Neutrosophic Sets and Systems, Vol. 72, 2024
University of New Mexico

Evaluation of Distributed Leadership in Education Using Neutrosophic HyperSoft Set

Nouran Ajabnoor
Management Department, Applied College, Jazan University, Jazan, KSA
E-mail: nyusuf@jazanu.edu.sa

Abstract

Leadership in education needs to transcend, be responsive, and be adaptable to the boundaries of school leadership. Distributed leadership refers to various organizational stakeholders with a transformative framework and methodology. This paper proposed a decision-making methodology to evaluate distributed leadership in education based on multiple criteria and alternatives. The multi-criteria decision-making is used to deal with multiple criteria and alternatives. The Multi-Attributive Border Approximation Area Comparison (MABAC) approach ranks the alternatives. The neutrosophic set was used to deal with uncertainty and vague information in decision-making problems. This study used the neutrosophic HyperSoft Set. Neutrosophic HyperSoft Set is a new method for computational intelligence and decision-making to deal with vague information. This study used sixteen criteria and eight alternatives. The criteria weights show that Criterion Six has the highest weight, and Criterion Sixteen has the lowest. The results of the MABAC method show that alternative one is the best and alternative six is the worst.

Keywords: Leadership; Education; Decision-making; HyperSoft set; School leadership; Organizational stakeholders.

1. Introduction

Leadership plays a vital role in the education sector through organizational management and has undergone significant evolution. Distributed leadership has gained notable traction in recent studies. To obtain sustainable educational leadership, the educator must evolve and understand the intellectual structures of leadership. The role of leaders in schools has transcended their old boundaries in the education sector. The interconnected world offered a responsive, adaptable, and flexible leadership education. The set of stakeholders, decision-makers, and experts in the school framework, redefined leaders known as distributed leadership[1-2]. Distributed leadership refers to sharing various responsibilities instead of single in the organization by making effective leadership. Leadership is continuing to grow due to multiple factors, such as advanced technology, changes in curriculum, various study populations, and old models[3-4].

A fuzzy set (FS) is an extension of the crisp set. It is used to deal with fuzziness in different decision-making problems[5]. Various extensions of FS have been proposed in previous studies. FS was applied in multi-criteria decision-making (MCDM)[6]. The soft set (SS) was proposed in the literature. SS is very important in measuring problems to make different choices[7].

The neutrosophic set (NS) was proposed in the literature to solve problems of uncertain and vague information in the decision-making process[8]. NS has three functions: truth, indeterminacy, and falsity[9]. NS is essential for various decision-making applications due to its truth, indeterminacy, and falsity, which are independent[10-11]. HyperSoft set was proposed in the previous studies to handle more uncertainty applications by extending the hypersoft set to change functions into multiple functions[12]. The Multi-Attributive Border Approximation Area Comparison (MABAC) approach is an MCDM methodology[13]. This method builds the decision matrix between criteria and alternatives. It used the cost and positive criteria to normalize the decision matrix. It computes the border approximation area for each criterion. It defines the distance between alternatives from the border approximation area. Then, the alternatives are ranked according to the descending total distance for each alternative. This method has various options it is a compensatory approach, the criteria are independent of each other, and qualitative criteria are changed into quantitative criteria[14-15].

1.1 Leadership

Leadership is the ability of a single person or team to affect and guide a set of other persons and organizations or teams. Leadership refers to the criterion tied to the title of a person or organization in the hierarchy. Leadership criterion can anyone obtain or team. Leadership is a skill that can be obtained over time. Leaders are found and required in various firms, organizations, and businesses. Leaders can make complex decisions in firms and organizations to make the firms and organizations do better and attain their goals. Leaders can assign tasks to teams and people to achieve goals using information and knowledge from firms and organizations. Business leaders have various criteria and factors, such as robust communication with teams and users, management skills, best information and knowledge, innovation, awareness of risks and challenges, leadership skills, creativity, thinking, and confidence[1-4].

leadership is very important in various business firms, and organizations due to it has the success factors for business. Businesses and organizations depend on effective and successful methods to achieve their goals and missions by assigning tasks and activities to teams and other people. The criteria of a leader are important in crisis to make the best decisions [4].

Complex decision-making processes lead to the success of businesses and organizations. Business depends on leaders with high capabilities of success. These capabilities lead to improved productivity of businesses and organizations. Strong leadership is very important for businesses and organizations to compete with other originations due to innovation. Evaluating distributed leadership in education through the neutrosophic HyperSoft sets offers a modern method for understanding the complexities of leadership dynamics within schools. This approach integrates neutrosophic theory, which assists uncertainty with HyperSoft sets, which provide a flexible context for analyzing relationships and interactions.

By applying these concepts, educators can assess how effectively leadership responsibilities are shared among teachers, administrators, and other stakeholders. This evaluation allows for analysis of how distributed leadership impacts various aspects of the school environment, such as collaboration, decision-making, and overall effectiveness. It helps identify strengths and areas for improvement in the distribution of leadership roles, ensuring that every participant's contributions are accurately recognized. Also, provides a comprehensive and adaptable tool for enhancing leadership practices and encouraging a more effective and comprehensive educational setting. The main contributions of this study are:

- This study proposed a decision-making methodology for evaluating distributed leadership in education.
- This study used the neutrosophic set to overcome uncertain information in the decision-making process.
- This study used a hypersoft set with a neutrosophic set for evaluation.
- This study used the MABAC method to rank the alternatives.
- Sixteen criteria and 8 alternatives are used in this study for evaluation in the decision-making process.

The rest of this study is organized as follows: Section two shows the education leadership. Section three shows the steps of the proposed methodology. Section four shows the results and discussions of the proposed method. Section five shows the conclusions of this study.

2. Leadership in Education

Education leadership plays a crucial role in today's schools, especially given the increasing responsibilities of school staff and the focus on accountability. Effective management and oversight are essential for improving administration within the education sector. Strong leadership is not just beneficial but necessary for advancing the quality of education, as it helps create supportive systems for both teachers and students. By enhancing learning environments and fostering positive change, leadership education contributes significantly to the development of educational systems [16].

Leadership education also impacts teacher practices and organizational policies, shaping how schools operate and adapt to new challenges. Various frameworks and methodologies have been explored in the literature to understand and improve education leadership. One such approach is distributed leadership, which builds upon existing theories and frameworks by emphasizing the sharing of leadership roles across various levels within a school. The characteristics of effective leadership and the key components necessary for its development are critical to advancing leadership education. These aspects help in identifying and nurturing the elements that contribute to successful school leadership. Understanding these properties not only supports the growth of individual leaders but also strengthens the overall educational environment, leading to more effective teaching and learning processes [16-17].

