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Comprehensive Evaluation of Safety Emergency Plans for Petrochemical Enterprises under Interval Valued Trapezoidal Neutrosophic Set to Enhance Preparedness and Risk Mitigation

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Abstract: Safety production incidents have had a significant impact on people's livelihoods and property as the petrochemical industry has grown. To prevent and respond to various types of mishaps, numerous nations have created emergency response systems. This study proposes a decision-making approach for evaluation of safety emergency plans for petrochemical enterprises under the uncertainty framework. We use the neutrosophic sets to deal with the uncertainty and vague information. This study uses the interval valued trapezoidal neutrosophic set (IVTNS). We define a set of definition related to IVTNS and their operations. Two decision making methods are used in this study such as LBWA to compute the criteria weights and CoCoSo method to rank the alternatives. This study uses nine criteria and eleven alternatives to be evaluated in the decision-making problem. The sensitivity analysis shows the ranks of the alternatives are stable under different cases.

Keywords: Interval Valued Trapezoidal Neutrosophic Set (IVTNS); Petrochemical Enterprises; Emergency; Safety.

1. Introduction and Related Work

To address the imprecision, incompleteness, and ambiguity in the information, Zadeh created the fuzzy set theory. In the event where the grade of membership is ambiguous and cannot be represented by a precise value, Zadeh [1] later introduced the interval valued fuzzy sets (IVFS). Based on fuzzy set theory, Atanassov [2] created an intuitionistic fuzzy set (IFS) and an interval-valued IFS. Numerous scholars have investigated the application of IFSs in MCDM scenarios[3].

Liu and Yuan [4] created triangular intuitionistic fuzzy sets (TIFS) by fusing the ideas of IFS and triangular fuzzy numbers (TFN). Additionally, the interval valued intuitionistic fuzzy set (IVIFS)

was introduced by Atanassov and Gargov, [5] who integrated the IFS and IVFS. Additionally, MADM and multi attribute group decision making (MAGDM) scenarios were used to illustrate the application of IVIFS. Wang used triangular intuitionistic fuzzy sets to propose the weighted geometric and hybrid geometric operators. Additionally, he used both operators to solve MAGDM issues.

Based on fuzzy number intuitionistic fuzzy numbers, Wei et al. [6] developed an induced ordered weighted geometric operator and presented a method for resolving group decision-making issues using the suggested operator. Ye [7] introduced the trapezoidal intuitionistic fuzzy set (TrIFS) as an extension of the TIFS for encoding the membership and non-membership values as a trapezoid. Even though many academics have proposed different forms of fuzzy sets, the impact of this ignorance should also be considered when making a judgment if an expert is not quite certain about their choice.

Experts may occasionally be unsure about the outcome but nonetheless reach a decision that is either positive (acceptable) or negative (rejection). Together with membership and non-membership functions, the unknowingness/indeterminacy component must be considered in this situation. To deal with imprecise, incomplete, and uncertain information, Smarandache introduced the neutrosophic set (NS) and expanded the concepts of classic, fuzzy, and IFS. Later, a single-valued neutrosophic set (SVNS), a version of an NS, is presented that has practical applications. Ye presented the TrNS as an expansion of the SVNS and trapezoidal fuzzy numbers (TrFN). Additionally, he presented the geometric averaging operator and weighted arithmetic based on the trapezoidal neutrosophic number.

Furthermore, he presented a technique to deal with MADM difficulties utilizing these operators. As previously mentioned, researchers have proposed a number of methods based on IVIFS, TrIFS, and TrNS sets to deal with inconsistency, impreciseness, uncertainty, incompleteness, and indeterminacy in information that is either (1) intuitionistic fuzzy and in the unit interval of real numbers and can be represented as a triangle/trapezoid, or (2) neutrosophic and can be represented as a trapezoid. However, the suggested approach deals with data that is neutrosophic in nature, falls inside the real number unit interval [8], and can be shown as a triangle or a trapezoid.

Based on the combination of IVIFN and TrNS, Kiran Khatter [9] suggested an interval valued trapezoidal neutrosophic set (IVTNS). The operating laws for IVTNN are also introduced in the study. Additionally, to incorporate the neutrosophic trapezoidal information in the unit interval of real number is introduced. To demonstrate the applicability of the created method, a mathematical illustration is presented after a method is developed to manage the issues in the MADM system utilizing the IVTNN operator.

It has been shown that a single valued neutrosophic set may encompass the indeterminacy in real-world decision-making problems. It is an expansion of the neutrosophic set with interval values. Most real-world issues contain some degree of uncertainty, and determining the

network's shortest path is one of the most well-known examples. Broumi et al. [10] proposed interval valued neutrosophic numbers to solve shortest path and a new score function for these numbers is proposed. By considering interval-valued neutrosophic numbers, trapezoidal, and triangular interval-valued neutrosophic numbers for the path length in a network with an illustrative example, new algorithms are also presented to determine the neutrosophic shortest path.

