteria." The third level involves the specific components within each strategic factor outlined in the previous level, called "sub-criteria." The final level contains the strategies that will be evaluated and compared, recognizing that the central theme revolves around supply chain ethics.

The next step is to evaluate the relative importance of the criteria, sub-criteria and (alternative) strategies based on the experience of specialists.

Step 3: Formulate the neutrosophic pairwise comparison matrix for the criteria, sub-criteria and strategies using the linguistic terms specified in Table 1. This stage is based on synthesizing expert opinions to evaluate the interrelationships and importance of these elements within the context of ethics. supply chain management.

The derivation of the neutrosophic scale is based on the consensus of expert judgment.

Consequently, pairwise neutrosophic comparison matrices are constructed for criteria, sub-criteria and strategies:

$$\tilde{A} = \begin{bmatrix} \tilde{1} & \tilde{a}_{12} \cdots & \tilde{a}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} \cdots & \tilde{1} \end{bmatrix} \quad (10)$$

The matrix $\tilde{A}$ must satisfy the condition $\tilde{a}_{ji} = \tilde{a}_{ij}^{-1}$, according to the inversion operator of Definition 4.

Step 4: involves evaluating the consistency of the experts' assessments. This step is essential to determine the consistency of the pairwise comparison matrix by checking if it maintains a transitive relationship, specifically when $a_{ik} = a_{ij a_{jk}}$ the condition is met for each possible trio of i , j and k . The focus of this consistency check is on the lower, middle, and upper limits of the triangular neutrosophic numbers represented in the comparison matrix, ensuring that these values adhere to the principle of transitivity in all element comparisons.

In Step 5, the task is to calculate the weights of the factors (S, W, O, T), sub-factors $\{(S_1, \dots, S_n), (W_1, \dots, W_n), (O_1, \dots, O_n), (T_1, \dots, T_n)\}$,and strategies/alternatives ($Alt_1, \dots, Alt_n$)derived from the data in the neutrosophic pairwise comparison matrix. The process involves transforming the neutrosophic matrix to a deterministic format through the application of specific equations. This conversion is essential to facilitate the quantitative analysis of the matrix, allowing the calculation of weights that reflect the relative importance of each factor, subfactor and strategy within the context of the analysis.

Let us represent $\tilde{a}_{ij} = \langle (a_1, b_1, c_1), \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$a singular triangular neutrosophic number; so,

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \quad (11)$$

and

$$A(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (12)$$

What are the grades of punctuation and precision $\tilde{a}_{ij}$respectively?

To obtain the score and the degree of precision of $\tilde{a}_{ij}$, the following equations are used:

$$S(\tilde{a}_{ji}) = 1/S(\tilde{a}_{ij}) \quad (13)$$

$$A(\tilde{a}_{ji}) = 1/A(\tilde{a}_{ij}) \quad (14)$$

By evaluating and scoring each triangular neutrosophic number within the pairwise neutrosophic comparison matrix, we obtain the following deterministic matrix:

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$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{bmatrix} \quad (15)$$

To determine the order of precedence, known as the eigenvector (X), from the given matrix, the process involves the following steps:

1. Standardization of column values: This is achieved by normalizing each entry within a column by dividing it by the sum of all entries in that column. This procedure ensures that each column of the matrix sums to 1, thus facilitating a comparison on a uniform scale.

2. Calculation of the cumulative average of rows: The next step is to determine the average of the values in each row after standardization. This average represents the relative weight or priority of each factor, subfactor or strategy within the matrix, providing a preliminary idea of its order of precedence.

The overall weighting value is calculated for an alternative (j=1, 2,… , n). This calculation involves integrating the relative weights or priorities of the alternatives derived from the normalized pairwise comparison matrix. The integral priority, which summarizes the overall importance of each alternative within the context of the analysis, can be expressed mathematically using a specific equation (referred to as Equation (16) in the context provided). This equation synthesizes individual weights or priorities into a holistic measure of importance, thus facilitating the ranking of alternatives based on their comprehensive priorities.

$$Tw_{\mathrm{Alt}_j} = w_S * \sum_{i=1}^{n} w_{S_i} * w_{\mathrm{Alt}_j} + w_W * \sum_{i=1}^{n} w_{W_i} * w_{\mathrm{Alt}_j} + w_O * \sum_{i=1}^{n} w_{O_i} * w_{\mathrm{Alt}_j} + w_T * \sum_{i=1}^{n} w_{T_i} * w_{\mathrm{Alt}_j} \quad (16)$$

where (i =1, …, n) and $(w_S, w_W, w_O, w_T)$are the weights of Strengths, Weaknesses, Opportunities and Threats; $(w_{S_i}, w_{W_i}, w_{O_i}, w_{T_i})$are the weights of the subfactors; and $w_{Alt_j}$is the weight of alternative j , corresponding to its subfactor.