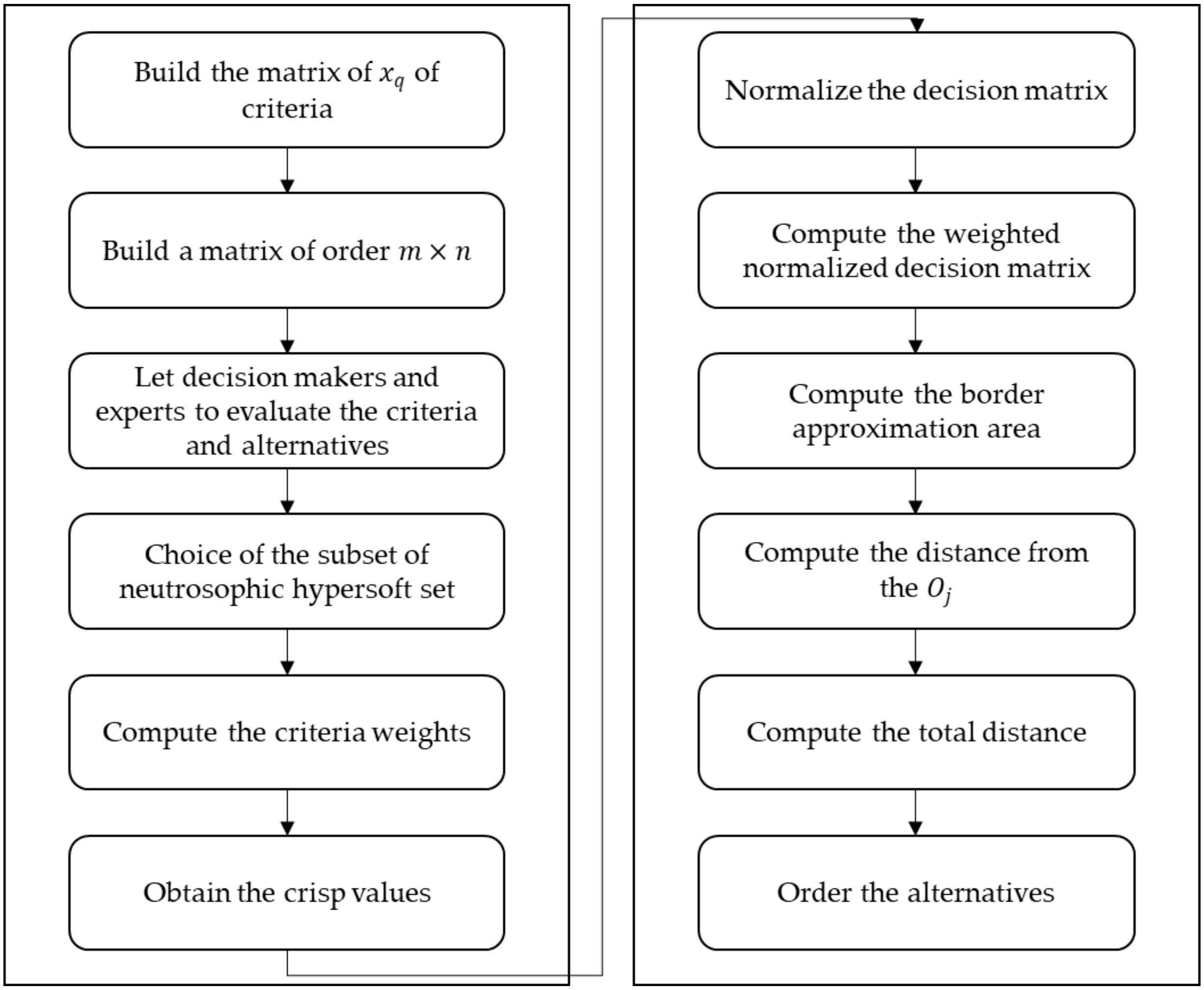

Figure 1. The steps of the methodology.

3. Methodology

This section introduces some operations of neutrosophic sets and steps of the MABAC methods with hypersoft set. Figure 1 shows the methodology steps. NS was used to deal with uncertainty in the decision-making process[18]. This paper used the single-valued neutrosophic set with three functions such as truth, indeterminacy, and falsity[19].

The operations of the single-valued neutrosophic set are shown as:

$$0- \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3+$$

Let $A\ and\ B\ are\ two\ single\ valued\ neutrosophic\ number\ as\ A = (T_A, I_A, F_A)\ and\ B = (T_B, I_B, F_B)$

$$A^c = (F_B, 1 - I_B, T_B)$$

$$A \cup B = (\max\{T_A, T_B\}, \min\{I_A, I_B\}, \min\{F_A, F_B\})$$

$$A \cap B = (\min\{T_A, T_B\}, \max\{I_A, I_B\}, \max\{F_A, F_B\})$$

$A \oplus B = (T_A + T_B - T_A T_B, I_A I_B, F_A F_B)$

$A \otimes B = (T_A T_B, I_A + I_B - I_A I_B, F_A + F_B - F_A F_B)$

$\curlywedge A = (1 - (1 - T_A)^{\curlywedge}, (I_A)^{\curlywedge}, (F_A)^{\curlywedge}, \curlywedge > 0)$

$A^{\curlywedge} = ((T_A)^{\curlywedge}, 1 - (1 - I_A)^{\curlywedge}, 1 - (1 - F_A)^{\curlywedge}), \curlywedge > 0$

Let the function be

$$Y: x_j \times x_k \times x_i \times \dots \times x_m \rightarrow x(a), such\ that\ x_q = x_j, x_k, x_i, \dots, x_m \quad (1)$$

Where

$$x_j = x_1, x_2, \dots, x_n; \quad 1 \leq j \leq n \quad (2)$$

$$x_k = x_1, x_2, \dots, x_n; \quad 1 \leq k \leq n \quad (3)$$

$$x_i = x_1, x_2, \dots, x_n; \quad 1 \leq i \leq n \quad (4)$$

$\vdots$

$$x_m = x_1, x_2, \dots, x_n; \quad 1 \leq m \leq n \quad (5)$$

refers to the neutrosophic criteria and is a universe of discourse.

Stage 1: Build the matrix of x_q of criteria of order $m \times n$.

$$T = [x_{qr}]_{m \times n}, 1 \leq q \leq m, 1 \leq r \leq n \quad (6)$$

Stage 2: Build a matrix of order $m \times n$.

