Retraction

Retracted: Aspiration of Public-Private Partnership Projects' Risk Management Supported on Probabilistic Linguistic Terms amid Weakened Hedges

Mathematical Problems in Engineering

Mathematical Problems in Engineering has retracted the article titled "Aspiration of Public-Private Partnership Projects' Risk Management Supported on Probabilistic Linguistic Terms amid Weakened Hedges" [1], due to concerns regarding overlap with a published article [2].

When contacted for a response, the authors confirmed the inappropriate overlap and the article is therefore being retracted due to these concerns with the agreement of the authors and the editorial board.

References

[1] Y. Sun, M. Ahmad, L. Rui, S. Ahmad, and Y. A. Khan, "Aspiration of public-private partnership projects' risk management supported on probabilistic linguistic terms amid weakened hedges," *Mathematical Problems in Engineering*, vol. 2021, Article ID 6669718, 17 pages, 2021.

[2] W. Lina and Xu. Zeshui, "The risk evaluation of PPP projects: a technique based on probabilistic linguistic terms with weakened hedges," *Journal of Intelligent and Fuzzy Systems*, vol. 41, no. 5, pp. 1173–1191, 2021.

Research Article

Aspiration of Public-Private Partnership Projects' Risk Management Supported on Probabilistic Linguistic Terms amid Weakened Hedges

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The provision of risk involved in a deal for a public-private partnership (PPP) is an essential aspect of triumph that should be based on the best smart party's opinion to organize it. This study anticipated the importance of risk management in PPP projects to adjust the risk management dilemma of the PPP projects' pedestal on the P-LTWHs with a new notion of FMEA. The dynamic linguistic expressions, P-LTWHs, were suggested in the theoretical aspect to articulate decision-makers' assessments, who take the reluctant information with weakened hedges and the likelihood of the linguistic information into account. Besides, the biprojection technique was used to rank risk management problem failure modes in a PPP project. The probabilistic linguistic terms with compromised hedges evaluate the risk management of the novel failure mode and impact analysis (NFMEA) and rank failure modes with the biprojection technique (P-LTWHs). This study also shows that it is possible to spread risks based on fuzzy set theory among public-private parties effectively. Likewise, with the biprojection practice of LTWHs with the VIKOR technique of P-LTWHs, the predicted model is estimated.

1. Introduction

Unlocking confidential organization requires the risk responsibility contribution in joint construction, the largest facilities available, in sequence and possessions, and individuals in common or confidential parts and expresses an opportunity for currency to recognize the structure [1]. Notable jobs for the accomplishment of PPP activities include public and private stakeholders. By assisting the automatic embrace up and projecting from the private portion, public segments are placed into a transportation mission to achieve high revenues with the aid of the following public sector occurrence [2]. The principles included are (1) the importance of the objectives of the use of confidential definition as well as the decision of the lessons of achievement of the PPP; (2) the implications of the risks of the provision of undertakings to the private sector; (3) the

necessity of a large and absolute legalized PPP organization; (4) the need to examine the incentive for cash, while the shipping arrangement was preferred [3].

The capacity of private components to deal with these threats is based on its (a) inspiration and unique mastery to discriminate and direct stealing with (b) additional authority to achieve cost efficiency more than growth potential and price and extrapopular momentum [4]. Risk management is a critical unpaid feature of the PPP project concerning the degree of uncertainty, diversity, and vagueness of risk aspects [5]. No risk mitigation in the classification to be supported must be entirely allocated to the private division. The PPP's achievement for business enterprises' growth in China failed to accommodate the private segment's full risk change goals from the open area [6]. While underlying a PPP venture, the organizations support chance management on a low recurrence risk assignment through the agreement swap

[7]. For a successful PPP implementation, the legal risk and the affiliation risks are essential variables. These risks are based on management techniques and soundness, although these risks need to be defined by the private division [8].

As the assembly works out, a separate heading for risk familiar proof process strength is not good because the information and sequence are forced [9]. In China's PPP ventures, almost all key risk items are at a national or production intensity rank, linked to monetary, subsequent, and legal circumstances [10]. The Spearman level association analysis showed no massive differentiation between respondents with and without concrete PPP practice on the role of the likelihood and outcome of risks known [11]. Failure Mode and Impact Analysis (FMEA) is a realistic analysis and removal of possible failures, issues, and services [12]. However, the conventional FMEA has several disadvantages during the process of handling risk factors [13]. First of all, there are several concerns with the O, S, and D weight tests. Secondly, the O, S, and D judgments may not be adequately reflected in a venture's risk management.

According to the novel FMEA (NFMEA) model, the RPN is expressed through the Project Feasibility Stage (PFS), the Project Bidding Stage (PBS), the Project Design Stage (PCS), and the Project Activity Stage (POS) in line with the Calculation Methods with Words (CWW) [14] to carry out risk management [15]. Optional scrap methodologies can be sufficiently expected between the public-private members using the fuzzy set system and RAC [16]. For additional testing and approval of the model [17], the artificial neural system and the fuzzy reasoning procedures will be obtained. A legendary technique is determined to break down venture risks and receive risk level evaluations of CRGs and tasks using fuzzy [18].

The fuzzy determination and the critical model of Choquet adequately predicted the real risk project based on the RMC worldview, when a risk division between public and private segments was routinely mixed up and needed to consider points of focus to decide on the actual scheme [19]. Fuzzy logic constructs allow us to construct risk data in two separate ways. (1) Risk evaluation outcomes flow into the energetic risk phase, and the outcome of the selection will then be able to refine the fuzzy sets, guidelines, and understanding of the framework [20]. (2) The frameworks remain risk managers and areas' specialists freed from the sourcing section for some risks. The fuzzy AHP approach needs to consider the complex multimodel problem in which the ability and convenience of the technique to produce valid FMEA outcomes have been affirmed [21]. In the complex method, the fuzzy calculation and the dim segment (2) specialists should not only use HFLTs or LTWHs to express the views of the master, and hybrid linguistic articulations should be used [22].

The reluctant fuzzy-linguistic PROMETHEE dual hierarchy was realistic in assessing a PPP project's success [23], which assesses substitutes by outranking flows. A persuasive strategy to take care of private division accomplice preference is performed in two distinct ways in a blurry coherent situation. Choose features first, identify potential accomplices, and get a detailed fuzzy evaluation [24]. In essence,

several new prepared PLTS laws are structured to ensure the limits of semantic term sets and the fulfillment of probabilities during the determination process [25]. The positioning technique for ORESTE and the probabilistic phonetic global inclination were combined [26].

The better FME RPN output can be used and coordinated with various techniques to advance the risk assessment process, such as fuzzy methodologies [27]. For analysis and dynamics, the FSE method is obtained. It handles the equivocality in the subjective RAC and precisely reflects the fuzziness in expert understanding that defines the dynamic of risk distribution. Five fundamental risk factors are distributed and addressed in water PPPs, including (1) outside swapping scale, (2) default of bills, (3) political obstruction (in levy setting and survey), (4) swelling cost, and (5) high operating expenses [28]. The DSS's fuzzy standard base's alignment is focused on how accurately the relations between pointers and their components have been characterized [29].

In a fuzzy area, there are numerous features of the dynamic hypothesis that require gradually intensive analysis, such as the control of fuzzy frameworks and the use of fuzzy algorithms, the concept of fuzzy critique, and its effect on dynamics [30]. Fuzzy risk assessment offers a promising method for calculating chance assessments where risk impacts are obscure and defined instead of goal details by emotional choices [31]. The cloud model's hypothesis is a persuasive technique for evaluating the fuzzy situation, taking into account the hypothesis of probability and the fuzzy semantic collection representing insecurity, fuzziness, and doubt [32]. An etymological variable's definition offers methods for approximating wonders that are overly complex or too poorly characterized to be manageable in standard quantitative terms [33]. The fuzzy risk assessment model has made it possible for nearby experts to predict the imaginable risk presentation via the PPP conspire of acquiring system superventures [34].

It discussed and applied the concept of a semantic variable to the impression of spatial-worldly limitations. A few problems with the representation of phonetic variables in scientific articulations remain intense [35]. Progressive designation rules and estimation of ambiguous semantic standards and experiential master knowledge have been implemented and developed by the fuzzy and adoptive model [36]. The useful portrayal mechanisms for mirroring specialists' real considerations in MEDM issues are semantic tendency orderings [37]. The cloud model, which constructs the conversation model with linguistic terms between the vocabulary of randomness and the conceptions of fuzziness, is a phrase awareness tool. A conversion mechanism for dealing with qualitative concepts and quantitative expressions is given by the cloud model, which could establish partiality relationships.

1.1. The Main Incentive Are Expressed in the Mutually Hypothetical and Realistic Characteristics. Evaluating the possibilities of various complex linguistic expressions is challenging for decision-makers. Therefore, together with

biprojections to denote the assessment details, we propose probabilistic linguistic terms with weakened hedges (P-LTWHs). In particular, according to the fuzzy theory and the likelihood theory, we establish linguistic words with weakened hedges (LTWHs) to P-LTWHs. To denote experts' assessments, the mathematical expression of P-LTWHs is formed. We are concerned with developing risk management estimates by the NFMEA for PPP projects with a biprojection model. There are many impulsive, unsettled, and convulsive tribulations in the risk management process, as risk management in a PPP project is an important practice for the complete life cycle. The NFMEA will define the PFS, PBS, PCS, and POS based on a PPP project's entire life cycle.

1.2. The Contributions of This Paper Are Listed by Two Aspects

(1) The P-LTWHs include weakened hedges, the theory of probability, and certain linguistic sets that convey complex linguistic expressions of vague knowledge. It further explains the quantitative and qualitative principles based on the cloud model, which gives thought to the degree of entropy and fuzziness.

(2) This paper analyses failure modes with P-LTWHs based on biprojection. Firstly, P-LTWHs represent experts' assessments, which could convey experts' hesitation through linguistic knowledge, weakened hedges, and the theory of probability. The NFMEA is used to study failure modes on behalf of the PPP project's risk management characteristics. Analyses of the modes of failure will then provide public and private stakeholders with assistance to increase risk management quality in a PPP project.

This paper's remainder is structured as follows: a few PLTS starters, the LTWHs, the cloud model, and the biprojection technique are reviewed in Section 2. The concept of P-LTWHs, operation laws, and accumulation managers are proposed in Section 3. In Section 4, an NFMEA model is studied to rank disappointment modes under the condition of P-LTWHs considering the biprojection procedure. Next, in Section 5, we apply the suggested risk model to the China-Russia East-Route Natural Gas pipeline's executive procedure. Section 6 is eventually drawn to a few ends and exploration bearings.