2. Interval valued trapezoidal neutrosophic set (IVTNS)

The interval valued trapezoidal neutrosophic number (IVTNN) can be defined as[9]:

$$N^L = \left\{\left(x, T_N^L(x), I_N^L(x), F_N^L(x)\right); x \in X\right\} \tag{1}$$

$$T_N^L(x) \subset [0,1] \tag{2}$$

$$I_N^L(x) \subset [0,1] \tag{3}$$

$$F_N^L(x) \subset [0,1] \tag{4}$$

These numbers refer to the trapezoidal neutrosophic fuzzy numbers

$$T_N^L(x) = \left(t^{L1}{}_N(x), t^{L2}{}_N(x), t^{L3}{}_N(x), t^{L4}{}_N(x)\right) x \to [0,1] \tag{5}$$

$$F_N^L(x) = \left(f^{L1}{}_N(x), f^{L2}{}_N(x), f^{L3}{}_N(x), f^{L4}{}_N(x)\right) x \to [0,1] \tag{6}$$

$$T_N^L(x) = \left(i^{L1}{}_N(x), i^{L2}{}_N(x), i^{L3}{}_N(x), i^{L4}{}_N(x)\right) x \to [0,1] \tag{7}$$

$$0 \le t^{L4}{}_N(x) + i^{L4}{}_N(x) + f^{L4}{}_N(x) \le 3 \tag{8}$$

$$N^L = \left\{\left((a,b,c,d),(,e,f,g,h),(l,l,n,p)\right) > X \to [0,1]\right\} \tag{9}$$

We can define the $T_N^L(x), I_N^L(x), F_N^L(x)$

$$T_N^L(x) = \begin{cases} \frac{x-a}{b-a} T_N^L & a \le x \le b \\ T_N^L & b \le x \le c \\ \frac{d-x}{d-c} T_N^L & c \le x \le d \\ 0 & otherwise \end{cases} \tag{10}$$

$$I_N^L(x) = \begin{cases} \frac{f-x+I_N^L(x-e)}{f-e} & e \le x \le f \\ I_N^L & f \le x \le g \\ \frac{x-g+I_N^L(h-x)}{h-g} & g \le x \le h \\ 1 & otherwise \end{cases} \tag{11}$$

$$F_N^L(x) = \begin{cases} \frac{m-x+F_N^L(x-l)}{m-l} & l \le x \le m \\ F_N^L & m \le x \le n \\ \frac{x-n+F_N^L(p-x)}{p-n} & n \le x \le p \\ 1 & otherwise \end{cases} \tag{12}$$

Definition

Let N^U be upper trapezoidal neutrosophic fuzzy number then $T^U{}_N(x), I^U{}_N(x)\ and\ F^U{}_N(x)$

$$T^U{}_N(x) = \begin{cases} \frac{x-a}{b-a} & a \le x < b \\ T^U{}_N & b \le x < c \\ \frac{d-x}{d-c} & c \le x < d \\ 0 & otherwise \end{cases} \tag{13}$$

$$I^U{}_N(x) = \begin{cases} \frac{f-x+I^U{}_N(x-e)}{f-e} & e \le x < f \\ I^U{}_N & f \le x < g \\ \frac{x-g+I^U{}_N(h-x)}{h-g} & g \le x < h \\ 1 & otherwise \end{cases} \tag{14}$$

$$F^U{}_N(x) = \begin{cases} \frac{m-x+F^U{}_N(x-l)}{m-l} & l \le x < m \\ F^U{}_N & m \le x < n \\ \frac{x-n+F^U{}_N(p-x)}{p-n} & n \le x < p \\ 1 & otherwise \end{cases} \tag{15}$$

Definition

Let two IVTNNs can be defined such as:

$$n_1 = \begin{Bmatrix} \left(\left[(a_1, b_1, c_1, d_1), \left(\overline{a_1}, \overline{b_1}, \overline{c_1}, \overline{d_1}\right)\right]; T_{n_1}\right), \\ \left(\left[(e_1, f_1, g_1, h_1), \left(\overline{e_1}, \overline{f_1}, \overline{g_1}, \overline{h_1}\right)\right]; I_{n_1}\right), \\ \left(\left[(l_1, m_1, n_1, p_1), \left(\overline{l_1}, \overline{m_1}, \overline{n_1}, \overline{p_1}\right)\right]; F_{n_1}\right) \end{Bmatrix} \tag{16}$$

$$n_2 = \begin{Bmatrix} \left(\left[(a_2, b_2, c_2, d_2), \left(\overline{a_2}, \overline{b_2}, \overline{c_2}, \overline{d_2}\right)\right]; T_{n_2}\right), \\ \left(\left[(e_2, f_2, g_2, h_2), \left(\overline{e_2}, \overline{f_2}, \overline{g_2}, \overline{h_2}\right)\right]; I_{n_2}\right), \\ \left(\left[(l_2, m_2, n_2, p_2), \left(\overline{l_2}, \overline{m_2}, \overline{n_2}, \overline{p_2}\right)\right]; F_{n_2}\right) \end{Bmatrix} \tag{17}$$