To build the matrix, the columns are filled with zeros if multiple attributes are $\leq n$.

Stage 3: Let decision-makers and experts evaluate the criteria and alternatives.

Stage 4: Choice of the subset of neutrosophic hypersoft set.

Stage 5: Compute the criteria weights.

The criteria weights are computed by using the average method.

Stage 6: Obtain the crisp values

The crisp values are obtained by using the score function.

Stage 7: Normalize the decision matrix

$$u_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-}; i = 1, \dots, m; j = 1, \dots, n \quad (7)$$

$$u_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+}; i = 1, \dots, m; j = 1, \dots, n \quad (8)$$

Where $x_i^+ = \max(x_1, x_2, \dots, x_m)$ and $x_i^- = \min(x_1, x_2, \dots, x_m)$

Stage 8: Compute the weighted normalized decision matrix

$$Q_{ij} = w_j + u_{ij}w_j \quad (9)$$

Stage 9: Compute the border approximation area

$$O_j = \left(\prod_{i=1}^{m} Q_{ij}\right)^{\frac{1}{m}} \quad (10)$$

Stage 10: Compute the distance from the O_j

$$L_{ij} = Q_{ij} - O_j \quad (11)$$

Stage 11: Compute the total distance

$$D_i = \sum_{j=1}^{n} L_{ij} \quad (12)$$

Stage 12: Order the alternatives.

The alternatives are ordered based on the descending order of total distance.

4. Results and Discussions

This section shows the results of the proposed method. This study collects sixteen criteria and eight alternatives as shown in Figure 2.

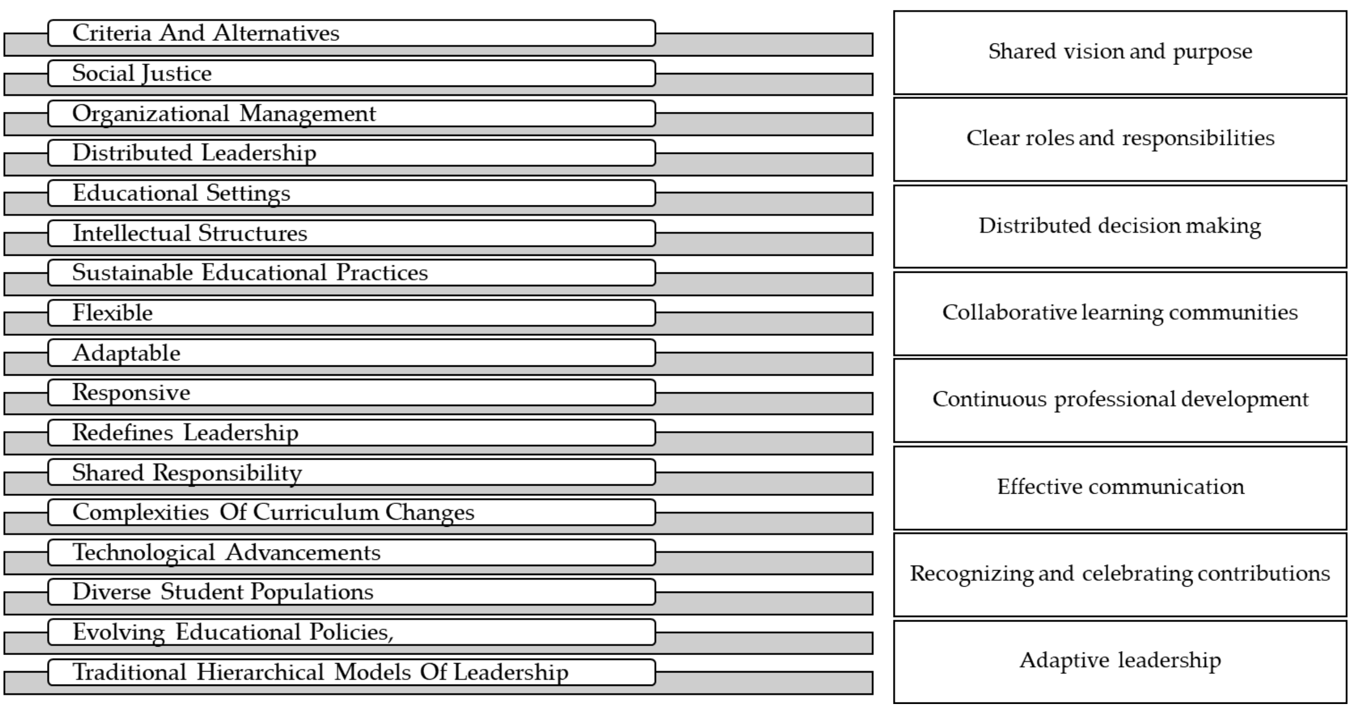

Figure 2. The criteria and alternatives.

Stage 1: Matrix of x_q of criteria of order $m \times n$ is built between criteria and alternatives.

Stage 2: Build a matrix of order $m \times n$.

Stage 3: Three experts who have expertise in leadership education evacuated the criteria and alternatives as shown in Table 1. Three experts used the linguistic terms of single-valued neutrosophic numbers.

Table 1. The opinions of three experts.