2. Primary Description of PLTS, LTWH, and Cloud Model

In this segment, the PLTSs and LTWHs are described, and the biprojection and the cloud models are described in sequence and operational rules.

2.1. Probabilistic Linguistic Term Sets.
The concept of PLTS is planned as well as the specifics are reported as follows:

Let $M = M\alpha | \alpha = 0, 1, \ldots, \tau$ be a LTS [36]. τ is the positive integer. The total order is $M_\alpha \leq M_\beta$, if $\alpha \leq \beta$ [37]. A PLTS mathematic expression is defined by [20]:

$$Jq = J^f q^f | J^f \in M \, q^f > 0, f = 1, 2, 3, \ldots, \#Jq, \sum_{f=1}^{\#M(p)} q^f \leq 1,$$

$$(1)$$

where q^f is the probability of the linguistic term J^f and $\#Jq$ is the number of all linguistic terms in $\mathbf{J} \, \mathbf{q}$. Particularly, $\sum_{f=1}^{\#M(p)} q^f \leq 1$ means the total information of rational linguistic terms, and $\sum_{f=1}^{\#M(p)} q^f \leq 0$. It demonstrates that the data is utter ignorance. Some PLTS operating laws are shown as a basis for proposing the novel notion. Let $J_1 q$, $J_2 q$, and $J_3 q$ be three ordered PLTSs based on $M, \lambda, \lambda_1, \lambda_2 \geq 0$, and then [20].

(i) $J_1 \, q \oplus J_2 \, 1q = J_2 \, q \oplus J_1 \, q$

(ii) $J_1 \, q \oplus J_2 \, q = J_2 \, q \oplus J_1 \, q$

(iii) $\lambda J_1 \, q = \vee_{J^f \in Jq} \lambda \, J^f \, q^f, \lambda \geq 0$

(iv) $J_1 \, q \, \lambda = \vee_{J^f \in Jq} J^f \, \lambda \, q^f$

2.2. Linguistic Terms with Weakened Hedges.
By means of Ref. [37], the weakened hedge set (WHS) is cleared through $G = gt | t = 1, 2, 3, \ldots, \mu$. The LTWH $[l = [g_t, M_\alpha]$ is uttered by a linguistic term with a weakened hedge, as well as the appearance is [38]:

$$[LTWH] := (\text{weakened hedge})(\text{atomic term}), \quad (2)$$

where (weakened hedge): $= g_t, g_t = G,$ (atomic term): $= M_\alpha$, and $M_\alpha \in M$. In this paper, we choose the weakened hedge set $G^{(4)} = \{g_0 = \text{definitely}, g_1 = \text{more or less}, g_2 = \text{roughly}, g_3 = \text{slightly}, g_4 = \text{barely}\}$. Some necessary operation rules of LTWHs are recalled to help define the laws of P-LTWHs. Let $l = \{g_t, M_\alpha\}, l_1 = \{g_{t_1}, M_{\alpha_1}.\},$ and $l_2 = \{g_{t_2}, M_{\alpha_2}\}$ be three LTWHs, then we have [38,39]

(i) $l_1 \oplus l_2 = \{g_{\max t_1, t_2}, M\alpha_1 + \alpha_2\}$

(ii) $l_1 \oplus l_2 = \{g_{\max t_1, t_2}, M\alpha_1 \alpha_2\}$

(iii) $\lambda l = \{g_{\lambda t}, M_{\lambda \alpha}\}$

(iv) $l^\lambda = \{g_{t^\lambda}, M_{\alpha^t}\}$

2.3. The Cloud Model Theory.
The cloud model is a competent way of changing the hesitant problems concerning probability theory and the theory of the fuzzy set. Specifically, a thought S separates a discussion more V, and let $x \in V$ be an arbitrary instantiation of S and $v_x, x \in 0, 1$. The degree of association of x goes to S, indicating an accidental numeral with a set tendency. Then, the association allocation is called a cloud of connections [28]. The three arithmetical factors are disclosed in the cloud model as follows [29]:

The most representative qualitative term is expectation Ex

The vagueness of a qualitative term implies Entropy En

He tests the unknown degree of En. Hyper entropy

The cloud standardization process must be established. The Gauss membership function and the usual cloud are shown as follows, according to the standard part [28].

Let V be the universe of discourse and S be a concept in V. If $\forall \in V$ is a concept of S, which meets $x \sim M (Fx, Fn^2)$, $Fn \sim M \, Fn$, De^2, and $y = e^{((-x-Fx^2)/2Fn^2)}$. Therefore, the arithmetical symbol of a normal cloud is expressed by $\overline{a} = Fx$, Fn, and De.

We mainly need to comprehend their operational laws before comparing various clouds. The rules for the process are shown as follows.

Let $a_1 = F_{x_1}$, Fn_1, and De_1 and $a_2 = Fx_2$, Fn_2, and De_2 be two normal clouds [29]:

(1) $a_1 + a_2 = Fx_1 + Fx_2$, $\sqrt{Fn_1^2 + Fn_2^2}$, and $\sqrt{De_1^2 + De_2^2}$

(2) $a_1 \times a_2 = Fx_1$, Fx_2, $\sqrt{Fn_1^2 Fx_2^2 + Fx_1 Fn_2^2}$, and $\sqrt{De_1 Fx_2^2 + De_2 Fn_2^2}$

(3) λ, $a_1 = \lambda$, F_{x_1}, $\sqrt{\lambda} . Fn_1$, $\sqrt{\lambda} \, De_1$, and λ, > 0

(4) $a_1^\lambda = F_{x_1}^\lambda$, $\sqrt{\lambda} \, F_{x_1}^{\lambda-1} \, Fn_1$, $\sqrt{\lambda} \, F_{x_1}^{\lambda-1} \, De_1$, and λ, > 0

And, the rules of comparison for two normal clouds are given as follows [29]:

(1) If $M_{1,2} = 2 \{Fx_1 - Fx_2\} > 0$, then $a_1 > a_2$

(2) If $M_{1,2} = 2 \{Fx_1 - Fx_2\} > 0$

if $Fn_1 < Fn_2$, then $a_1 > a_2$

if $Fn_1 = Fn_2$,

2.4. The BiProjection Method.

Given the decision matrix $Y = (y_{ij})_{m \times n}$ and $y_{ij} = [y_{ij}^l, y_{ij}^r]$, then $y_j^+ = [\max y_{ij}^l$ and $\max y_{ij}^r$ $i = 1, 2, 3, \ldots, n]$, and $j = 1, 2, 3, \ldots, m$ is the positive ideal solution (PIS). At the same time, the negative ideal solution (NIS) can be expressed with $y_j^- = [\max y_{ij}^-, \max y_{ij}^r$ $i = 1, 2, 3, \ldots, n$, and $i = 1, 2, 3, \ldots, n]$ and $j = 1, 2, 3, \ldots, m$. In the interval form, according to Ref. [40], y_{ij}^l and y_{ij}^r are called the "left part" and the "right part" of x_{ij}, respectively. Thus, the vectors of the "left part" and the "right part" in the PIS are denoted as follows [40]:

$$l^+ = y_{i1}^{l+}, y_{i2}^{l+}, \ldots, y_{im}^{l+},$$
$$r^+ = y_{i1}^{r+}, y_{i2}^{r+}, \ldots, y_{im}^{r+}, \tag{3}$$

where $y_{ij}^{l+} = \max y_{ij}^l$ $i = 1, 2, 3, \ldots, n$ and $y_{ij}^{r+} = \max y_{ij}^r$ $i = 1, 2, 3, \ldots, n$, $\forall [y_{ij}^l, y_{ij}^r] \in x_{ij}$, $j = 1, 2, \ldots, m$. Similarly, the vectors of the "left part" and the "right part" in the NIS are indicated by [40]:

$$l^- = y_{i1}^{l-}, y_{i2}^{l-}, \ldots, y_{im}^{l-},$$
$$r^- = y_{i1}^{r-}, y_{i2}^{r-}, \ldots, y_{im}^{r-}, \tag{4}$$

where $y_{ij}^{l-} = \max y_{ij}^l$ $i = 1, 2, 3, \ldots, n$, $y_{ij}^{r-} = \max y_{ij}^r$ $i = 1, 2, 3, \ldots, n$, $\forall [y_{ij}^l, y_{ij}^r] \in x_{ij}$, and $j = 1, 2, \ldots, m$. The deviation between the PIS and the NIS could be decomposed to its "left part," denoted as l_q^-, and its "right part," signified as r_q^-, as follows [40]:

$$l_q^- = y_{i1}^{l+} - y_{i1}^{l-}, y_{i2}^{l+} - y_{i2}^{l-}, \ldots, y_{im}^{l+} - y_{im}^{l-},$$
$$r_q^- = y_{i1}^{r+} - y_{i1}^{r-}, y_{i2}^{r+} - y_{i2}^{r-}, \ldots, y_{im}^{r+} - y_{im}^{r-}. \tag{5}$$

Similarly, the deviation between the alternative and the NIS could degrade to the "left part" denoted as "left part $l_{x_i}^-$," and its "right part," signified as $r_{x_i}^-$, as follows [40]:

$$l_{x_i}^- = y_{i1}^l - y_{i1}^{l-}, y_{i2}^l - y_{i2}^{l-}, \ldots, y_{im}^l - y_{im}^{l-},$$
$$r_{x_i}^- = y_{i1}^r - y_{i1}^{r-}, y_{i2}^r - y_{i2}^{r-}, \ldots, y_{im}^r - y_{im}^{r-}. \tag{6}$$

Then, respectively, the vector modules are expressed as follows:

$$|l_q^-| = \sqrt{\sum_{j=1}^m x_j^{l+} - x_j^{l-2}},$$

$$|r_q^-| = \sqrt{\sum_{j=1}^m x_j^{l+} - x_j^{l-2}},$$

$$|l_{x_i}^-| = \sqrt{\sum_{j=1}^m x_{ij}^l - x_j^{l-2}},$$

$$|r_{x_i}^-| = \sqrt{\sum_{j=1}^m x_{ij}^{r+} - x_j^{l-2}}. \tag{7}$$

Finally, the biprojection of the "left part," denoted as $qr_{l_q^-}^{l_{x_i}}$, is the projection of the vector l_q^- onto the vector r_q^-, which is expressed as

$$qr_{l_q^-}^{l_{x_i}} = \frac{\sum_{j=1}^n x_j^{l+} - x_j^{l-} \times x_{ij}^l - x_j^{l-}}{|l_q^-|}. \tag{8}$$