$$n_1 \oplus n_2 = \begin{pmatrix} \left[\begin{pmatrix} a_1 + a_2 - a_1a_2, b_1 + b_2 - b_1b_2 \\ c_1 + c_2 - c_1c_2 + d_1 + d_2 - d_1d_2 \end{pmatrix}, \right] \\ \left[\begin{pmatrix} \overline{a_1} + \overline{a_2} - \overline{a_1a_2}, \overline{b_1} + \overline{b_2}, \overline{b_1b_2}, \\ \overline{c_1} + \overline{c_2} - \overline{c_1c_2}, \overline{d_1} + \overline{d_2} - \overline{d_1d_2} \end{pmatrix} \right], \\ \left[\begin{matrix} (e_1e_2, f_1f_2, g_1g_2, h_1h_2), \\ (\overline{e_1e_2}, \overline{f_1f_2}, \overline{g_1g_2}, \overline{h_1h_2}) \end{matrix}\right], \\ \left[\begin{matrix} (l_1l_2, m_1m_2, n_1n_2, p_1p_2), \\ (\overline{l_1l_2}, \overline{m_1m_2}, \overline{n_1n_2}, \overline{p_1p_2}) \end{matrix}\right] \end{pmatrix} \tag{18}$$

$$n_1 \otimes n_2 = \left\{ \begin{matrix} \left[\begin{matrix} (a_1a_2, b_1b_2, c_1c_2, d_1d_2), \\ (\overline{a_1a_2}, \overline{b_1b_2}, \overline{c_1c_2}, \overline{d_1d_2}) \end{matrix}\right], \\ \left[\begin{matrix} \left[\begin{pmatrix} e_1 + e_2 - e_1e_2, f_1 + f_1 - f_1f_2, \\ g_1 + g_2 - g_1g_2, h_1 + h_2 - h_1h_2 \end{pmatrix}, \right] \\ \left[\begin{pmatrix} \overline{e_1} + \overline{e_1} - \overline{e_1e_2}, \overline{f_1} + \overline{f_2} - \overline{f_1f_2} \\ , \overline{g_1} + \overline{g_2} - \overline{g_1g_2}, \overline{h_1} + \overline{h_2} - \overline{h_1h_2} \end{pmatrix} \right], \end{matrix}\right. \\ \left[\begin{matrix} \left[\begin{pmatrix} l_1 + l_2 - l_1l_2, m_1 + m_2 - m_1m_2, \\ n_1 + n_2 - n_1n_2, p_1 + p_2 - p_1p_2 \end{pmatrix}, \right] \\ \left[\begin{pmatrix} \overline{l_1} + \overline{l_2} - \overline{l_1l_2}, \overline{m_1} + \overline{m_2} - \overline{m_1m_2}, \\ \overline{n_1} + \overline{n_2} - \overline{n_1n_2}, \overline{p_1} + \overline{p_2} - \overline{p_1p_2} \end{pmatrix} \right] \end{matrix}\right. \end{matrix} \right\} \tag{19}$$

$$\varphi n_1 = \begin{pmatrix} \left[\begin{pmatrix} 1 - (1 - a_1)^{\varphi}, 1 - (1 - b_1)^{\varphi}, \\ 1 - (1 - c_1)^{\varphi}, 1 - (1 - d_1)^{\varphi} \end{pmatrix}, \right] \\ \left[\begin{pmatrix} 1 - (1 - \overline{a_1})^{\varphi}, 1 - \left(1 - \overline{b_1}\right)^{\varphi}, \\ 1 - (1 - \overline{c_1})^{\varphi}, 1 - \left(1 - \overline{d_1}\right)^{\varphi} \end{pmatrix} \right], \\ \left[(e_1^{\varphi}, f_1^{\varphi}, g_1^{\varphi}, h_1^{\varphi}), (\overline{e_1}^{\varphi}, \overline{f_1}^{\varphi}, \overline{g_1}^{\varphi}, \overline{h_1}^{\varphi})\right], \\ \left[(l_1^{\varphi}, m_1^{\varphi}, n_1^{\varphi}, p_1^{\varphi}), (\overline{l_1}^{\varphi}, \overline{m_1}^{\varphi}, \overline{n_1}^{\varphi}, \overline{p_1}^{\varphi})\right] \end{pmatrix} \tag{20}$$

$$n_1^{\varphi} = \begin{pmatrix} \left[(a_1^{\varphi}, b_1^{\varphi}, c_1^{\varphi}, d_1^{\varphi}), (\overline{a_1}^{\varphi}, \overline{b_1}^{\varphi}, \overline{c_1}^{\varphi}, \overline{d_1}^{\varphi})\right], \\ \left[\begin{pmatrix} 1 - (1 - e_1)^{\varphi}, 1 - (1 - f_1)^{\varphi}, \\ 1 - (1 - g_1)^{\varphi}, 1 - (1 - h_1)^{\varphi} \end{pmatrix}, \right] \\ \left[\begin{pmatrix} 1 - (1 - \overline{e_1})^{\varphi}, 1 - \left(1 - \overline{f_1}\right)^{\varphi}, \\ 1 - (1 - \overline{g_1})^{\varphi}, 1 - \left(1 - \overline{h_1}\right)^{\varphi} \end{pmatrix} \right], \\ \left[\begin{pmatrix} 1 - (1 - l_1)^{\varphi}, 1 - (1 - m_1)^{\varphi}, \\ 1 - (1 - n_1)^{\varphi}, 1 - (1 - p_1)^{\varphi} \end{pmatrix}, \right] \\ \left[\begin{pmatrix} 1 - \left(1 - \overline{l_1}\right)^{\varphi}, 1 - (1 - \overline{m_1})^{\varphi}, \\ 1 - (1 - \overline{n_1})^{\varphi}, 1 - (1 - \overline{p_1})^{\varphi} \end{pmatrix} \right] \end{pmatrix} \tag{21}$$

3. IVTN-LBWA-CoCoSo

Another new subjective weighting technique is the LBWA method. Its foundation is the pairwise evaluation of criteria at criteria significance levels using non-decreasing strings. The approach does not require redefining the ordinal scale for pairwise criteria comparison because it employs

a novel algorithm for grouping criteria according to their significance levels. Following level-by-level categorization, criteria's relevance is determined in relation to DM preferences. LBWA has recently been used to address decision-making problems[11], [12].