	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	(0.6,0.4,0.5)	(0.7,0.3,0.4)	(0.8,0.2,0.1)	(0.9,0.1,0.2)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.5,0.5,0.5)
LEC_2	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.9,0.1,0.2)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
LEC_3	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.6,0.4,0.5)	(0.7,0.3,0.4)
LEC_4	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.7,0.3,0.4)	(0.9,0.1,0.2)	(0.6,0.4,0.5)	(0.4,0.6,0.7)	(0.7,0.3,0.4)	(0.8,0.2,0.1)
LEC_5	(0.2,0.8,0.9)	(0.9,0.1,0.2)	(0.6,0.4,0.5)	(0.8,0.2,0.1)	(0.7,0.3,0.4)	(0.5,0.5,0.5)	(0.8,0.2,0.1)	(0.9,0.1,0.2)
LEC_6	(0.9,0.1,0.2)	(0.7,0.3,0.4)	(0.5,0.5,0.5)	(0.7,0.3,0.4)	(0.8,0.2,0.1)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.9,0.1,0.2)
LEC_7	(0.8,0.2,0.1)	(0.6,0.4,0.5)	(0.4,0.6,0.7)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.7,0.3,0.4)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_8	(0.7,0.3,0.4)	(0.5,0.5,0.5)	(0.3,0.7,0.8)	(0.5,0.5,0.5)	(0.2,0.8,0.9)	(0.8,0.2,0.1)	(0.3,0.7,0.8)	(0.2,0.8,0.9)
LEC_9	(0.6,0.4,0.5)	(0.4,0.6,0.7)	(0.2,0.8,0.9)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.9,0.1,0.2)	(0.4,0.6,0.7)	(0.3,0.7,0.8)
LEC_{10}	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.9,0.1,0.2)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)
LEC_{11}	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.5,0.5,0.5)	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)
LEC_{12}	(0.9,0.1,0.2)	(0.3,0.7,0.8)	(0.7,0.3,0.4)	(0.9,0.1,0.2)	(0.6,0.4,0.5)	(0.2,0.8,0.9)	(0.7,0.3,0.4)	(0.6,0.4,0.5)
LEC_{13}	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.6,0.4,0.5)	(0.8,0.2,0.1)	(0.7,0.3,0.4)	(0.2,0.8,0.9)	(0.8,0.2,0.1)	(0.7,0.3,0.4)
LEC_{14}	(0.7,0.3,0.4)	(0.9,0.1,0.2)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.9,0.1,0.2)	(0.8,0.2,0.1)
LEC_{15}	(0.6,0.4,0.5)	(0.8,0.2,0.1)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.9,0.1,0.2)
LEC_{16}	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.6,0.4,0.5)
	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.4,0.6,0.7)	(0.5,0.5,0.5)
LEC_2	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.4,0.6,0.7)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
LEC_3	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.7,0.3,0.4)
LEC_4	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)
LEC_5	(0.2,0.8,0.9)	(0.9,0.1,0.2)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.9,0.1,0.2)
LEC_6	(0.9,0.1,0.2)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.9,0.1,0.2)	(0.9,0.1,0.2)
LEC_7	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.7,0.3,0.4)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_8	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_9	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.4,0.6,0.7)	(0.3,0.7,0.8)
LEC_{10}	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.4,0.6,0.7)
LEC_{11}	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.5,0.5,0.5)
LEC_{12}	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.2,0.8,0.9)
LEC_{13}	(0.8,0.2,0.1)	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.7,0.3,0.4)
LEC_{14}	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)
LEC_{15}	(0.6,0.4,0.5)	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.9,0.1,0.2)
LEC_{16}	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.6,0.4,0.5)
	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_2	(0.4,0.6,0.7)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
LEC_3	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.3,0.7,0.8)	(0.6,0.4,0.5)	(0.7,0.3,0.4)
LEC_4	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.7,0.3,0.4)	(0.8,0.2,0.1)
LEC_5	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.9,0.1,0.2)
LEC_6	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.9,0.1,0.2)
LEC_7	(0.8,0.2,0.1)	(0.6,0.4,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_8	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_9	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_{10}	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.4,0.6,0.7)
LEC_{11}	(0.4,0.6,0.7)	(0.4,0.6,0.7)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.5,0.5,0.5)
LEC_{12}	(0.9,0.1,0.2)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.6,0.4,0.5)
LEC_{13}	(0.8,0.2,0.1)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_{14}	(0.7,0.3,0.4)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.9,0.1,0.2)	(0.8,0.2,0.1)
LEC_{15}	(0.6,0.4,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)
LEC_{16}	(0.5,0.5,0.5)	(0.4,0.6,0.7)	(0.3,0.7,0.8)	(0.8,0.2,0.1)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)	(0.2,0.8,0.9)

Stage 4: Choice of the subset of neutrosophic hypersoft set.

$$LEC_1 = \{LEC_{11}, LEC_{12}, LEC_{13}\}$$

$$LEC_2 = \{LEC_{22}, LEC_{22}, LEC_{23}\}$$

$$LEC_3 = \{LEC_{31}, LEC_{32}, LEC_{33}\}$$

$$LEC_4 = \{LEC_{41}, LEC_{42}, LEC_{43}\}$$

$$LEC_5 = \{LEC_{51}, LEC_{52}, LEC_{53}\}$$

$$LEC_6 = \{LEC_{61}, LEC_{62}, LEC_{63}\}$$

$$LEC_7 = \{LEC_{71}, LEC_{72}, LEC_{73}\}$$

$$LEC_8 = \{LEC_{81}, LEC_{82}, LEC_{83}\}$$

$$LEC_9 = \{LEC_{91}, LEC_{92}, LEC_{93}\}$$

$$LEC_{10} = \{LEC_{101}, LEC_{102}, LEC_{103}\}$$

$LEC_{11} = \{LEC_{111}, LEC_{112}, LEC_{113}\}$

$LEC_{12} = \{LEC_{121}, LEC_{122}, LEC_{123}\}$

$LEC_{13} = \{LEC_{131}, LEC_{132}, LEC_{133}\}$

$LEC_{14} = \{LEC_{141}, LEC_{142}, LEC_{143}\}$

$LEC_{15} = \{LEC_{151}, LEC_{152}, LEC_{153}\}$

$LEC_{16} = \{LEC_{161}, LEC_{162}, LEC_{163}\}$

Stage 5: The criteria weights are computed as shown in Figure 3. We show that criterion six has the highest weight and criterion sixteen has the lowest weight.

Stage 6: Obtain the crisp values

Stage 7: Normalize the decision matrix as shown in Table 2.

Stage 8: Compute the weighted normalized decision matrix as shown in Table 3.

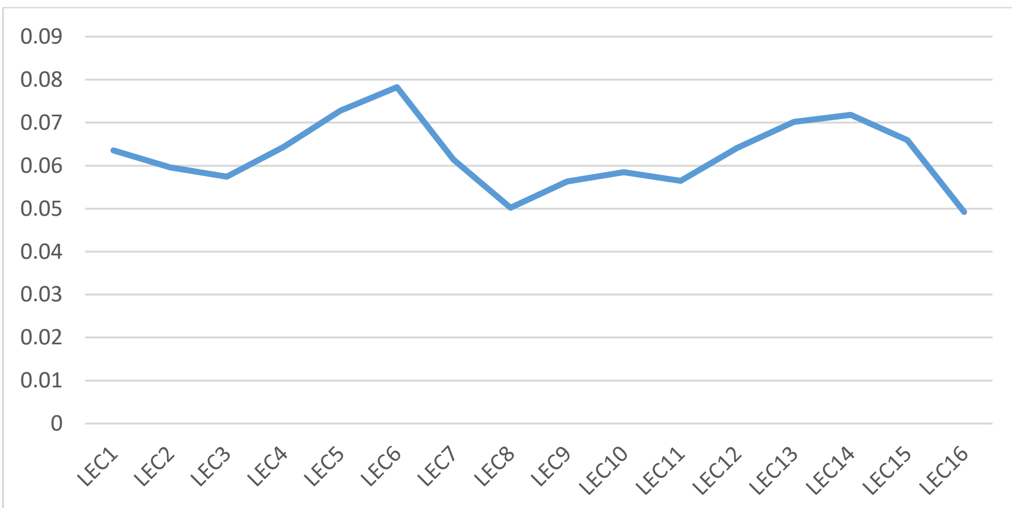

Figure 3. The criteria weights.