Finally, the biprojection of the "left part," denoted as $qr_{r_q^-}^{r_{x_i}}$, is the projection of the vector $r_{x_i}^-$ onto the vector r_q^-:

$$qr_{l_q^-}^{l_{x_i}} = \frac{\sum_{j=1}^n x_j^{r+} - x_j^{r-} \times x_{ij}^r - x_j^{r-}}{|r_q^-|}. \tag{9}$$

Finally, the biprojection of the "left part," denoted as $qr_{r_q^-}^{r_{x_i}}$, is the projection of the vector l_q^- onto the vector $l_{x_i}^-$:

$$qr_{l_{x_i}}^{l_q} = \frac{\sum_{j=1}^n x_j^{l+} - x_j^{l-} \times x_{ij}^l - x_j^{l-}}{|l_{x_i}^-|}. \tag{10}$$

Similarly, the other projection of the "right part," indicated as $qr_{r_{x_i}}^{r_q}$, is the projection of the vector l_q^- onto the vector $r_{x_i}^-$ having the following form:

$$qr_{r_{x_i}}^{r_q} = \frac{\sum_{j=1}^n x_j^{r+} - x_j^{r-} \times x_{ij}^r - x_j^{r-}}{|r_{x_i}^-|}. \tag{11}$$

Two projections are determined by the biprojection method: first, the projection is the vector generated by the NIS, and an alternative is projected onto the vector formed by the PIS and NIS. Secondly, the projection of the vector generated by the PIS and NIS is projected onto the vector consisting of the NIS and an alternative. Not only does the technique express the projection data for each alternative and the ideal solution but it also responds to the degree of proximity between different vectors.

3. The Probabilistic Linguistic Terms with Weakened Hedges

To better express the probabilistic information in CWW, we will propose the concept of the P-LTWHs and define some operation rules.

3.1. The Concept of P-LTWHs. As the issue has been addressed in the Introduction, it is poorly successful for decision-makers to communicate their judgments in practical problems with a hesitation degree or weakened hedges. In order to express the probability data in both linguistic terms and weakened hedges, the following concepts suggest the P-LTWHs and other techniques.

Definition 1. Let $l = (g_t, M)$ be an LTWH, a P-LTWH can be defined by the following mathematical symbol:

$$\mathcal{L}q = \mathcal{L}^k q^k | \mathcal{L} \in \ell q^k \geq 0, \quad k = 1, 2, \ldots, \#\mathcal{L}q,$$
$$\sum_{k=1}^{\#\mathcal{L}q} q^k \leq 1, \tag{12}$$

where $\mathcal{L}^k q^k = [g_t^k, M_\alpha^k] q^k$ and $\#\mathcal{L}q$ is the number of all different linguistic terms in $\mathcal{L}q$.

Example 1. Suppose that the WHS $D^2 = d_0 =$ definitely, $d_1 =$ more or less, and $d_2 =$ roughly, and the LTS $M = M_0 =$ very low, $M_1 =$ low, $M_2 =$ middle, $M_3 =$ high, and $M_4 =$ very high, and the P-LTWH could be expressed by $\mathcal{L}(q) = (\{[d_0, M_2], 0.4\}$ and $\{[d_1, M_3], 0.5\})$. The implication is that, where the likelihood of low is 0.4 and the probability of more or less is 0.5, the item is low or more or less high. We must put forward a technique to make comparisons with various P-LTWHs after defining P-LTWHs. However, during the comparison process, certain unsatisfactory conditions often occur. Firstly, if $\sum_{k=1}^{\#\mathcal{L}(p)} q^{(k)} < 1$, we have a P-LTWH to deal with ignorance. Secondly, given two separate ones, P-LTWHs $\mathcal{L}_1 q$ and $\mathcal{L}_2 q$, if $\# \mathcal{L}_1(q)$ and $\# \mathcal{L}_2(q)$, Comparing the two is complicated. To normalize P-LTWHs, we are going to suggest some rules.

3.2. The Normalization of P-LTWHs. The first task is to standardize the probability information, similar to the normalization of PLTSs [20], and the second is to normalize the numbers of P-LTWHs.

Definition 2. Given a P-LTWH $\mathcal{L}q$ with $\sum_{k=1}^{\#\mathcal{L}(p)} q^{(k)} < 1$, the associated P-LTWH $\mathcal{L}(q)$ can be shown by

$$\mathcal{L}q = \mathcal{L}^k q^k | k = 1, 2, \ldots, \#\mathcal{L}q, \tag{13}$$

where $q^k = q^k + 1 - \sum_{k=1}^{\#\mathcal{L}(q)} q^{(k)} \times (q^k / \sum_{k=1}^{\#\mathcal{L}(q)} q^{(k)})$, for all $k = 1, 2, \ldots, \# \mathcal{L}q$. Generally, in the process of decision analyses, the different numbers of P-LTWHs may lead to trouble to operate. In order to compare different P-LTWHs, the number of linguistic terms must be the same.

Example 2. Given two different P-LTWHs, by $\mathcal{L}_1 q = [d_0, M_4], 0.4, [d_1, M_3], 0.2, [d_2, M_2], 0.2$, and $\mathcal{L}_2 q = [d_1, M_4], 0.5, [d_2, M_2], 0.3$. According to the steps of normalization, we have

$$\overline{\mathcal{L}_1}q = [d0, M4], 0.5, [d1, M3], 0.25, [d2, M2], 0.25,$$
$$\overline{\mathcal{L}_2}q = [d1, M4], 0.625, [d2, M2], 0.485, [d2, M2], 0. \tag{14}$$

3.3. The Comparison between P-LTWHs. We can compare various P-LTWHs concerning the characteristics of the LTS and the WHS after considering the definition of P-LTWHs. It lists the specifics as follows:

Definition 3. Let $\mathcal{L}q$ is a P-LTWH, a linguistic term that defines the expected linguistic term $M_{\overline{\alpha}}$, where $\overline{\alpha} = \sum_{k=1}^{\#Aq} \alpha q^k / \sum_{k=1}^{\#Aq} q^k$ and the expected weakened hedge can be depicted $d_{\overline{t}}$, where $\overline{t} = \sum_{k=1}^{\#Aq} tq^k / \sum_{k=1}^{\#Aq} q^k$. Based on Definition.4, for any two P-LTWHs $\mathcal{L}_1 q$ and $\mathcal{L}_2 q$, in terms of the LTS and the WHS, the comparison details are shown as follows:

(1) If $M_{\alpha_1} > M_{\alpha_2}$, then $\mathcal{L}_1 q > \mathcal{L}_2 q$
(2) if $M_{\alpha_1} < M_{\alpha_2}$, then $\mathcal{L}_1 q < \mathcal{L}_2 q$
(3) if $M_{\alpha_1} > M_{\alpha_2}$, then we have
(a) if $d_{t_1} > d_{t_2}$, then $\mathcal{L}_1 q < \mathcal{L}_2 q$
(b) if $d_{t_1} < d_{t_2}$, then $\mathcal{L}_1 q > \mathcal{L}_2 q$
(c) if $d_{t_1} = d_{t_2}$, then $\mathcal{L}_1 q \sim \mathcal{L}_2 q$

Example 3. Consider the two P-LTWHs in Example.2, according to Definition.3, we have

$$\alpha_1 = 5 \times 0.6 + 4 \times 0.30 + 3 \times 0.30 / 0.6 + 0.30 + 0.30$$
$$\alpha_2 = 5 \times 0.625 + 3 \times 0.485 + 3 \times 0 / 0.625 + 0.485 \tag{15}$$

Because of $M_{\alpha_1} = M_{\alpha_2} = M_{3.25}$, we need to calculate $d_{\overline{t}}$:

$$\overline{t}_1 = 0 \times 0.6 + 2 \times 0.30 + 3 \times 0.30 / 0.6 + 0.30 + 0.30$$
$$\overline{t}_2 = 2 \times 0.625 + 3 \times 0.485 + 3 \times 0 / 0.625 + 0.485 \tag{16}$$

Thus, $d_1 < d_{2.375}$ then $\mathcal{L}_1 q > \mathcal{L}_2 q$.

3.4. The Operation Rules of P-LTWHs. We will have some operating rules for P-LTWHs to solve practical problems according to the operating laws of PLTSs and LTWHs. We presume that all P-LTWHs are normalized for measuring convenience. The specifics are illustrated as follows:

Theorem 1. Let $\mathcal{L}_i q_i^k | k = 1, 2, \ldots, \# \mathcal{L}_i^k q$, $i = 1, 2, 3$, and $\# \mathcal{L}_1 q = \# \mathcal{L}_2 q = \# \mathcal{L}_3 q$ be three P-LTWHs, λ_1, λ_2, and $\lambda_3 \geq 0$, then

(1) $\lambda \mathcal{L}_1 q \oplus \mathcal{L}_2 q = \mathcal{L}_2 q_2 \oplus \mathcal{L}_2 q_1$
(2) $\lambda \mathcal{L}_1 q_1 \oplus \mathcal{L}_2 q_2 = \lambda \mathcal{L}_{1'} q_1 \oplus \lambda \mathcal{L}_2 q_2$
(3) $\lambda_1 + \lambda_2 \mathcal{L}q = \lambda_1 \mathcal{L}q \oplus \lambda_2 \mathcal{L}q$

(4) $\mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2 = \mathscr{L}_2 q_2 \oplus \mathscr{L}_1 q_1$

(5) $\mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2^\lambda = \mathscr{L}_2 q_1^\lambda \oplus \mathscr{L}_1 q_2^\lambda$

(6) $\mathscr{L}_3 q^{\lambda_1 + \lambda_2} = \mathscr{L}_2 q^{\lambda_1}, \oplus \mathscr{L}_3 q^{\lambda_2}$

Attestation.