The steps of this methodology are organized as follows:

1. Experts define the most important criterion

These criteria can be defined such as: $\{C_1, \dots, C_n\}$

2. Rest the criteria are classified into different levels

Level 1: Criteria in this level are either up to twice as important as the most important criterion or equally so.

Level 2: Criteria with a significance level that is precisely twice or even three times lower than the most crucial criterion are positioned in this level.

Level 3: Criteria that are precisely k times less significant than the most important criterion or up to k + 1 times less significant than the most essential criterion are placed in this level. By assigning the criteria to varying degrees of significance, DMs utilize this grouping process to create a rough classification of the criteria.

$$S = S_1 \cup S_2 \dots \cap S_k \tag{22}$$

3. Each criterion assigned into integral value

$$r = \max\{|S_1|, |S_2|, \dots, |S_k|\} \tag{23}$$

4. The value of r should meet $r_0 > r \; where \; r_0$ is defined as the elasticity coefficient.

5. The influence function is computed such as:

$$f(C_{ip}) = \frac{r_0}{i(r_0)+I_{ip}} \tag{24}$$

6. Compute the criteria weights such as:

$$w_j = \frac{1}{1+f(C_j)+\cdots+f(C_n)} \tag{25}$$

Then we applied the steps of the CoCoSo method to rank the alternatives

1. Build the decision matrix

The decision matrix is built between the criteria and alternatives by a set of experts

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \tag{26}$$

2. Normalize the decision matrix based on the positive and negative criteria such as:

$$n_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (27)$$

$$n_{ij} = \frac{\min_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (28)$$

3. Compute the sum of weighted comparability and power weighted

$$a_i = \sum_{j=1}^{n} (w_j n_{ij}) \quad (29)$$

$$b_i = \sum_{j=1}^{n} (w_j)^{n_{ij}} \quad (30)$$

4. Compute appraisal scores such as:

$$U_{ia} = \frac{a_i + b_i}{\sum_{i=1}^{m} (a_i + b_i)} \quad (31)$$

$$U_{ib} = \frac{a_i}{\min a_i} + \frac{b_i}{\min b_i} \quad (32)$$

$$U_{ic} = \frac{\pi(a_i) + (1-\pi)(b_i)}{\pi \max a_i + (1-\pi) \max b_i} \quad (33)$$

Where $0 \leq \pi \leq 1$

5. Compute the combined score

$$U_i = (U_{ia} U_{ib} U_{ic})^{(1/3)} + \frac{1}{3}(U_{ia} + U_{ib} + U_{ic}) \quad (34)$$

6. Rank the alternatives

4. Results

Petrochemical companies have grown to represent a significant sector of the national economy, and their growth has increased the risk of accidents. According to statistics, 10% of incidents in the petrochemical sector from 1985 to 2002 caused environmental damage, while 20% of accidents resulted in human fatalities, according to Nivolianitou et al[13]. Regretfully, many accidents and fatalities still occur that are not reported. There were 5207 hazardous chemical leakage incidents in China between 2009 and 2018, with varying degrees of financial losses, fatalities, and environmental harm[14]. Environmentally speaking, unexpected air pollution incidents can release a lot of toxic and dangerous pollutants quickly, resulting in significant harm to the environment and fatalities. They are also challenging to control. The petrochemical sector is prone to accidents, which have a more significant effect on the environment, property, and worker safety. Numerous studies show that it is challenging to combine the cause of an accident and the post-event emergency procedures[15], [16]. This section shows the results of evaluation of safety emergency plans for petrochemical enterprises with the neutrosophic sets. Three experts have evaluated a set of criteria and alternatives. This study uses nine criteria and ten alternatives to evaluate this problem as shown in Fig 1.