Table 2. The normalized decision matrix.

	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	0.545455	0.545455	1	0.613636	0	0.386364	0.136364	0.318182
LEC_2	0.757576	0.575758	0.818182	0.606061	0	0.272727	0.818182	1
LEC_3	0.26087	0.065217	1	0.086957	0	0.065217	0.391304	0.847826
LEC_4	0.06383	0	0.574468	1	0.340426	0.12766	0.574468	0.723404
LEC_5	0	0.684211	0.421053	0.473684	0.614035	0.122807	0.245614	1
LEC_6	0.705882	0.352941	0.54902	0.176471	0.215686	0	0.588235	1
LEC_7	1	0.653846	0.346154	0.346154	0.788462	0.576923	0	0
LEC_8	1	0.694444	0.916667	0.444444	0.083333	0.555556	0.083333	0
LEC_9	0.685714	0.428571	0.685714	0.342857	0.085714	1	0.171429	0
LEC_{10}	0.689655	0.275862	1	0.206897	0.758621	0.172414	0	0.275862
LEC_{11}	0.692308	0.5	1	0	0.923077	0.346154	0.230769	0.923077
LEC_{12}	1	0.388889	0.518519	0.87037	0.277778	0	0.333333	0.444444
LEC_{13}	1	0	0.214286	0.428571	0.142857	0.119048	0.047619	0.285714
LEC_{14}	0.916667	0.777778	0.277778	0.805556	0.194444	0	1	0.861111
LEC_{15}	0.833333	0.888889	0.611111	0.5	0.277778	0.555556	0	1
LEC_{16}	1	0.6875	0.375	0.71875	0	0.1875	0.375	0.75

Table 3. The weighted normalized decision matrix.

	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	0.098201	0.098201	0.127084	0.102533	0.063542	0.088092	0.072207	0.08376
LEC_2	0.104786	0.093946	0.108399	0.095753	0.05962	0.075879	0.108399	0.119239
LEC_3	0.072452	0.06121	0.114924	0.062459	0.057462	0.06121	0.079947	0.10618
LEC_4	0.068432	0.064326	0.10128	0.128653	0.086225	0.072538	0.10128	0.11086
LEC_5	0.072759	0.122542	0.103395	0.107224	0.117436	0.081695	0.09063	0.145519
LEC_6	0.133486	0.105869	0.121212	0.09206	0.095128	0.078251	0.12428	0.156501
LEC_7	0.122769	0.101521	0.082633	0.082633	0.109784	0.096799	0.061385	0.061385
LEC_8	0.100412	0.085071	0.096228	0.07252	0.05439	0.078098	0.05439	0.050206
LEC_9	0.094881	0.080408	0.094881	0.075583	0.06111	0.112571	0.065934	0.056286
LEC_{10}	0.098748	0.074565	0.116886	0.070534	0.102779	0.068519	0.058443	0.074565
LEC_{11}	0.095584	0.084722	0.112963	0.056482	0.108619	0.076033	0.069516	0.108619
LEC_{12}	0.12826	0.08907	0.097383	0.119947	0.081944	0.06413	0.085507	0.092633
LEC_{13}	0.14042	0.07021	0.085255	0.1003	0.08024	0.078568	0.073553	0.09027
LEC_{14}	0.137576	0.127607	0.091717	0.129601	0.085736	0.071779	0.143558	0.133588
LEC_{15}	0.120808	0.124469	0.106165	0.098843	0.0842	0.102504	0.065895	0.131791
LEC_{16}	0.098451	0.083068	0.067685	0.084606	0.049225	0.058455	0.067685	0.086144

Table 4. The distance matrix.

	LEA_1	LEA_2	LEA_3	LEA_4	LEA_5	LEA_6	LEA_7	LEA_8
LEC_1	0.008334	0.008334	0.037217	0.012667	-0.02633	-0.00177	-0.01766	-0.00611
LEC_2	0.011021	0.000181	0.014634	0.001988	-0.03415	-0.01789	0.014634	0.025474
LEC_3	-0.00206	-0.0133	0.04041	-0.01206	-0.01705	-0.0133	0.005433	0.031666
LEC_4	-0.02082	-0.02493	0.012024	0.039397	-0.00303	-0.01672	0.012024	0.021605
LEC_5	-0.03008	0.019706	0.000559	0.004389	0.0146	-0.02114	-0.01221	0.042683
LEC_6	0.022616	-0.005	0.010341	-0.01881	-0.01574	-0.03262	0.01341	0.045631
LEC_7	0.035359	0.014111	-0.00478	-0.00478	0.022374	0.009389	-0.02603	-0.02603
LEC_8	0.028803	0.013462	0.024619	0.00091	-0.01722	0.006489	-0.01722	-0.0214
LEC_9	0.016693	0.00222	0.016693	-0.0026	-0.01708	0.034383	-0.01225	-0.0219
LEC_{10}	0.017694	-0.00649	0.035831	-0.01052	0.021724	-0.01254	-0.02261	-0.00649
LEC_{11}	0.008785	-0.00208	0.026164	-0.03032	0.021819	-0.01077	-0.01728	0.021819
LEC_{12}	0.035347	-0.00384	0.004469	0.027033	-0.01097	-0.02878	-0.00741	-0.00028
LEC_{13}	0.052628	-0.01758	-0.00254	0.012508	-0.00755	-0.00922	-0.01424	0.002478
LEC_{14}	0.025651	0.015681	-0.02021	0.017675	-0.02619	-0.04015	0.031632	0.021663
LEC_{15}	0.018688	0.022349	0.004045	-0.00328	-0.01792	0.000384	-0.03622	0.029671
LEC_{16}	0.025688	0.010305	-0.00508	0.011843	-0.02354	-0.01431	-0.00508	0.013382

Stage 9: Compute the border approximation area

Stage 10: Compute the distance from the O_j as shown in Table 4.