(1) $\mathscr{L}_1 \oplus \mathscr{L}_2 = \coprod_{k=1}^{\mathscr{L}_1 q^1} d^k_{\max t_1 t_2}, M^k_{\alpha_1 + \alpha_2}, \quad q^k_1 + q^k_2 n = \coprod_{k=1}^{\mathscr{L}_1 q^1} d^k_{\max t_2 t_1}, M^k_{\alpha_2 + \alpha_1}, \text{ and } q^k_2 + q^k_1 = \mathscr{L}_2 \oplus \mathscr{L}_1$

(2) $\lambda \mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2 = \lambda, \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_1} \oplus d^k_{t_2}, M^k_{\alpha_1} \oplus M^k_{\alpha_1}, q^k_1 + q^k_2 = \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{\lambda t_1}, M^k_{\lambda \alpha_1}, \lambda q^k_1 \oplus \coprod_{d^k_{t_2}, M^k_{\alpha_2} \in \mathscr{L}_2 q_2} d^k_{\lambda t_1}, M^k_{\lambda \alpha_1}, \text{ and } \lambda q^k_2 = \lambda \mathscr{L}_1 q_1 \oplus \lambda \mathscr{L}_2 q_2$

(3) $\lambda_1 + \lambda_2 \mathscr{L} q = \lambda_1 \oplus \lambda_2 \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_1} \oplus d^k_{t_2}, M^k_{\alpha_1} \oplus M^k_{\alpha_1}, q^k_1 + q^k_2 = \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{\lambda_1 t_1} \oplus d^k_{\lambda_2 t_2}, M^k_{\lambda_1 \alpha_1} \oplus M^k_{\lambda_2 \alpha_2}, \text{ and } \lambda_1 q^k_1 + \lambda_2 q^k_2 = \lambda_1 \mathscr{L} q \oplus \lambda_2 \mathscr{L} q$

(4) $\mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2 = \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_1} \oplus d^k_{t_2}, M^k_{\alpha_1} \oplus M^k_{\alpha_2}, q^k_1 \times q^k_2 = \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_2} \oplus d^k_{t_1}, M^k_{\alpha_2} \oplus M^k_{\alpha_1}, \text{ and } q^k_2 \times q^k_1$

$= \mathscr{L}_2 q_2 \oplus \mathscr{L}_1 q_1$

(5) $\mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2 = \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_1^\lambda} \oplus d^k_{t_2^\lambda}, M^k_{\alpha_1^\lambda} \oplus M^k_{\alpha_1^\lambda}$ and $q^{\lambda k}_1 q^{\lambda k}_2 = \mathscr{L}_1 q_1^\lambda \oplus \mathscr{L}_2 q_2^\lambda$

(6) $\mathscr{L}_3 q^{\lambda_1 + \lambda_2} = \coprod_{k=1}^{\mathscr{L}_3 q} d^k_{t^{\lambda_1}}, M^k_{\alpha^{\lambda_1}}, q^{\lambda_1 k} \oplus \coprod_{k=1}^{\mathscr{L}_3 q} d^k_{t^{\lambda_2}}, M^k_{\alpha^{\lambda_2}}, q^{\lambda_2 k}$

3.5. The Aggregation Operators for P-LTWHs.
For combined data below the unclear issues, some simple aggregation operators are shown as follows.

Definition 4. Let $\mathscr{L}_i q = \mathscr{L}_i^k \mathscr{L}_i^k q_i^k | k = 1, 2, \ldots, \# \mathscr{L}_i q \, i = 1, 2, \ldots, m$ be "m" normalized P-LTWHs, the P-LTWHs arithmetical averaging (P-LTWHA) operator is

$$\mathscr{L}_1 q_1, \mathscr{L}_2 q_2, \ldots, \mathscr{L}_m q_m = \frac{1}{m}, \mathscr{L}_1 q_1 \oplus \mathscr{L}_2 q_2 \oplus \cdots \oplus \mathscr{L}_m q_m,$$

$$= \frac{1}{m} \coprod_{k=1}^{\mathscr{L}_1 q_1} d^k_{t_1} \oplus d^k_{t_2} \oplus \cdots \oplus d^k_{t_m}, M^k_{\alpha_1} \oplus M^k_{\alpha_2} \oplus \cdots \oplus M^k_{\alpha_m}, q^k_1 + q^k_2 + \cdots + q^k_m, \qquad (17)$$

$$= \frac{1}{m} \left\{ \left(d \, \text{round} \left(\max_{i = 1, 2, \ldots, m} t_1 \right) S \, \text{round} \right) \sum_{i=1}^{m} \alpha_i, \ldots, \sum_{i=1}^{m} q_i \right\}.$$

Example 4. Given the WHS and LTS are defined in Example 1, three different normalized P-LTWHs are

$$\mathscr{L}_1 = \langle d_0, M_4 \rangle, 0.60, \langle d_1, M_3 \rangle, 0.70,$$
$$\mathscr{L}_2 = \langle d_4, M_3 \rangle, 0.575, \langle d_3, M_0 \rangle, 0.465, \qquad (18)$$
$$\mathscr{L}_3 = \langle d_1, M_2 \rangle, 0.475, \langle d_3, M_0 \rangle, 0.425.$$

According to the P-LTWHA operator, we have

$$\text{P} - \text{LTWHA}[\mathscr{L}_1(q_1), \mathscr{L}_2(q_2), \mathscr{L}_3(q_3)]$$

$$= \frac{1}{3} \{ d \, (\text{round} \, (\max(0, 2, 1)) S \, \text{round}) \, (4 + 3 + 2) \} \{ (1.6, d \, \text{round} \, (\max(0, 2, 1))) S \} \qquad (19)$$

$$(\{\text{round} \, (4 + 3 + 2), 1.4\} = \{ \langle d_1, M_3 \rangle, 0.63, \langle d_3, M_0 \rangle, 0.57 \}).$$

The weights of the P-LTWHs in the P-LTWHA operator are identical. In contrast, it is not sufficient for the P-LTWHA operator to only aggregate the language information, especially when the weights of the P-LTWHs are different. We provide the weighted average operator of P-LTWHs to aggregate complex, dynamic, and incomplete linguistic knowledge. And, the concept is demonstrated as follows.

4. Multicriteria Decision-Making with P-LTWHs

The multicriteria decision-making (MCDM) problem is defined in this section within the setting of P-LTWHs. Afterward, experts with P-LTWHs measure the failure modes and rate them according to the biprojection model. The proposed method is described in four phases: (1) the

failure modes are evaluated and translated into clouds with P-LTWHs; (2) the weights of the experts are constructed based on the names, expertise, and experience of the experts; (3) the evaluations are shown and determined by the cloud matrix; (4) the failure modes are defined in terms of the biprojection model. Therefore, in Figure 1, the specifics are shown.

$$\mathbb{R} = \mathscr{L}_{ij}q_{m \times n} \begin{pmatrix} & CRF_1 & CRF_2 & \dots & \dots & CRF_n \\ FM_1 & \mathscr{L}_{11}q & \mathscr{L}_{12}q & \dots & \mathscr{L}_{1n}q \\ FM_2 & \mathscr{L}_{21}q & \mathscr{L}_{22}q & \dots & \mathscr{L}_{2n}q \\ \vdots & \vdots & \vdots & \vdots & \dots & \vdots \\ & \vdots & \vdots & \vdots & \dots & \vdots \\ & \vdots & \vdots & \vdots & \dots & \vdots \\ FM_m & \mathscr{L}_{m1}q & \mathscr{L}_{m2}q & \dots & \mathscr{L}_{mn}q \end{pmatrix},$$

$$\mathscr{L}_{ij}(q) = \left\{ \mathscr{L}_{ij}^{(k)}\left(q_{ij}^{(k)}\right) | k = 1,2,3,\dots,\#\mathscr{L}_{ij}(q)\right\}, \quad i = 1,2,3,\dots,m, j = 1,2,3,\dots,n. \tag{20}$$

We assume that each P-LTWH is normalized.

4.2. The Procedure of the NFMEA Based on P-LTWHs.
Based on the above analyses, the procedures of risk management are listed as follows:

Stage 1: convert P-LTWHs' information into clouds.

Step 1: evaluate failure modes with P-LTWHs.
The dynamic linguistic expressions, P-LTWHs, are used in the risk management process because of the complexity and vagueness of realistic problems to express the ratings of the NFMEA members under the essential modes of risk failure. Let $\mathbb{R} = (\mathscr{L}_{ij}(q)_{m \times n}$ be the evaluation matrix of the θth expert of the NFMEA team, where $\mathscr{L}_{ij} q$ is the value of TM_θ in terms of CRF$_j$.
Step 2: transform P-LTWHs' matrix into the cloud matrix.
Each P-LTWH could be transferred into a normal cloud based on the cloud theory and will be expressed with $\bar{c}_{ij}^{(\theta)} = (Fx_{ij}^{(\theta)}, Fn_{ij}^{(\theta)}, De_{ij}^{(\theta)})$; next, the cloud matrix will be denoted as $\bar{c}_{ij}^{(\theta)} = (\bar{c}_{ij}^{(\theta)})_{m \times n}$ and $\theta = 1,2,3,\dots,g$.

Stage 2: determine the weights of NFMEA members.

They will explain different assessments of the same failure modes due to the different backgrounds, understanding, and interests of different experts. Consequently, during the crucial risk management phase, it is important to assign the weights of team members.

Step 3: build the weight table.
We presume in this paper that the weights depend on professional titles, work experience, and risk expectations of team members.

4.1. Problem Description.
We represent failure modes with P-LTWHs, inspired by the need to evaluate failure modes, and use the biprojection model to rank failure modes. For a risk management problem, the members of the team TM_θ $\theta = 1, 2, 3, \dots, g$ evaluate failure modes TM_i $i = 1, 2, 3, \dots, m$ concerning the CRF_j $j = 1, 2, 3, \dots, n$ with P-LTWHs. And, the evaluations are shown in the decision matrix $\mathbb{R} = (\mathscr{L}_{ij}(q))_{m \times n}$:

Step 4: determine the weights of NFMEA team members.
Based on the professional title, job experience, and risk preference of each member of the NFMEA team, the weight of the TM_θ is expressed by $\omega_\theta = (T_\theta / \sum_{\theta=1}^{g})$, $\theta = 1, 2, \dots, g$ where T_θ is the weight score of TM_θ derived by Step 3.

Stage 3: calculate the cloud matrix.

The cloud matrix is aggregated and weighted in this step, and the details are shown as follows.