Indeterminate Likert scale

Within the framework established by Smarandache's advanced interpretation of neutrosophic logic , the following elaborations are presented:

Definition 5[14]: The notion of truth, denoted as T, is segmented into a series of subclasses denoted as $T_1, T_2, \ldots, T_p$; Similarly, the concept of indeterminacy, denoted as I, is divided into $I_1, I_2, \ldots, I_r$, and the concept of falsity, denoted as F, is subdivided into $F_1, F_2, \ldots, F_s$, where p, r and s are positive integers satisfying the equation p + r + s = n .

In this context, triply refined indeterminate neutrosophic sets (TRINS) further parse the domain of indeterminacy into three unique membership categories, thereby improving granularity and utility in applications such as Likert scale-type scaling methodologies. TRINS have been leveraged in domains including, but not limited to, personality categorization, offering a nuanced perspective. By comparison, a double-valued neutrosophic set (DVNS) dichotomizes the realm of indeterminacy into a binary division[15, 16].

Definition 6 [17,18]: A $IP_{A(x)}$,TRINS w_mA defined $IN_{A(x)}$,within a $P_A(x$domain $N_{A(x)}$,range $I_{A(x)}$,[0, 5]. For any element x in X, it is stated that: [11,17]

$P_{A(x)}, IP_{A(x)}, I_{A(x)}, IN_{A(x)}, N_{A(x)} \in [0,1]$

And, consequently, its weighted formulations:

$W = w_m P(P_{A(x)}), w_m IP(IP_{A(x)}), w_m I(I_{A(x)}), w_m IN(IN_{A(x)}), w_m N(N_{A(x)})$

Under the restriction that:

$0 \leq P_{A(x)} + IP_{A(x)} + I_{A(x)} + IN_{A(x)} + N_{A(x)} \leq 5$

Therefore, TRINS A is defined as[19,120]:

$A = \{x, P_{A(x)}, IP_{A(x)}, I_{A(x)}, IN_{A(x)}, N_{A(x)}\} \mid x \in X$

Given two triply refined indeterminate neutrosophic sets (TRINS), denoted A and B, within the metric space X, the intersection of A and B produces a third TRINS C, formalized as $C = A \cap B$. The membership function of C in terms of truth, indeterminacy toward truth, indeterminacy, indeterminacy toward falsity, and falsity is established by the following relational equations based on the membership values in A and B:

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$T_{C(x)} = \min(T_{A(x)}, T_{B(x)})$

$IT_{C(x)} = \min(IT_{A(x)}, IT_{B(x)})$

$I_{C(x)} = \min(I_{A(x)}, I_{B(x)})$

$IF_{C(x)} = min(IF_{A(x)}, IF_{B(x)})$

$F_{C(x)} = \max(F_{A(x)}, F_{B(x)})$

Within the field of refined neutrosophic logic, a fourth definition for the calculation of a generalized weight is introduced. This calculation is essential for aggregating the influence of all membership functions within a TRINS framework, elucidating the importance and contribution of each membership function to the added value of a neutrosophic set.

3. Case study

This study examines the difficulties involved in safeguarding mounted police horses through an exploratory qualitative approach. The study focuses on the perspectives and encounters of professionals involved in the topic, including law enforcement officers, veterinarians, and people responsible for the well-being and feeding of horses. The sample consisted of 60 participants, 20 individuals each from the groups of mounted police, veterinarians, and service personnel. The study employed neutrosophic logic and indeterminate Likert scales to analyze the data, which facilitated a deeper understanding of the complexities and uncertainties involved in decision making.

The findings indicated a significant consensus regarding deficiencies related to nutrition and medical treatment. Respondents emphasized the pressing need to improve nutrition, indicating a deficiency in sufficient preparation among professionals. The availability of medical services and the efficiency of care times presented notable shortcomings, which generated delays and additional expenses. The identification of delays in veterinary procedures and inadequate service during rest periods has highlighted the urgent need for care. A significant level of uncertainty was observed among participants regarding fair and equal access to medical services, as well as the use of medications and vaccines. A small percentage of participants believed that vaccination procedures were completed within the designated time frames, suggesting a critical evaluation of staff responsibility and animal welfare expertise.