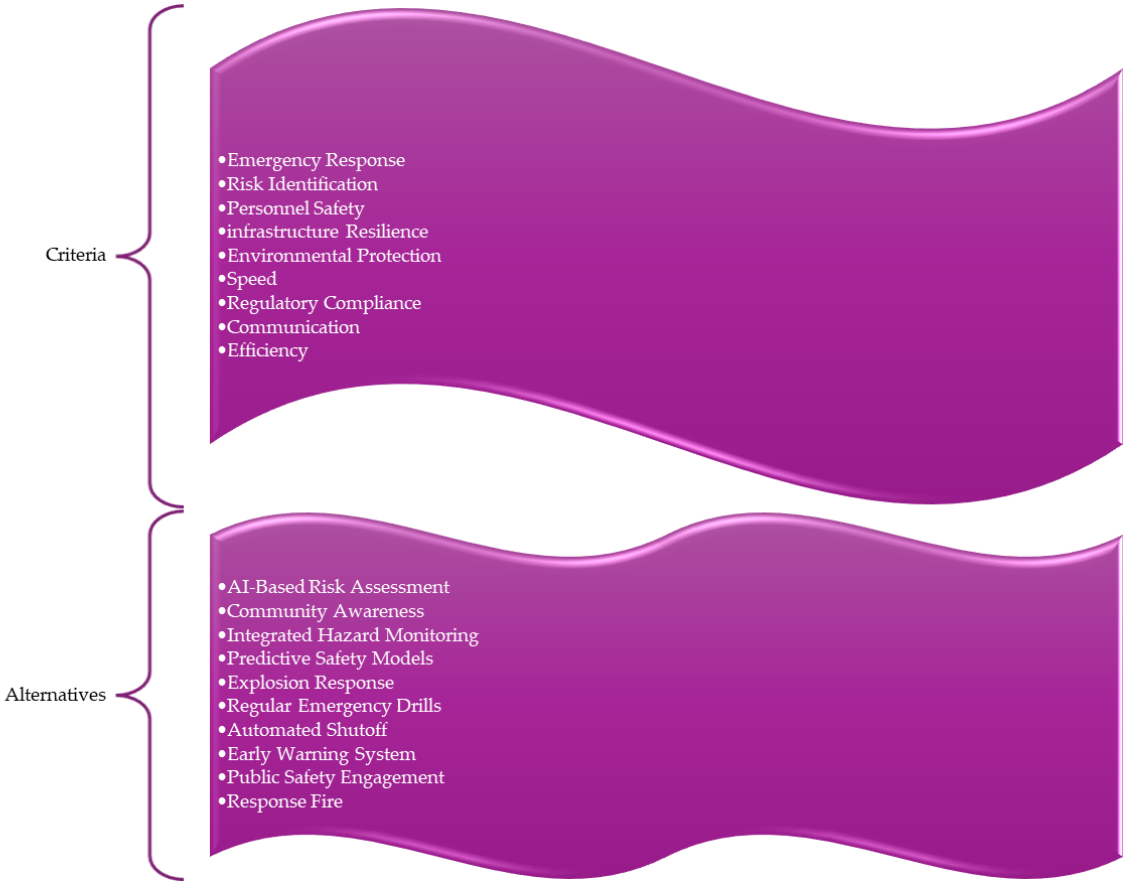

Fig 1. The safety emergency plans for petrochemical enterprises criteria.

1. Three experts are evaluated the criteria.

2. We put other criteria with set of levels. In this study we put two levels.

3. Eq. (3) is used to each criterion assigned into integral value

4. We defined r_0 is defined as the elasticity coefficient.

5. Eq. (24) is used to compute the influence function

6. Eq. (25) is used to compute the criteria weights as shown in Fig 2.

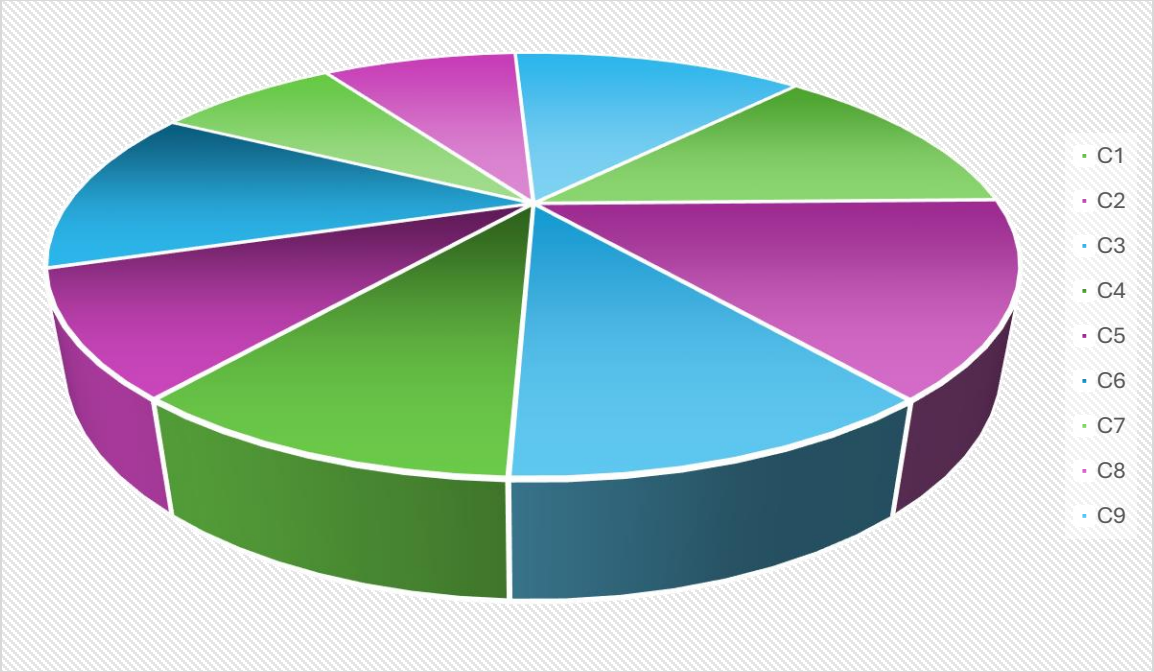

Fig 2. safety emergency plans for petrochemical enterprises criteria weights.