Stage 11: Compute the total distance.

Stage 12: Order the alternatives as shown in Figure 4. We show that alternative one is the best and alternative six is the worst.

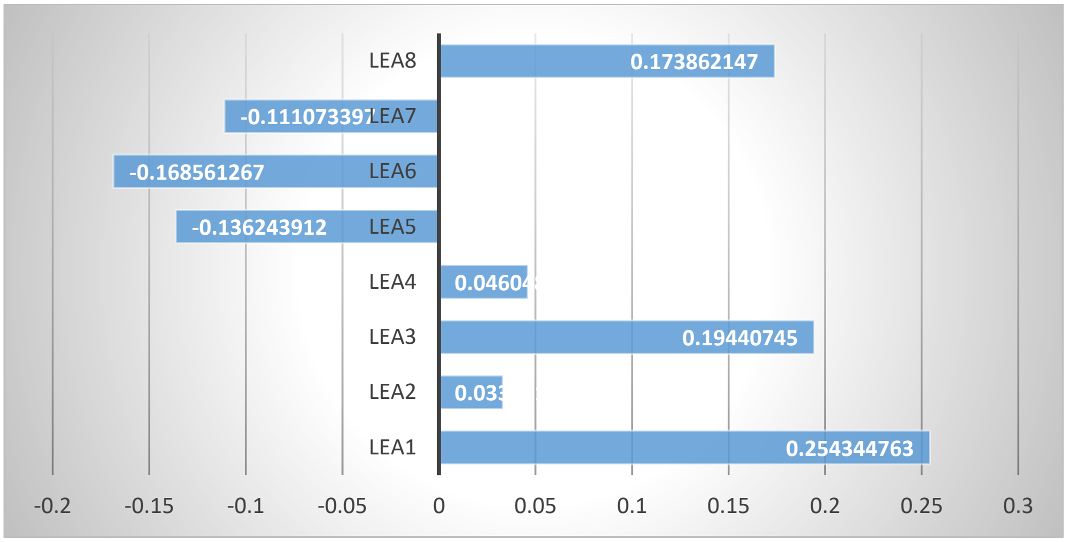

Figure 4. The total distances.

4.1 Findings

This part introduces the discussion of the results. This paper uses neutrosophic sets to overcome uncertainty in the evaluation process. The neutrosophic set is used with the hypersoft set. The MABAC method is used to rank the alternatives. This study uses sixteen criteria and eight alternatives. The criteria weights are computed using the average method.

Three decision-makers evaluated the criteria and alternatives. They used the linguistic terms of single-valued neutrosophic sets. Then, we replaced these terms by using the single-valued neutrosophic numbers. These numbers contain three values: truth, indeterminacy, and falsity. Then, we used the score function to convert these three values into one value. Then, we combine the tree matrices into a single matrix. Then, we obtained the criteria weights. The results show that criterion six has the highest weight with a value equal to 0.078, followed by criterion five with a weight equal to 0.072, criterion Fourteen with a weight equal to 0.071, criterion Thirteen with a weight equal to 0.070, and criterion Fifteen with a weight equal to 0.065. The results show that criterion Sixteen has the lowest importance with a weight equal to 0.049, followed by criterion eight with a weight equal to 0.050, criterion with a weight equal to 0.0562, and criterion Eleven with a weight equal to 0.0564. Then, we applied the MABAC method to show the rank of alternatives. We built the decision matrix between criteria and alternatives. Then, we normalize the decision matrix between criteria and alternatives. Then, we obtained a weighted normalized decision matrix. Then, we compute the border approximation area. Then, we compute the distance from the border approximation area. Then, we rank the alternatives based on the highest total distance. The results show that Alternative One has the highest rank with a total distance equal to 0.0254, followed by Alternative Three with a total distance equal to 0.194, and Alternative Eight with a total distance equal to 0.173. alternative six has the lowest total distance, and alternative Five.

4.2 Sensitivity Analysis

This part explains how we tested the results to see if they stayed consistent when we changed the weights of different criteria. We looked at seventeen different scenarios, as shown in Table 5.

In each scenario, we adjusted the weight of one criterion to 0.7 while keeping the weights of the other criteria the same. For example, in the first scenario, all criteria had equal weight. In the next scenarios, we changed the weight of one specific criterion to 0.7, such as the first criterion in the second case, the second criterion in the third case, and so on, up to the ninth criterion in the tenth case. Then, we applied the MABAC method to the criteria weights. Table 6 shows the total distance. Then, we rank the alternatives as shown in Figure 5. In the first case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the second case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the third case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the fourth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the fifth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the sixth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the seventh case, we show the first alternative has the highest rank, followed by the third. Alternative six has the lowest rank. In the eighth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the ninth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank. In the tenth case, we show the first alternative has the highest rank, followed by the third alternative. Alternative six has the lowest rank.

Table 4. The criteria weights under sensitivity analysis.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}
LEC_1	0.0625	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_2	0.0625	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_3	0.0625	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_4	0.0625	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_5	0.0625	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_6	0.0625	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_7	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_8	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_9	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062	0.062
LEC_{10}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062	0.062
LEC_{11}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062	0.062
LEC_{12}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062	0.062
LEC_{13}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062	0.062
LEC_{14}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062	0.062
LEC_{15}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7	0.062
LEC_{16}	0.0625	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.7

Table 5. The total distances under sensitivity analysis.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}
LEA_1	0.262514	0.316316	0.317702	0.316047	0.313888	0.313216	0.318484	0.320636	0.320619	0.31854	0.318587	0.317483	0.32045	0.321938	0.318996	0.318443	0.32023
LEA_2	0.035518	0.02732	0.027343	0.025584	0.024414	0.029352	0.026841	0.029045	0.029331	0.027616	0.026488	0.027045	0.026871	0.025442	0.028959	0.029864	0.028891
LEA_3	0.209805	0.173198	0.175039	0.178473	0.1746	0.173256	0.174189	0.172615	0.176876	0.175423	0.177796	0.176672	0.173721	0.172927	0.171087	0.173659	0.172425
LEA_4	0.041833	0.029375	0.029625	0.027801	0.033968	0.029827	0.027572	0.028791	0.029511	0.029027	0.028025	0.025349	0.032536	0.030711	0.031221	0.029002	0.031179
LEA_5	-0.14055	-0.11466	-0.11896	-0.11689	-0.11501	-0.11316	-0.11617	-0.11193	-0.11723	-0.11694	-0.11187	-0.11176	-0.11594	-0.11547	-0.1174	-0.1167	-0.11825
LEA_6	-0.15395	-0.1522	-0.15445	-0.15394	-0.15415	-0.15438	-0.15533	-0.15105	-0.15123	-0.14762	-0.15381	-0.15363	-0.15557	-0.15319	-0.1564	-0.15216	-0.15438
LEA_7	-0.12221	-0.10484	-0.103	-0.10413	-0.10344	-0.1061	-0.10356	-0.10802	-0.10742	-0.10648	-0.10774	-0.10714	-0.10571	-0.10636	-0.10154	-0.10897	-0.10562
LEA_8	0.154909	0.160916	0.164121	0.165049	0.163435	0.165316	0.16529	0.157737	0.157719	0.157998	0.160084	0.163814	0.160883	0.161181	0.16318	0.164293	0.162955