Step 5: calculate the integrated cloud matrix.
In order to incorporate the cloud assessment matrix, the cloud weighted averaging (CWA) operator [29] is used. The interconnected matrix of clouds $\overline{C} = \bar{\bar{c}}_{ij_{m \times n}}$ is indicated by

$$\tilde{c}_{ij} = \left(Fx_{ij}, Fn_{ij}, De_{ij}\right) = CWA\left(\tilde{c}_{ij}^1, \tilde{c}_{ij}^2, \dots, \tilde{c}_{ij}^n\right)$$

$$= \left(\sum_{\theta=1}^{h} \Omega_\theta Fx_{ij}^\theta \sqrt{\sum_{\theta=1}^{h} \Omega_\theta \left(Fn_{ij}^\theta\right)^2} \sqrt{\sum_{\theta=1}^{h} \Omega_\theta \left(De_{ij}^\theta\right)^2}\right). \tag{21}$$

Step 6: calculate the weight cloud matrix.
The weighted cloud matrix $\check{C} = \tilde{c}_{ij_{m \times n}}$ [29]. Based on the optimized cloud matrix and weights of important risk factors, the calculation is carried out. The mathematical expression is then explained as follows:

$$\check{C} = w_r \tilde{c}_{ij}, \quad i = 1, 2, 3, \dots, m, j = 1, 2, 3, \dots, n, \tag{22}$$

where w_r is the weight of each critical risk factors, $w_r \in 0,1$, and $\sum_{r=1}^{m} w_r = 1$.
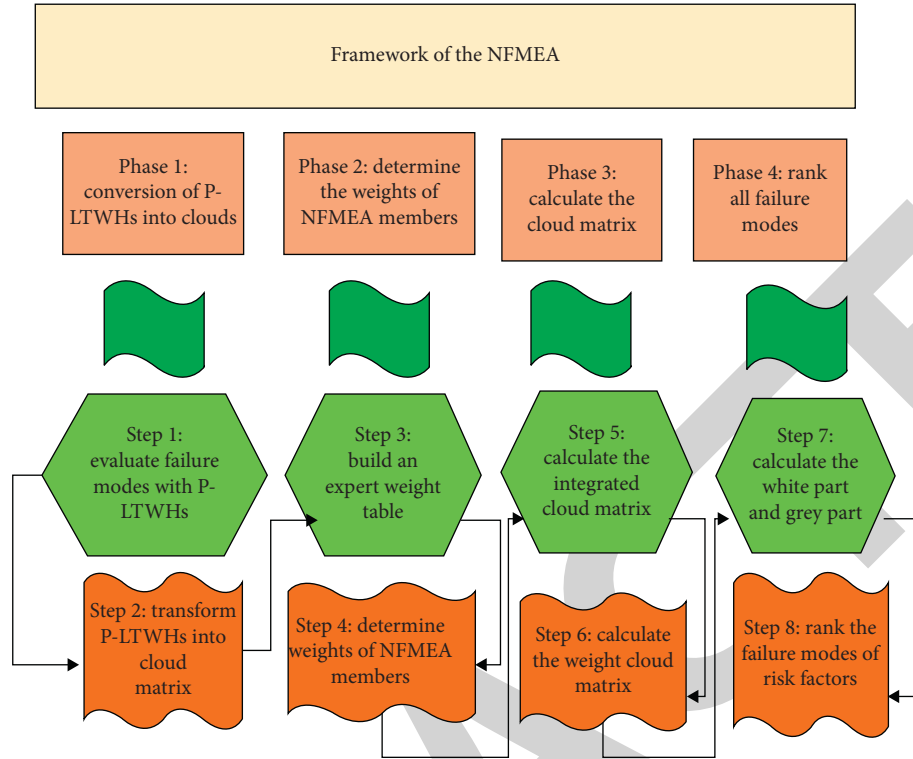
Figure 1: The framework of the NFMEA.

Stage 4: rank all failure modes.

The failure modes are rated with respect to the biprojection model at this point.

Step 7: calculate the biprojections.

The "left part" and the "right part" centered on the biprojection are shown as follows, according to Ref. [41] and Equations (23–26):

$$\delta_i^l = \frac{\left(Qs_{l_q^-}^{l_{x_i}^-}\right)^2}{\left(Qs_{l_q^-}^{l_{x_i}^-}\right)^2 + \left(Qs_{l_{x_i}^-}^{l_q^-}\right)^2},$$

$$\delta_i^r = \frac{\left(Qs_{l_q^-}^{r_{x_i}^-}\right)^2}{\left(Qs_{r_q^-}^{r_{x_i}^-}\right)^2 + \left(Qs_{r_{x_i}^-}^{r_q^-}\right)^2}.$$

(23)

Step 8: determine the ranking of failure modes:

$$y_i = s\delta_i^l + (1-s)\delta_i^r.$$

(24)

The proposed approach classifies the failure modes based on the biprojection technique, which has two advantages: first, the P-LTWHs' form takes the likelihood of knowledge from linguistic words and considers the compromised hedges in the aspect of complex linguistic expressions. Second, a way to quantify the fuzzy information is given by the merits of the cloud model. The biprojection method takes the relation between the PIS and the NIS in the ranking method aspect and calculates the link between the NIS and the alternative. Accordingly, the proposed model could improve risk management efficiency.

5. An Illustrative Example

The issue of risk management is used in this section to demonstrate the availability and practicality of the proposed model for constructing the PPP Power of Siberia gas pipeline project.

5.1. Background of the Risk Management for the PPP Project. According to a contract signed in 2014 between Gazprom and China's CNPC, Russia will supply 38 billion cubic meters of gas to China annually for 30 years, according to the building of the Power of Siberia gas pipeline. Several features could cause the sophistication, dynamics, and fuzziness of the risk management process. Due to the importance of the project, the variety of capital, and the partners' complexity, the first aspect is important to the various partners (there are many partners, namely, the construction of the Siberian gas pipeline investment company Strength. Another aspect is the risk factors, such as the likelihood of risk factors, the degree of harm of risk factors, and the dynamics of r.

The failure modes are used in this paper to discuss the risk management of constructing the Power of Siberia gas pipeline. Studying failure modes will decrease the risk factors' possibility and increase project performance efficiency. The three risk management processes in the construction of Siberia gas pipeline are represented in Table 1.

TABLE 1: Three basic components of risk management.

Groups symbol	Functions	Failure modes	
Risk identification	Identify the known/ unknown risk factors	Unrecognized critical risk factors	FM_1
Risk evaluation	Assess the probability and the severity degree of risk	Improper assessments of risks probabilities	FM_2
		Negative results of improper evaluation	FM_3
		Unreasonable risk allocation among partners	FM_4
Risk allocation	Allocate risk factors with effective, reasonable, and impartial	Unreasonable risk allocation of negative results	FM_5

In terms of professional titles, work experience, and risk priorities, NFMEA team members' value is listed. And, Table 2 shows the data.

Several important risk factors need to be analyzed in the risk assessment process to ensure that failure modes are assessed effectively. Based on the four levels, the essential risk factors are classified into 9 groups, namely, the PFS, the PBS, the PCS, and the POS. The structure of risk factors and the four phases' weight are also shown in Figure 2, respectively, and Table 3.

5.2. The Proposed Model for the PPP Project of Risk Management.
Three experts analyze the five failure modes, and the judgments are expressed with complex linguistic phrases, where the LTS is

$$M = \left\{ \begin{array}{l} M_{-4} = \text{Absolutely insignificant}(Ai), M_{-3} = \text{Quite insignificant}(Qi), M_{-2} = \text{insignificant}(I) \\ M_{-1} = \text{moderately insignificant}(Mi), M_0 = \text{Middling}(M), M_1 = \text{moderately significant}(Ms) \\ M_2 = \text{Significant}(S), M_3 = \text{Quite insignificant}(Qs), M_4 = \text{absolutely significant}(As) \end{array} \right\}. \tag{25}$$

And, the WHS is

$$D^{(4)} = \{d_0 = \text{definitely}, d_1 = \text{more or less}, d_2 = \text{roughly}, d_3 = \text{slightly}, d_4 = \text{barely}\}. \tag{26}$$

Therefore, the experts express their judgments concerning P-LTWHs, and the result is set out in Table 4.

The clouds are represented using the golden segmentation process, according to the conversion rules between linguistic knowledge and the cloud module. The specifics are, therefore, illustrated as follows:

Stage 1convert P-LTWHs into clouds.

According to different meanings of the WHS d_t and the $LTSS_\alpha$, we take them as two clouds. Set the domain $V = 0$, 30, $De_2^h = 0.08$ and $De_2^h = 0.06$. Then, the basic clouds of WHS and LTS are listed as

$$\left\{ \begin{array}{l} \widetilde{w}_{d_0} = (1.836, 0.566, 0.064), \\ \widetilde{w}_{d_1} = (3.843, 0.412, 0.043), \\ \widetilde{w}_{d_2} = (6, 0.283, 0.06), \\ \widetilde{w}_{d_3} = (6.345, 0.456, 0.043), \\ \widetilde{w}_{d_4} = (8.452, 0.576, 0.061), \end{array} \right. \left\{ \begin{array}{l} \widetilde{w}_{s_{-4}} = (4.42, 1.53, 0.078), \\ \widetilde{w}_{s_{-3}} = (4.52, 0.74, 0.082), \\ \widetilde{w}_{s_{-2}} = (4.65, 0.57, 0.064), \\ \widetilde{w}_{s_{-1}} = (4.86, 0.45, 0.044), \\ \widetilde{w}_{s_0} = (5, 0.46, 0.04), \end{array} \right. \left\{ \begin{array}{l} \widetilde{w}_{d_1} = (3.843, 0.412, 0.043), \\ \widetilde{w}_{d_2} = (6, 0.283, 0.06), \\ \widetilde{w}_{d_3} = (6.345, 0.456, 0.043), \\ \widetilde{w}_{d_4} = (8.452, 0.576, 0.061). \end{array} \right. \tag{27}$$

Next, the three-team members' gestures are converted into standard matrices of clouds. And, in Table 5, the usual cloud assessment matrix of three experts is shown.

Stage 2: determine the weights of NFMEA members

The weights are listed in Table 6 according to the members' professional title, job experience, and risk preference.

Stage 3: calculate the cloud matrix

The integrated normal cloud matrix is shown in Table 7, as indicated by phase 5. In Table 8, the weighted values of the different phases are then computed using the usual cloud matrix.

Stage 4: rank the NFMEA

In keeping with the biprojection model, rank failure modes and details are then seen as follows: we need to list the left sequence and the right sequence primarily:

TABLE 2: The weight table of the NFMEA team member.