Then we applied the steps of the CoCoSo method to rank the alternatives

1. We used the IVTNNs to evaluate the criteria and alternatives as shown in Tables 1-3.

2. Eq. (27) is used to normalize the decision matrix as shown in Table 4. All criteria are beneficial criteria.

3. Eqs. (29 and 30) are used to compute the sum of weighted comparability and power weighted.

4. Eqs. (31, 32, and 33) are used to compute appraisal scores. We put π value with 0.5.

5. Eq. (34) is used to compute the combined score as shown in Fig 3.

6. Then we ranked the alternatives as shown in Fig 4.

Table 1. The first IVTNNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_2	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1	[((0.4,0.5,0.6,0.7),(0,0.1,0.2	[((0.2,0.3,0.4,0.5),(0,0.1,0.2	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1	[((0.4,0.5,0.6,0.7),(0,0.1,0.2

	,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_3	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_4	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_5	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_6	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_7	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_8	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_9	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_{10}	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0

	.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0. 1))]	.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0. 1))]	(0.1,0.1,0.1,0. 1))]	.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0. 1))]	.1,0.1,0.1,0.1))]	.1,0.1,0.1,0.1))]

Table 2. The second IVTNNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]
A_2	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]
A_3	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]
A_4	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]
A_5	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]
A_6	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0 .7,0.7,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]
A_7	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4 ,0.5,0.6,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7 ,0.7,0.7,0.7),(0,0.1,0.2,0.3), (0.1,0.1,0.1,0. 1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0 .5,0.6,0.7),(0, 0.1,0.2,0.3),(0 .1,0.1,0.1,0.1))]
A_8	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.4,0	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0	[((0.4,0.5,0.6, 0.7),(0,0.1,0.2 ,0.3),(0.1,0.1, 0.1,0.1)),((0.7	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.4	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0	[((0.2,0.3,0.4, 0.5),(0,0.1,0.2 ,0.3),(0,0.1,0. 2,0.2)),((0.7,0	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7	[((0,0.1,0.1,0. 2),(0.1,0.1,0.1 ,0.1),(0.6,0.7, 0.8,0.9)),((0.7

	.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_9	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_{10}	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]

Table 3. The third IVTNNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_2	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_3	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_4	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_5	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_6	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),

	(0.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]	.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]	.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]	(0.1,0.1,0.1,0.1))]
A_7	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_8	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_9	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]
A_{10}	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0,0.1,0.1,0.2),(0.1,0.1,0.1,0.1),(0.6,0.7,0.8,0.9)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.4,0.5,0.6,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]	[((0.2,0.3,0.4,0.5),(0,0.1,0.2,0.3),(0,0.1,0.2,0.2)),((0.7,0.7,0.7,0.7),(0,0.1,0.2,0.3),(0.1,0.1,0.1,0.1))]

Table 4. The normalized IVTNNs.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
A_1	0.311594	1	0.840909	0.130435	0.69697	0	0.934783	1	0
A_2	0	0.651515	0	1	0.840909	0.139535	0.130435	0	1
A_3	0.956522	0.886364	0.840909	0.130435	1	0.953488	0.57971	0.569767	0.804348
A_4	0.355072	0.30303	0.742424	0	0.651515	0.356589	1	0.069767	0.130435
A_5	0.57971	0.606061	0.371212	0.666667	0.045455	0.689922	0	0.895349	0.934783
A_6	1	0.045455	0.954545	0.268116	0.628788	0.333333	0.934783	0.569767	0
A_7	0	0.863636	0.045455	0.978261	0.977273	0.689922	0.333333	0	0.934783
A_8	0.934783	0.931818	1	0.311594	0.325758	0.930233	0.934783	0.5	0
A_9	0	0	0.280303	0.043478	0.136364	0.093023	0.57971	0	1
A_{10}	0.934783	0.090909	0.606061	1	0	1	0.398551	0.569767	0.804348