Overall, the study demonstrates a prevailing lack of attention and significant deficiencies in the protection of Mounties' horses, highlighting the pressing need for systematic changes to improve the speed of medical care, improve support services and expand training of the professionals involved. The study conducted data analysis to identify concerns related to horse protection, with specific emphasis on nutrition and medical treatment. Most concerns were related to the lack of training of professionals, which could undermine the protection of active horses. The findings indicated a significant consensus on the need to implement more comprehensive and personalized nutritional and health initiatives. Significant deficiencies were identified in terms of access to medical services and delivery times, resulting in delays and additional expenses. The study also discovered a significant lack of certainty among participants about fair access to medical services and utilization of medications and vaccines. Only a small percentage of participants believed that vaccination procedures were completed on time, suggesting a critical evaluation of staff competence and the quality of animal welfare training. The results indicate the need for structural changes to improve medical response times, improve auxiliary services and expand the training of the professionals involved.

Strengths:

- F1. Strong legal framework: There are strong, specific regulations governing animal welfare, including laws that protect horses used by mounted police.
- F2. Awareness of stakeholders: The professionals involved, such as police, veterinarians and keepers, show increasing awareness of the importance of horse welfare and protection.
- F3. Willingness to collaborate: The shared perception of challenges in equine protection suggests significant potential for inter-agency alliances and effective collaborations.
- F4. Importance of Animal Welfare: The priority given to animal welfare in the work processes and care of horses constitutes an essential pillar for their protection.

Weaknesses:

- D1. Lack of resources: Limited means and insufficient government support hinder the efficient and sustainable protection of Mounted Police horses.

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- D2. Insufficient training: The lack of specialization in equine care of the staff in charge affects the quality of care and well-being of the horses.
- D3. Delays in Medical Processes: Prolonged veterinary care times can have negative effects on the health and performance of horses.
- D4. Lack of Interinstitutional Coordination: The absence of effective collaboration between the responsible institutions generates challenges in the comprehensive protection of horses.
- D5. Limited community outreach: Insufficient efforts to educate and engage the community in the welfare of RCMP horses.

Opportunities:

- O1. Pro-Animal Legislation: National and international legislation focused on animal welfare represents an opportunity to strengthen the protection of mounted police horses.
- O2. Civil Society Organizations: The presence of NGOs and animal protection groups offers an opportunity to establish synergies and improve the quality of life of horses.
- O3. Government support: Highlighting current needs could lead to policies and budget allocations aimed at strengthening the protection and care of horses.
- O4. Increased media coverage: Increased media attention to animal welfare can help raise awareness and support for Mounties' horses.

Threats:

- A1. Lack of awareness: Insufficient understanding of the specific needs of horses by staff and society can be an obstacle to their proper protection.
- A2. Resistance to change: An aversion to adapting and modernizing existing methods and processes could inhibit the implementation of reforms necessary to improve equine welfare.
- A3. Logistical Complexity: Difficulties inherent in the logistics and coordination of specialized care can complicate effective and consistent protection of horses.

To eliminate and reduce the number of elements that are subjected to pairwise comparison, the importance of each element is evaluated using the Likert neutrosophic scale.

Table 2: TRIM values and W scores for the importance of each sub criterion

Criteria	**Subcriteria**	**TRINAS**	**W.**
Threats	A1	(0.52, 0.1, 0.4, 0.3, 0)	4.8
	A2	(0.55, 0.2, 0.4, 0, 0)	4.0
	A3	(0.74, 0.15, 0.15, 0.05, 0)	4.85
Opportunities	O1	(0.6, 0, 0.3, 0.1, 0)	4.1
	O2	(0.3, 0.05, 0.5, 0.1, 0)	3.4
	O3	(0.4, 0.35, 0.35, 0.1, 0)	4.65
	O4	(0.1, 0.05, 0.35, 0.4, 0.3	2.85
Strengths	F1	(0.5, 0.3, 0.3, 0.01, 0)	4.62
	F2	(0.6, 0.35, 0.05, 0, 0)	4.55
	F3	(0.45, 0.3, 0.25, 0.1, 0)	4.4

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	F4	(0.55, 0.25, 0.2, 0.1, 0)	4.55
Weaknesses	D1	(0.3, 0.4, 0.4, 0.1, 0)	4.5
	D2	(0.5, 0.3, 0.15, 0.05, 0)	4.25
	D3	(0.45, 0.35, 0.21, 0.1, 0)	4.48
	D4	(0.35, 0.4, 0.2, 0.05, 0)	4.05
	D5	(0.1, 0.16, 0.18, 0.2, 0.35)	2.43

Due to the low importance value (W), O4 and D5 are removed.