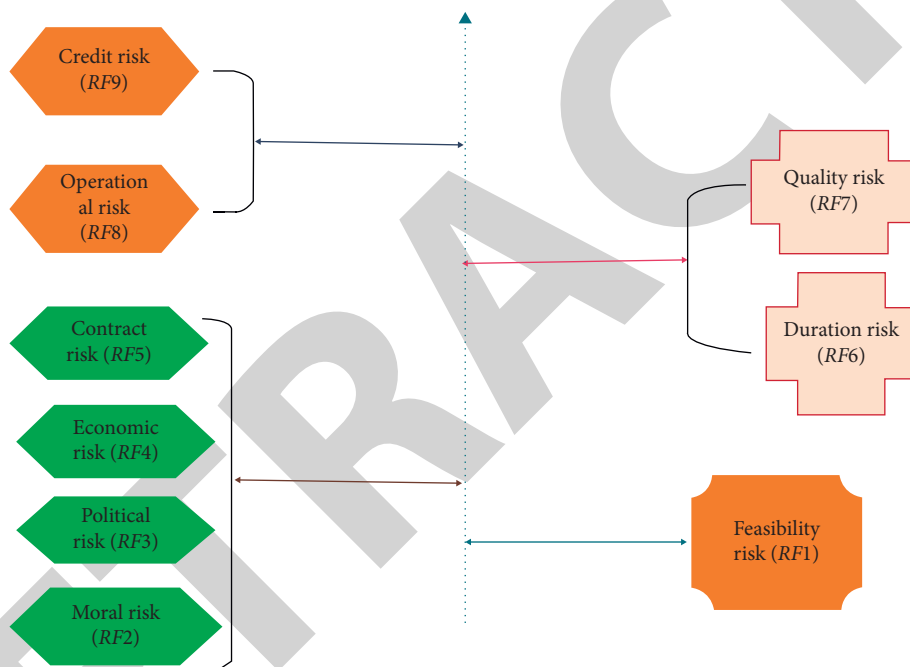| Aspects	Classes	Scores
Professional title	Senior	7
	Intermediate	4
	Junior	2
Work experience	>15 years	6
	10–15 years	4
	5–10 years	3
	<5 years	2
Risk preference	Positive	7
	Neutral	4
	Negative	2

FIGURE 2: The structure of risk factors.

TABLE 3: The weights of project life cycle and risk factors.

Stages	Weights	Risk factors	Local weights (W_f)	Final weights
PFS	0.3	Feasibility risk RF_1	1.00	0.3
PBS	0.4	Moral risk RF_2	0.28	0.082
		Political risk RF_3	0.342	0.0826
		Economic risk RF_4	0.41	0.097
		Contract risk RF_5	0.312	0.0832
PCS	0.45	Duration risk RF_6	0.64	0.199
		Quality risk RF_7	0.54	0.193
POS	0.25	Operational risk RF_8	0.52	0.082
		Credit risk RF_9	0.63	0.081

$*w_f = q_f \times c_f$, where q_f means the possibility of risk occurence.

TABLE 4: Experts express their judgments with P-LTWHs, and the result is listed.

FM$_i$	PFS	PBS	
	RF$_1$	RF$_2$	RF$_3$
FM$_1$	⟨d_0, Bi⟩, 0.45, ⟨d_1, S⟩, 0.81	⟨d_0, Ri⟩, 0.6, ⟨d_1, Rs⟩, 0.6	⟨d_0, Ri⟩, 0.35, ⟨d_1, S⟩, 0.81
	⟨d_2, I⟩, 0.64, ⟨d_3, Si⟩, 0.65	⟨d_0, Sr⟩, 0.5, ⟨d_3, I⟩, 0.7	⟨d_2, Rs⟩, 0.6, ⟨d_3, Si⟩, 0.60
	⟨d_1, M⟩, 0.4, ⟨d_2, Bs⟩, 0.85	⟨d_2, Ri⟩, 0.8, ⟨d_3, M⟩, 0.4	⟨d_1, I⟩, 0.45, ⟨d_2, S⟩, 0.81
FM$_2$	⟨d_0, S⟩, 0.45, ⟨d_3, Bs⟩, 0.81	⟨d_0, Bi⟩, 0.81, ⟨d_4, Qi⟩, 0.45	⟨d_1, Si⟩, 0.45, ⟨d_0, S⟩, 0.81
	⟨d_1, Qs⟩, 0.64, ⟨d_2, Si⟩, 0.65	⟨d_2, Si⟩, 0.65, ⟨d_4, Rs⟩, 0.64	⟨d_2, Bs⟩, 0.5, ⟨d_4, Ri⟩, 0.7
	⟨d_4, S⟩, 0.5, ⟨d_0, Si⟩, 0.60	⟨d_1, M⟩, 0.7, ⟨d_3, Si⟩, 0.5	⟨d_1, Si⟩, 0.64, ⟨d_3, Ss⟩, 0.45
FM$_3$	⟨d_2, Si⟩, 0.4, ⟨d_4, Qs⟩, 0.8	⟨d_0, Bi⟩, 0.63, ⟨d_4, Ri⟩, 0.57	⟨d_1, S⟩, 0.6, ⟨d_4, Ri⟩, 0.6
	⟨d_0, S⟩, 0.46, ⟨d_3, Bs⟩, 0.74	⟨d_1, Ss⟩, 0.48, ⟨d_3, S⟩, 0.72	⟨d_2, Ss⟩, 0.42, ⟨d_3, I⟩, 0.78
	⟨d_1, I⟩, 0.65, ⟨d_2, Si⟩, 0.67	⟨d_2, Rs⟩, 0.56, ⟨d_0, Bi⟩, 0.64	⟨d_0, Si⟩, 0.48, ⟨d_1, S⟩, 0.62
FM$_4$	⟨d_1, Rs⟩, 0.72, ⟨d_2, I⟩, 0.48	⟨d_4, Rs⟩, 0.62, ⟨d_2, Bs⟩, 0.58	⟨d_0, Ri⟩, 0.52, ⟨d_1, S⟩, 0.68
	⟨d_0, Si⟩, 0.57, ⟨d_3, Ss⟩, 0.43	⟨d_3, I⟩, 0.47, ⟨d_0, Si⟩, 0.73	⟨d_1, I⟩, 0.45, ⟨d_3, Bi⟩, 0.81
	⟨d_1, Qs⟩, 0.61, ⟨d_2, Bi⟩, 0.49	⟨d_4, Ri⟩, 0.81, ⟨d_2, S⟩, 0.39	⟨d_2, Ri⟩, 0.43, ⟨d_4, S⟩, 0.77
FM$_5$	⟨d_0, Bi⟩, 0.7, ⟨d_4, Ri⟩, 0.5	⟨d_2, I⟩, 0.47, ⟨d_0, Si⟩, 0.73	⟨d_1, I⟩, 0.44, ⟨d_0, M⟩, 0.76
	⟨d_2, Si⟩, 0.6, ⟨d_3, Rs⟩, 0.6	⟨d_1, S⟩, 0.49, ⟨d_4, Rs⟩, 0.97	⟨d_4, S⟩, 0.45, ⟨d_2, Bi⟩, 0.81
	⟨d_1, Bi⟩, 0.56, ⟨d_0, S⟩, 0.64	⟨d_3, I⟩, 0.64, ⟨d_2, Bs⟩, 0.65	⟨d_3, I⟩, 0.68, ⟨d_1, Rs⟩, 0.5

FM$_i$	PFS	PBS	
	RF$_4$	RF$_5$	RF$_6$
FM$_1$	⟨d_0, S⟩, 0.38, ⟨d_2, Bs⟩, 0.82	⟨d_1, I⟩, 0.72, ⟨d_0, S⟩, 0.48	⟨d_1, M⟩, 0.58, ⟨d_0, Ss⟩, 0.62
	⟨d_4, Ri⟩, 0.58, ⟨d_3, Ss⟩, 0.62	⟨d_2, Rs⟩, 0.47, ⟨d_4, Mi⟩, 0.73	⟨d_3, Bi⟩, 0.69, ⟨d_4, Rs⟩, 0.51
	⟨d_1, S⟩, 0.46, ⟨d_0, S⟩, 0.74	⟨d_1, Ss⟩, 0.59, ⟨d_3, I⟩, 0.61	⟨d_2, M⟩, 0.47, ⟨d_1, Bs⟩, 0.73
FM$_2$	⟨d_4, I⟩, 0.48, ⟨d_2, Ss⟩, 0.72	⟨d_0, Bi⟩, 0.64, ⟨d_3, S⟩, 0.64	⟨d_2, Si⟩, 0.57, ⟨d_4, Rs⟩, 0.63
	⟨d_0, Bi⟩, 0.42, ⟨d_3, S⟩, 0.68	⟨d_1, S⟩, 0.61, ⟨d_4, Rs⟩, 0.59	⟨d_1, Bs⟩, 0.67, ⟨d_0, Bi⟩, 0.65
	⟨d_4, S⟩, 0.46, ⟨d_1, I⟩, 0.74	⟨d_0, Ss⟩, 0.47, ⟨d_4, Bi⟩, 0.73	⟨d_3, Bi⟩, 0.6, ⟨d_2, Ri⟩, 0.6
FM$_3$	⟨d_2, I⟩, 0.48, ⟨d_0, Rs⟩, 0.72	⟨d_1, S⟩, 0.56, ⟨d_0, Bi⟩, 0.64	⟨d_1, I⟩, 0.49, ⟨d_0, S⟩, 0.97
	⟨d_1, M⟩, 0.58, ⟨d_4, Rs⟩, 0.62	⟨d_4, I⟩, 0.68, ⟨d_3, Ss⟩, 0.52	⟨d_2, Rs⟩, 0.44, ⟨d_3, Bi⟩, 0.76
	⟨d_3, I⟩, 0.42, ⟨d_2, Bs⟩, 0.68	⟨d_2, S⟩, 0.58, ⟨d_1, Bs⟩, 0.62	⟨d_4, I⟩, 0.48, ⟨d_1, Ri⟩, 0.73
FM$_4$	⟨d_0, Bi⟩, 0.72, ⟨d_4, Ri⟩, 0.48	⟨d_1, Ss⟩, 0.46, ⟨d_4, Rs⟩, 0.74	⟨d_1, S⟩, 0.42, ⟨d_4, Ri⟩, 0.78
	⟨d_2, Ss⟩, 0.47, ⟨d_3, I⟩, 0.73	⟨d_2, Bi⟩, 0.56, ⟨d_3, I⟩, 0.64	⟨d_2, Ss⟩, 0.47, ⟨d_3, I⟩, 0.73
	⟨d_0, S⟩, 0.61, ⟨d_1, Bi⟩, 0.59	⟨d_0, Ss⟩, 0.61, ⟨d_1, Si⟩, 0.59	⟨d_0, S⟩, 0.57, ⟨d_1, Si⟩, 0.63
FM$_5$	⟨d_4, S⟩, 0.61, ⟨d_2, Bi⟩, 0.59	⟨d_0, Ss⟩, 0.61, ⟨d_1, Si⟩, 0.59	⟨d_1, S⟩, 0.45, ⟨d_3, Ri⟩, 0.81
	⟨d_1, Si⟩, 0.72, ⟨d_0, Bi⟩, 0.48	⟨d_3, Ri⟩, 0.52, ⟨d_2, Ss⟩, 0.68	⟨d_4, Ri⟩, 0.64, ⟨d_2, Ss⟩, 0.65
	⟨d_3, I⟩, 0.45, ⟨d_4, M⟩, 0.81	⟨d_1, Bi⟩, 0.67, ⟨d_0, I⟩, 0.65	⟨d_1, Bi⟩, 0.56, ⟨d_0, Rs⟩, 0.64