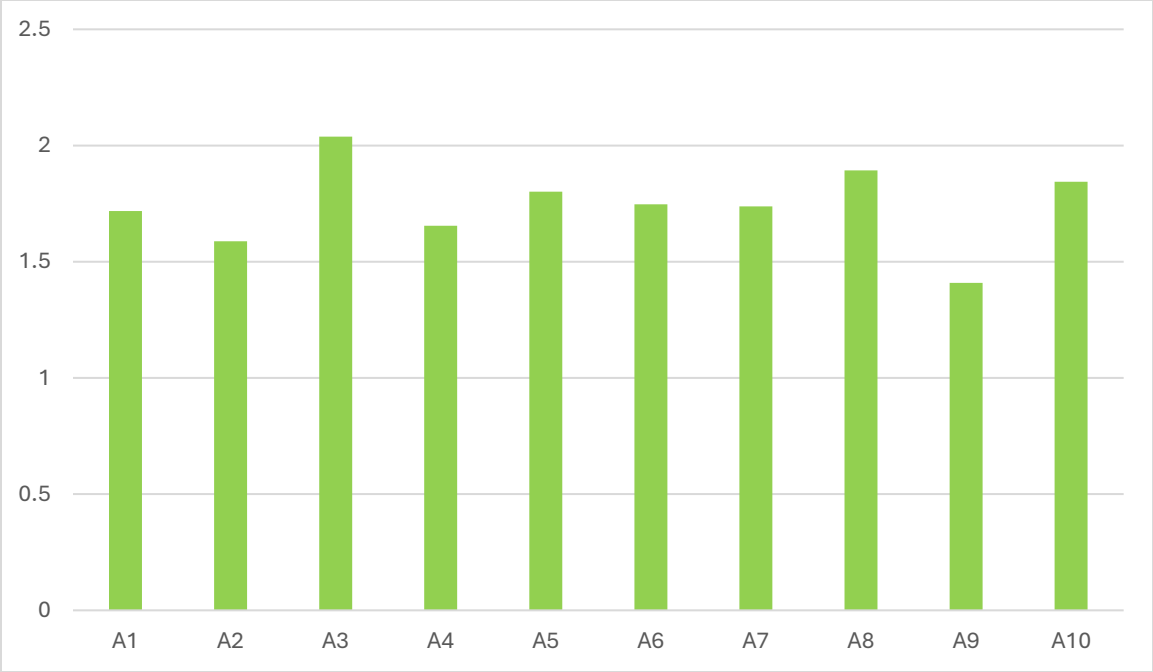

Fig 3. The combined score of each alternative.

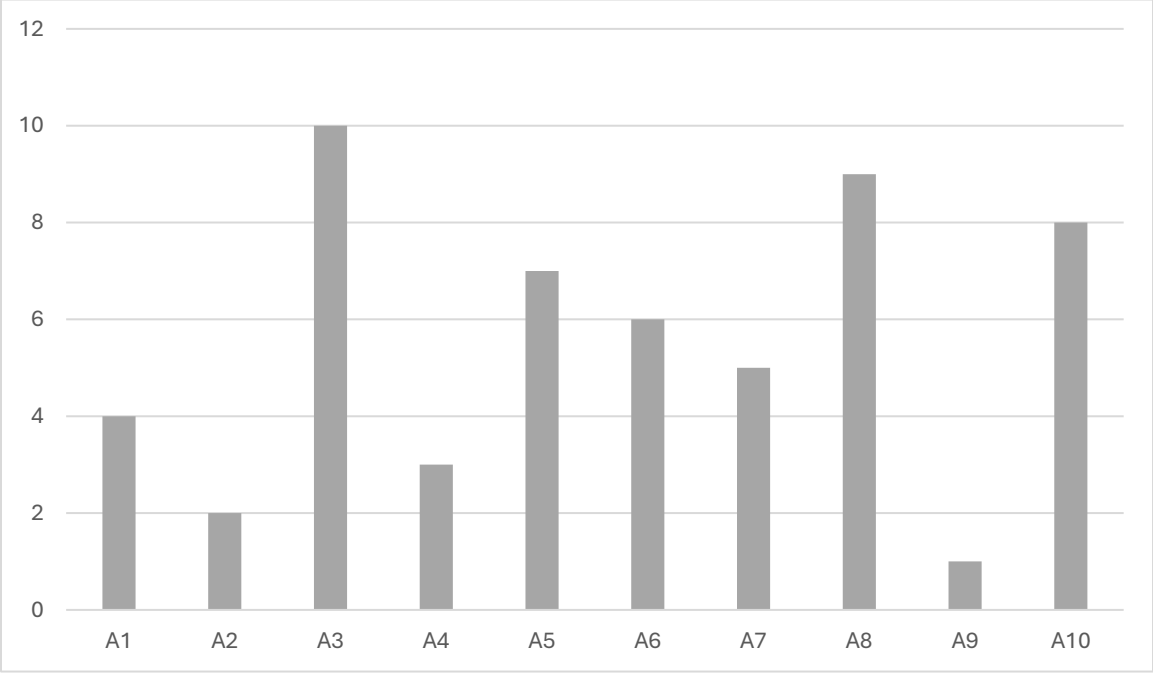

Fig 4. The rank of alternatives.

Sensitivity analysis

This section shows the ranks of alternatives under different cases. The aim of this sensitivity analysis is to show the stability of the rank under different cases. We change value of π value between 0 and 1. Then we rank the alternatives under different cases. Figs 5 and 6 show the combined scores and ranks of alternatives.

In case 1, we show alternative 3 is the best, followed by alternative 8, alternative 10, and alternative 5. We show the alternative 9 is the worst. In case 2, we show alternative 3 is the best, followed by alternative 8, alternative 10, and alternative 5. We show the alternative 9 is the worst. In case 3, we show alternative 3 is the best, followed by alternative 8, alternative 10, and alternative 5. We show the alternative 9 is the worst. In case 4, we show alternative 3 is the best, followed by alternative 8, alternative 10, and alternative 5. We show the alternative 9 is the worst.