The analysis combined two complementary methodologies: the multicriteria method [18,19,20] in its neutrosophic version and the SWOT analysis. The neutrosophic variant of the AHP stands out for its ability to incorporate and manage uncertainty and indeterminacy, characteristics frequently present in the evaluation of perceptions and subjective judgments. Especially in environments as complex as animal health and welfare. Applying this neutrosophic approach, it is possible to consider elements that are neither completely true nor false but that may present degrees of truth, falsity and indeterminacy simultaneously.

The proposed method is followed, which allows obtaining the results shown in Table 2.

Table 3: Global analysis for each subcriterio.

Criteria	**Criterion weight**	**Subcriteria**	**Global influence sub-criteria**
Threats	0.35	**A1**	0.10
		A2	0.07
		A3	0.18
Opportunities	0.25	**O1**	0.11
		O2	0.06
		O3	0.08
Strengths	0.19	**F1**	0.06
		F2	0.04
		F3	0.03
		F4	0.06
Weaknesses	0.21	**D1**	0.07
		D2	0.08
		D3	0.04
		D4	0.02

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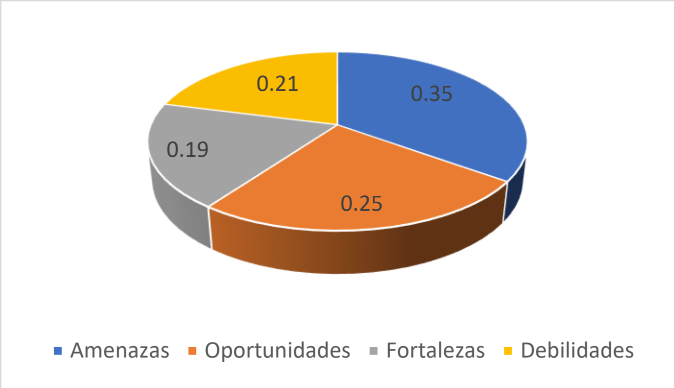

Figure 1. Global analysis for each sub criterion.

Protecting mounted police horses is a multifaceted issue that has both benefits and challenges. Ensuring the welfare and protection of horses depends on the presence of a well-established legal framework, increased awareness among stakeholders and effective collaboration between institutions. However, there are also disadvantages, including limited resources, lack of government assistance, and insufficient training. The problems are further compounded by long delays in veterinary medical procedures and lack of coordination between institutions. Potential areas for improvement include the development of both national and global animal welfare laws, strengthening civil society organizations and greater government support.

Treatments encompass factors such as limited public knowledge, reluctance to adapt, and the intricate challenges of organizing specialized medical services. These challenges can impede efforts to improve equine well-being and adaptability to change. It is essential to address these vulnerabilities and potential dangers in a proactive and coordinated manner to ensure a safer and more dignified future for these animals. In summary, while there are positive aspects and potential to improve the protection of Mounties' horses, it is crucial to address any potential weaknesses and risks in a coordinated manner to ensure a safer future.

4. Conclusion

This study emphasizes the use of the indeterminate Likert scale, neutrosophic AHP, and SWOT analysis as crucial methodologies to address the physical and emotional needs of horses. Ensuring animal well-being involves implementing comprehensive health programs and employing stress-reducing management practices, such as regular veterinary checks, balanced diets, and specialized exercise regimens. Enacting and upholding explicit regulations and policies, as well as providing ongoing education and training to officers, are essential measures to protect these animals.

Future research should focus on developing sophisticated methodologies that use the combined approach of indeterminate Likert scale, neutrosophic AHP, and SWOT analysis to address weaknesses and threats while maximizing strengths and opportunities. It is about improving veterinary care procedures through the implementation of preventive health protocols and efficient emergency response systems. Additionally, promoting inter-agency collaborations and raising public awareness through educational campaigns and partnerships with non-governmental organizations can provide additional support for the safeguarding of Mounties' horses. Efforts should be made to actively pursue technological advances, such as remote health monitoring systems, and conduct animal welfare research. This will help ensure that care practices can continually improve and adapt to changing needs and challenges.

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