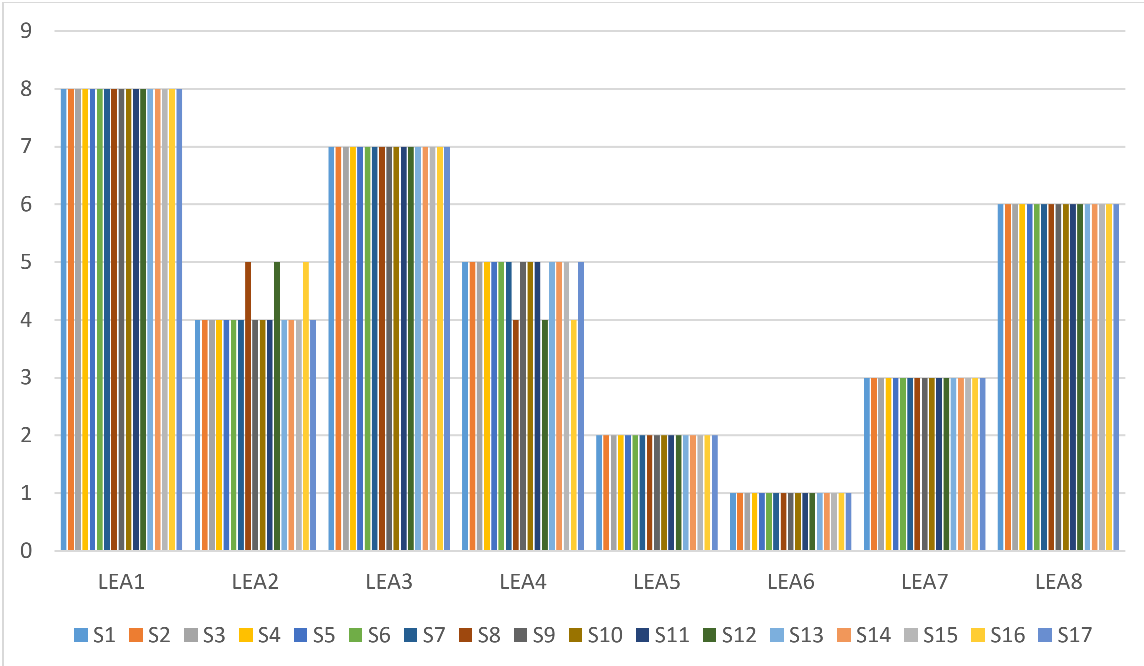

Figure 5. The rank of alternatives under different weights.

4.3 Comparative Analysis

This part shows the comparative study between our model and other models. We compared our model with TOPSIS, VIKOR, EDAS, WASPAS, and COPRAS methods. These methods are compared under the weights of this study. These methods are evaluated under single-valued neutrosophic sets. Figure 6 shows the comparative study. Figure 6 shows the comparative study. In our model, alternative one has the highest rank, followed by Alternative three, alternative eight, and alternative four. Alternative six has the lowest rank, followed by alternative five, and alternative seven. In the TOPSIS method, alternative 1 has the highest rank, followed by alternative eight, alternative three, and alternative four. Alternative six has the lowest rank, followed by Alternative four, and Alternative seven. In the VIKOR method, alternative one has the highest rank, followed by alternative three, alternative eight, and alternative four. Alternative six has the lowest rank, followed by Alternative seven, and Alternative five. In the WASPAS method, alternative one has the highest rank, followed by alternative four, alternative eight, and alternative three. Alternative six has the lowest rank, followed by Alternative five, and Alternative seven. In COPRAS, Alternative One has the highest rank, followed by Alternative Four, alternative 8, and Alternative Three. Alternative six has the lowest rank, followed by Alternative five, and Alternative seven. In the EDAS method, alternative one has the highest rank, followed by alternative two, alternative eight, and alternative four. Alternative six has the lowest rank, followed by Alternative seven, and Alternative five.

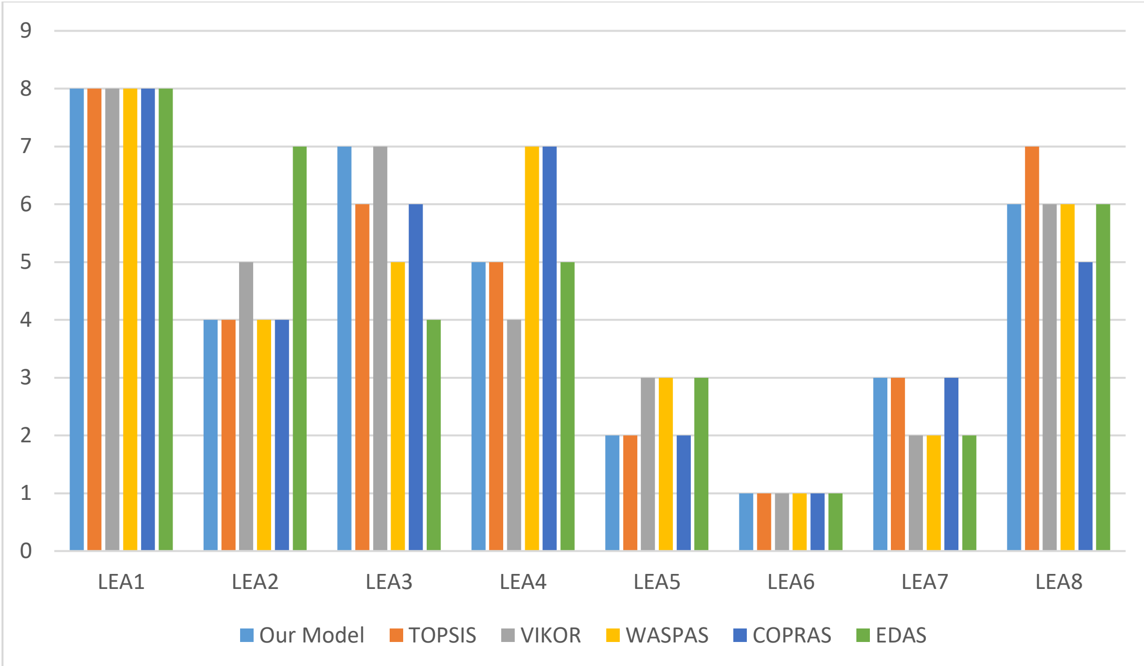

Figure 6. Comparative Study between other models.