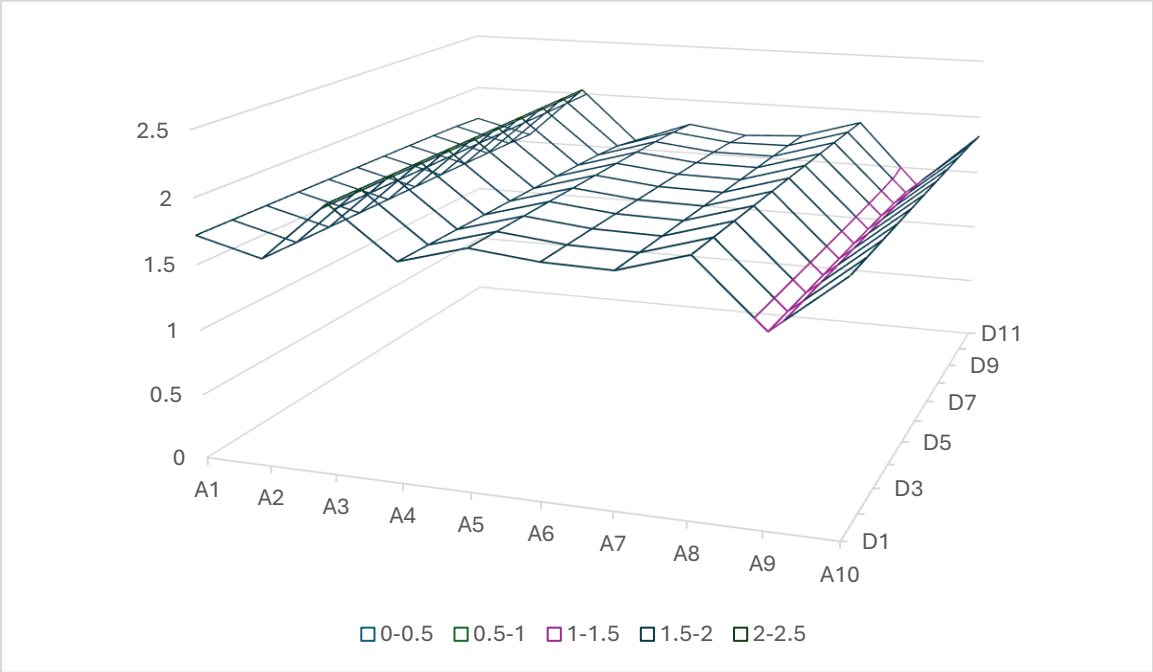

Fig 5. The different combined scores

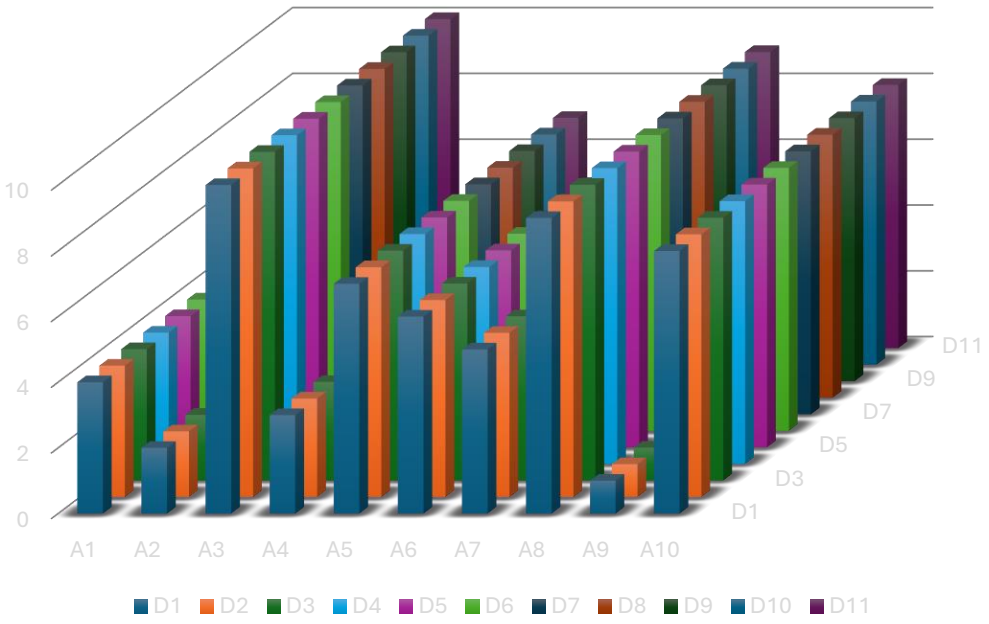

Fig 6. The different ranks.

5. Conclusions

This paper suggested the framework for evaluation of safety emergency plans for petrochemical enterprises. We used two decision making approaches in this study. We used LBWA to compute the criteria weights. Then we used the CoCoSo method to rank the alternatives. Two methods are used under the interval valued trapezoidal neutrosophic sets to dela with uncertainty and vague information. The criteria weights are computed such as Risk Identification which identify as the highest weights and the Regulatory Compliance criterion is defined as the lowest weights. The results show the alternative 3 is the best and alternative 9 is the worst. The sensitivity analysis was conducted between the ranks of the alternative. We proposed eleven cases, then we ranked the proposed approach into eleven cases. The results show the rank of alternatives is stable in different cases.

Acknowledgements

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