FM$_i$	PFS	PBS	
	RF$_7$	RF$_8$	RF$_9$
FM$_1$	⟨d_1, I⟩, 0.44, ⟨d_3, S⟩, 0.76	⟨d_3, I⟩, 0.58, ⟨d_2, Ss⟩, 0.62	⟨d_1, Rs⟩, 0.59, ⟨d_2, I⟩, 0.61
	⟨d_4, S⟩, 0.6, ⟨d_2, Bi⟩, 0.6	⟨d_0, Bi⟩, 0.47, ⟨d_4, S⟩, 0.73	⟨d_3, Ss⟩, 0.66, ⟨d_0, Si⟩, 0.54
	⟨d_1, Rs⟩, 0.65, ⟨d_0, I⟩, 0.67	⟨d_1, I⟩, 0.52, ⟨d_3, Bs⟩, 0.68	⟨d_1, Si⟩, 0.51, ⟨d_2, Si⟩, 0.69
FM$_2$	⟨d_4, I⟩, 0.74, ⟨d_2, Rs⟩, 0.46	⟨d_2, Si⟩, 0.64, ⟨d_4, Rs⟩, 0.56	⟨d_0, Bi⟩, 0.67, ⟨d_3, Ri⟩, 0.6
	⟨d_1, Si⟩, 0.77, ⟨d_2, Rs⟩, 0.46	⟨d_2, Si⟩, 0.64, ⟨d_4, Rs⟩, 0.56	⟨d_0, Bi⟩, 0.6, ⟨d_3, Ri⟩, 0.6
	⟨d_3, I⟩, 0.81, ⟨d_4, M⟩, 0.45	⟨d_1, Mi⟩, 0.67, ⟨d_2, I⟩, 0.65	⟨d_0, S⟩, 0.65, ⟨d_1, Bi⟩, 0.67
FM$_3$	⟨d_2, Ss⟩, 0.58, ⟨d_0, Si⟩, 0.62	⟨d_1, S⟩, 0.81, ⟨d_4, Ri⟩, 0.45	⟨d_2, I⟩, 0.47, ⟨d_0, Si⟩, 0.73
	⟨d_1, S⟩, 0.64, ⟨d_3, Bi⟩, 0.56	⟨d_3, I⟩, 0.65, ⟨d_2, Ss⟩, 0.64	⟨d_1, Bi⟩, 0.57, ⟨d_4, Rs⟩, 0.63
	⟨d_4, Ss⟩, 0.46, ⟨d_2, Ri⟩, 0.76	⟨d_0, S⟩, 0.63, ⟨d_1, Si⟩, 0.57	⟨d_3, I⟩, 0.5, ⟨d_2, Bs⟩, 0.5
FM$_4$	⟨d_2, Si⟩, 0.97, ⟨d_3, Rs⟩, 0.49	⟨d_1, Rs⟩, 0.44, ⟨d_2, I⟩, 0.76	⟨d_3, Bi⟩, 0.49, ⟨d_4, Ri⟩, 0.97
	⟨d_1, Bs⟩, 0.72, ⟨d_4, Bi⟩, 0.48	⟨d_4, Ss⟩, 0.6, ⟨d_0, Si⟩, 0.6	⟨d_0, Ss⟩, 0.63, ⟨d_2, I⟩, 0.58
	⟨d_4, Si⟩, 0.5, ⟨d_2, Ri⟩, 0.7	⟨d_3, Rs⟩, 0.57, ⟨$very$, Bi⟩, 0.63	⟨d_1, Bi⟩, 0.56, ⟨d_3, Rs⟩, 0.64
FM$_5$	⟨d_0, S⟩, 0.65, ⟨d_4, I⟩, 0.67	⟨d_1, Si⟩, 0.64, ⟨d_0, S⟩, 0.56	⟨d_4, Rs⟩, 0.5, ⟨d_3, Rs⟩, 0.7
	⟨d_1, S⟩, 0.69, ⟨d_3, Rs⟩, 0.51	⟨d_4, Ri⟩, 0.52, ⟨d_2, Bs⟩, 0.68	⟨d_4, I⟩, 0.81, ⟨d_0, Si⟩, 0.45
	⟨d_2, S⟩, 0.97, ⟨d_0, Ss⟩, 0.49	⟨d_3, Si⟩, 0.65, ⟨d_1, I⟩, 0.64	⟨d_4, S⟩, 0.6, ⟨d_1, Rs⟩, 0.60

$$
\begin{aligned}
Y^+ &= 0.96, 1.13, 0.19, 0.02 \quad 1.46, 1.9, 0.58, 5.09 \quad 1.7, 1.74, 0.5, 0.09 \quad 0.74, 0.81, 0.28, 0.08, \\
Y^- &= 0.96, 1.13, 0.19, 0.08 \quad 1.47, 1.64, 0.64, 0.09 \quad 1.81, 1.83, 0.31, 0.08 \quad 0.81, 0.76, 0.27, 0.04.
\end{aligned}
\tag{28}
$$

TABLE 5: The normalized cloud evaluation matrix.

FM$_i$	PFS	PBS	
	RF$_1$	RF$_2$	RF$_3$
FM$_1$	4.89, 6, 0.93, 0.09	6, 5.23, 0.65, 0.43	6.05, 5.34, 0.65, 0.09
	4.99, 5.34, 0.34, 0.09	4.79, 5.12, 0.34, 0.08	5.09, 5.01, 0.65, 0.09
	5.23, 5.05, 0.54, 0.09	5.23, 5.09, 0.39, 0.09	5.09, 5.0, 0.22, 0.04
FM$_2$	5, 5.23, 1.08, 0.06	4.99, 5.05, 0.43, 0.08,	5, 5.09, 0.23, 0.04
	4.92, 5.23, 0.95, 5.09	4.92, 5.02, 0.58, 0.16	5.09, 5.02, 0.34, 0.08
	4.15, 5.09, 0.19, 0.04	4.99, 5.09, 0.73, 0.14	4.99, 5.09, 0.22, 0.04
FM$_3$	5.09, 5.09, 0.56, 0.09	4.94, 5.09, 1.17, 0.28	5.01, 5.09, 0.26, 0.04
	4.95, 5.08, 0.66, 5.09	4.94, 4.95, 0.26, 0.04	5.02, 5.07, 0.81, 0.19
	4.93, 4.99, 0.29, 0.04	4.99, 5.09, 0.28, 0.04	4.95, 5.23, 0.28, 0.06
FM$_4$	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
	4.93, 5.0, 1.13, 0.27	4.93, 5.0, 0.28, 0.06	5.09, 5.07, 0.33, 0.04
	4.15, 5.23, 0.28, 0.06	5, 5.09, 0.65, 0.09	5, 5.02, 0.42, 0.06
FM$_5$	5, 5.09, 0.69, 5.09	4.93, 5.09, 0.63, 0.16	4.99, 5.070, 4, 0.08
	4.95, 5.1, 0.28, 0.04	4.95, 5.23, 0.97, 0.16	5.09, 5.09, 0.79, 0.19
	4.94, 5.09, 0.46, 0.65	5.02, 5.09, 0.65, 0.09	4.99, 5.09, 0.65, 0.48

FM$_i$	PFS	PBS	
	RF$_4$	RF$_5$	RF$_6$
FM$_1$	4.99, 5, 0.85, 0.09	5, 5.23, 0.59, 0.34	5.09, 5.07, 0.47, 0.08
	4.94, 5.23, 0.28, 0.09	5.01, 5.23, 0.23, 0.04	4.94, 4.96, 0.56, 0.08
	5.09, 5.07, 0.47, 0.09	5.23, 5.09, 0.39, 0.09	5.09, 5.0, 0.22, 0.04
FM$_2$	5, 5.23, 1.07, 0.06	4.99, 5.07, 0.43, 0.08	5, 5.09, 0.23, 0.04
	4.92, 5.23, 0.95, 5.09	4.92, 5.02, 0.58, 0.16	5.09, 5.02, 0.34, 0.08
	4.15, 5.09, 0.19, 0.04	4.99, 5.09, 0.73, 0.14	4.99, 5.01, 0.22, 0.04
FM$_3$	5.09, 5.09, 0.56, 0.09	4.94, 5.09, 1.17, 0.28	5.01, 5.09, 0.26, 0.04
	4.95, 5.08, 0.66, 5.09	4.94, 4.95, 0.26, 0.04	5.02, 5.07, 0.81, 0.19
	4.93, 4.99, 0.29, 0.04	4.99, 5.09, 0.28, 0.04	4.95, 5.23, 0.28, 0.06
FM$_4$	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
	4.93, 5.07, 1.13, 0.27	4.93, 5.07, 0.28, 0.06	5.09, 5.07, 0.33, 0.04
	4.15, 5.23, 0.28, 0.06	5, 5.09, 0.65, 0.09	5, 5.02, 0.42, 0.06

TABLE 5: Continued.