5. Conclusions

This study introduced a new model for evaluating distributed leadership in education. To handle uncertainty in decision-making, we used a method called the neutrosophic hypersoft set. We applied a technique known as MCDM (Multi-Criteria Decision-Making) to manage different criteria and factors and used the MABAC method to rank the options. Three experts assessed sixteen criteria and eight options using descriptive terms. We then converted these assessments into single-valued neutrosophic numbers to get clear values. From this, we calculated the weights for each criterion. The results showed that criterion six was the most important, while criterion sixteen was the least important. Next, we used the MABAC method to rank the alternatives, finding that alternative one was the best and alternative six was the worst. For future research, other MCDM methods like AHP and DEMATEL could be used to determine criteria weights, and methods like VIKOR and TOPSIS could be used to rank the alternatives.

References

[1] C. A. Groenewald, E. Groenewald, F. Uy, J. M. Mugadza, A. N. Cuyos, and O. K. Kilag, "Exploring Multiculturalism and Educational Leadership: A Systematic Review of Global Perspectives," *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence (IMJRISE)*, vol. 1, no. 3, pp. 45–50, 2024.

[2] E. Groenewald, C. A. Groenewald, R. A. Dela Cruz, F. Uy, O. K. Kilag, and M. Villaver Jr, "Navigating Educational Leadership: Challenges, Styles, and Impacts–A Systematic Review," *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence (IMJRISE)*, vol. 1, no. 2, pp. 262–267, 2024.

[3] K. Leithwood, "Educational Leadership. A Review of the Research.," *Laboratory for*

Student Success (LSS), The Mid-Atlantic Regional Educational Laboratory, 2005.

[4] E. Daniëls, A. Hondeghem, and F. Dochy, "A review on leadership and leadership development in educational settings," *Educational research review*, vol. 27, pp. 110–125, 2019.

[5] A. M. Ali, A. Abdelhafeez, T. H. M. Soliman, and K. ELMenshawy, "A probabilistic hesitant fuzzy MCDM approach to selecting treatment policy for COVID-19," *Decision Making: Applications in Management and Engineering*, vol. 7, no. 1, pp. 131–144, 2024.

[6] M. M. Ismail, M. Ibrahim, A. Sleem, and M. Mohamed, "Blending Uncertainty Theory Innovative into Decision Support Framework for Selecting Agricultural Machinery Suppliers," *Optimization in Agriculture*, vol. 1, pp. 115–128, 2024.

[7] F. Smarandache, "New Types of Soft Sets" HyperSoft Set, IndetermSoft Set, IndetermHyperSoft Set, and TreeSoft Set": An Improved Version," *Neutrosophic Systems with Applications*, vol. 8, pp. 35–41, 2023.

[8] A. A. El-Douh, S. Lu, A. Abdelhafeez, and A. S. Aziz, "Assessment the Health Sustainability using Neutrosophic MCDM Methodology: Case Study COVID-19," *Sustainable Machine Intelligence Journal*, vol. 3, p. 1, 2023.

[9] A. Abdel-Monem and A. A. Gawad, "A hybrid Model Using MCDM Methods and Bipolar Neutrosophic Sets for Select Optimal Wind Turbine: Case Study in Egypt," *Neutrosophic Sets and Systems*, vol. 42, no. 1, p. 1, 2021.

[10] H. Wang, F. Smarandache, Y. Zhang, and R. Sunderraman, "Single valued neutrosophic sets," *Infinite study*, vol. 12, 2010.

[11] H.-L. Yang, C.-L. Zhang, Z.-L. Guo, Y.-L. Liu, and X. Liao, "A hybrid model of single valued neutrosophic sets and rough sets: single valued neutrosophic rough set model," *Soft Computing*, vol. 21, pp. 6253–6267, 2017.

[12] F. Smarandache, A. M. Ali, and A. Abdelhafeez, *Single Valued Neutrosophic HyperSoft Set based on VIKOR Method for 5G Architecture Selection*. Infinite Study, 2024.

[13] N. A. Nabeeh, A. Abdel-Monem, and A. Abdelmouty, "A novel methodology for assessment of hospital service according to BWM, MABAC, PROMETHEE II," *Neutrosophic Sets and Systems*, vol. 31, no. 1, pp. 63–79, 2020.

[14] D. Pamučar and G. Ćirović, "The selection of transport and handling resources in logistics centers using Multi-Attributive Border Approximation area Comparison (MABAC)," *Expert systems with applications*, vol. 42, no. 6, pp. 3016–3028, 2015.

[15] A. Alinezhad, J. Khalili, A. Alinezhad, and J. Khalili, "MABAC method," *New Methods and Applications in Multiple Attribute Decision Making (MADM)*, pp. 193–198, 2019.

[16] M. Prabhuswamy, R. Tripathi, M. Vijayakumar, T. Thulasimani, P. Sundharesalingam, and B. Sampath, "A Study on the Complex Nature of Higher Education Leadership: An Innovative Approach," in *Challenges of Globalization and Inclusivity in Academic Research*, IGI Global, 2024, pp. 202–223.

[17] A. McKay, K. MacDonald, and F. Longmuir, "The emotional intensity of educational leadership: A scoping review," *International Journal of Leadership in Education*, pp. 1–23, 2024.

[18] N. Nabeeh, "Assessment and Contrast the Sustainable Growth of Various 1 Road Transport Systems using Intelligent Neutrosophic 2 Multi-Criteria Decision-Making Model," *Sustainable Machine Intelligence Journal*, vol. 2, 2023.

[19] M. Luo, Z. Sun, and L. Wu, "Fuzzy Inference Quintuple Implication Method Based on Single Valued Neutrosophic t-representable t-norm," *Neutrosophic Optimization and Intelligent Systems*, vol. 3, pp. 8–22, 2024.

Received: January 03, 2024. **Accepted**: August 26, 2024.