FM$_i$	PFS	PBS	
FM$_5$	5, 5.09, 0.69, 5.09	4.93, 5.09, 0.63, 0.16	4.99, 5.07, 0.4, 0.08
	4.95, 5.8, 0.28, 0.04	4.95, 5.23, 0.97, 0.16	5.09, 5.09, 0.79, 0.19
	4.94, 5.09, 0.46, 0.65	5.02, 5.09, 0.65, 0.09	4.99, 5.09, 0.65, 0.48

FM$_i$	PFS	PBS	
	RF$_4$	RF$_5$	RF$_6$
FM$_1$	4.99, 5, 0.85, 0.09	5, 5.23, 0.59, 0.34	5.09, 5.07, 0.47, 0.08
	4.94, 5.23, 0.28, 0.09	5.01, 5.23, 0.23, 0.04	4.94, 4.96, 0.56, 0.08
	5.09, 5.07, 0.47, 0.09	5.23, 5.09, 0.39, 0.09	5.09, 5.0, 0.22, 0.04
FM$_2$	5, 5.23, 1.07, 0.06	4.99, 5.07, 0.43, 0.08	5, 5.09, 0.23, 0.04
	4.92, 5.23, 0.95, 5.09	4.92, 5.02, 0.58, 0.16	5.09, 5.02, 0.34, 0.08
	4.15, 5.09, 0.19, 0.04	4.99, 5.09, 0.73, 0.14	4.99, 5.01, 0.22, 0.04
FM$_3$	5.09, 5.09, 0.56, 0.09	4.94, 5.09,1.17, 0.28	5.01, 5.09, 0.26, 0.04
	4.95, 5.08, 0.66, 5.09	4.94, 4.95, 0.26, 0.04	5.02, 5.07, 0.81, 0.19
	4.93, 4.99, 0.29, 0.04	4.99, 5.09, 0.28, 0.04	4.95, 5.23, 0.28, 0.06
FM$_4$	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
	4.93, 5.07, 1.13, 0.27	4.93, 5.07, 0.28, 0.06	5.09, 5.07, 0.33, 0.04
	4.15, 5.23, 0.28, 0.06	5, 5.09, 0.65, 0.09	5, 5.02, 0.42, 0.06
FM$_5$	5, 5.09, 0.69, 5.09	4.93, 5.09, 0.63, 0.16	4.99, 5.07, 0.4, 0.08
	4.95, 5.1, 0.28, 0.04	4.95, 5.23, 0.97, 0.16	5.09, 5.09, 0.79, 0.19
	4.94, 5.09, 0.46, 0.65	5.02, 5.09, 0.65, 0.09	4.99, 5.09, 0.65, 0.48

TABLE 6: Weights of NFMEA members.

Weights	TM_1	TM_2	TM_3
T_θ	13	18	14
ω_θ	0.367	0.543	0.4

In addition, we calculate the biprojections:

$$\begin{cases} Ps_1^r Y^- Y^{+(Y^-X_1)} = 0.0098, \\ Ps_2^r Y^- Y^{+(Y^-X_2)} = 0.00018, \\ Ps_3^r Y^- Y^{+(Y^-X_3)} = 0.042, \\ Ps_4^r Y^- Y^{+(Y^-X_4)} = 0.0047, \\ Ps_5^r Y^- Y^{+(Y^-X_5)} = 0.0473, \end{cases} \begin{cases} Ps_1^l Y^- Y^{+(Y^-X_1)} = 0.0098, \\ Ps_2^l Y^- Y^{+(Y^-X_2)} = 0.0033, \\ Ps_3^l Y^- Y^{+(Y^-X_3)} = 0.0417, \\ Ps_4^l Y^- Y^{+(Y^-X_4)} = 0.0011, \\ Ps_5^l Y^- Y^{+(Y^-X_4)} = 0.9125. \end{cases}$$

(29)

TABLE 7: The normalized cloud evaluation matrix.

FM_i	PFS	PBS	
	RF_1	RF_2	RF_3
FM_1	4.99, 5, 0.85, 0.09	5, 5.23, 0.59, 0.34	5.09, 5.07, 0.47, 0.08
FM_2	5, 5.23, 1.0, 0.06	4.99, 5.07, 0.43, 0.08	5, 5.09, 0.23, 0.04
FM_3	5.09, 5.09, 0.56, 0.09	4.94, 5.09, 1.17, 0.28	5.01, 5.09, 0.26, 0.04
FM_4	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
FM_5	5, 5.09, 0.69, 5.09	4.93, 5.09 0.63, 0.16	4.99, 5.07, 0.4, 0.08
FM_i	PBS	PCS	
	RF_4	RF_5	RF_6
FM_1	4.99, 5, 0.85, 0.09	5, 5.23, 0.59, 0.34	5.09, 5.07, 0.47, 0.08
FM_2	5, 5.23, 1.07, 0.06	4.99, 5.07, 0.43, 0.08	5, 5.09, 0.23, 0.04
FM_3	5.09, 5.09, 0.56, 0.09	4.94, 5.09, 1.17, 0.28	5.01, 5.09, 0.26, 0.04
FM_4	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
FM_5	5, 5.09, 0.69, 5.09	4.93, 5.09, 0.63, 0.16	4.99, 5.07, 0.4, 0.08
FM_i	PCS	POS	
	RF_7	RF_8	RF_9
FM_1	4.99, 5, 0.85, 0.09	5, 5.23, 0.59, 0.34	5.09, 5.07, 0.47, 0.08
FM_2	5, 5.23, 1.0, 0.06	4.99, 5.07, 0.43, 0.08	5, 5.09, 0.23, 0.04
FM_3	5.09, 5.09, 0.56, 0.09	4.94, 5.09, 1.17, 0.28	5.01, 5.09, 0.26, 0.04
FM_4	5.09, 5.09, 0.56, 0.09	4.92, 5.02, 0.28, 0.04	4.96, 5.02, 0.73, 5.09
FM_5	5, 5.09, 0.69, 5.09	4.93, 5.09, 0.63, 0.16	4.99, 5.07, 0.4, 0.08

TABLE 8: The weighted cloud matrix of different stages.

FM_i	PFS	PBS	PCS	POS
FM_1	0.96, 1.13, 0.35, 0.14	1.43, 1.52, 0.48, 0.1	1.74, 1.76, 0.65, 0.08	0.81, 0.76, 0.33, 0.08
FM_2	0.96, 1.13, 0.19, 0.01	1.46, 1.5, 0.58, 5.09	1.7, 1.74, 0.5, 0.09	0.74, 0.81, 0.28, 0.08
FM_3	0.96, 1.13, 0.19, 0.06	1.47, 1.52, 0.64, 0.09	1.81, 1.83, 0.31, 0.08	0.81, 0.76, 0.27, 0.04
FM_4	0.96, 1, 0.1, 0.04	1.44, 1.51, 0.59, 5.09	1.72, 1.81, 0.44, 0.07	0.74, 0.81, 0.3, 0.08
FM_5	0.96, 1.13, 0.28, 0.04	1.49, 1.51, 0.6, 0.31	1.81, 1.76, 0.36, 0.06	0.81, 0.76, 0.3, 0.06

Moreover, we list the coefficient of consistency δ_i $i = 1$, 2, 3, 4, and 5:

$$\begin{cases} \delta_1^r = 0.600, \\ \delta_1^l = 0.7642, \end{cases} \begin{cases} \delta_2^r = 0.4475, \\ \delta_2^l = 0.4050, \end{cases} \begin{cases} \delta_3^r = 0.6884, \\ \delta_3^l = 0.9790, \end{cases} \begin{cases} \delta_4^r = 0.2342, \\ \delta_4^l = 0.2153, \end{cases} \begin{cases} \delta_5^r = 0.5744, \\ \delta_2^l = 0.4050. \end{cases} \quad (30)$$

Finally, calculate the comprehensive consistency coefficient x_i and rank all alternatives in accordance with $x_i = s\delta_i^r + (1-s)\delta_i^l$ and $s \in 0$ and 1:

$$\begin{aligned} x_1 &= 0.6001s + 0.7642 \quad 1-s, \\ x_2 &= 0.4475s + 0.4050 \quad 1-s, \\ x_3 &= 0.6884s + 0.9790 \quad 1-s, \quad (31) \\ x_4 &= 0.2342s + 0.2153 \quad 1-s, \\ x_5 &= 0.5744s + 0.9824 \quad 1-s. \end{aligned}$$

It is clear to find that $\forall s \in 0$ and 1, FM_3. The new airport line project is larger than other failure modes in the risk management scheme of developing the Power of Siberia gas pipeline metro project. According to the rules of risk management and the realistic project features, in view of two factors, FM_3 is the significant failure mode. Specifically, risk assessment plays an important role in the stages of risk management. This implies that irrational risk assessments may cause the unfairness of risk allocation and even lead to risk management failure. Besides, in terms of failure modes, inappropriate risk negative impact assessments may cause irrational solutions to risk management and even lead to risk management failure. On these grounds, it is evident that this mode of failure would directly impact the risk allocation process, including the progress of constructing the Siberian gas pipeline project. It is therefore important to manage the negative consequences of improper risk factor assessments.

5.3. Comparison and Discussion.

The biprojection method of LTWHs and the VIKOR method of P-LTWHs contrast with the suggested method to explain the benefits of the biprojection model of P-LTWHs for risk management of the PPP project.

5.4. The VIKOR Method of P-LTWHs with the Cloud Model.

The VIseKriterijumska Optimization I KOmpromisno Resenje (VIKOR) approach aims to identify alternatives to the ideal solution in terms of the degree of closeness of each program [42] and then to take decisions in the light of the maximum "group utility" and the individual vector of regret [43]. Thus, the VIKOR process procedures based on P-LTWHs are implemented as follows.

Step 1. The normalized decision matrix is shown in Table 8

Step 2. Calculate the PIS and the NIS, and the details are shown as follows:

$$
\begin{aligned}
Y^+ &= 0.96, 1.13, 0.19, 0.01 \quad 1.46, 1.5, 0.58, 5.09 \quad 1.7, 1.74, 0.5, 0.09 \quad 0.74, 0.81, 0.28, 0.08, \\
Y^- &= 0.96, 1.13, 0.19, 0.06 \quad 1.47, 1.52, 0.64, 0.09 \quad 1.81, 1.83, 0.31, 0.08 \quad 0.81, 0.76, 0.27, 0.04.
\end{aligned}
\tag{32}
$$

Step 3. Calculate the utility S_i and the individual regret vector T_i based on the method of Ref. [42], where $i = 1, 2, 3, \ldots, m$ and $j = 1, 2, 3, \ldots, n$. The utility and regret vectors are shown in Table 9.

Step 4. Rank all alternatives in terms of the values of S_i, T_i, and Q_i, $i = 1, 2, 3,$ and 4, and select the optimal alternative.

It is clear that the ranking orders vary with different ranking values v. If $s \in 0$ and 0.87, then the mode FM_5 the building of the Power of Siberia gas pipeline project is important for risk management. Due to the negative outcomes of FM_5 (unreasonable risk allocation of negative outcomes) should be taken seriously at this stage. During the risk management process, the risk distribution may be changed, although it is difficult for experts to adjust the negative consequences if experts provide unreasonable assessments. The explanation is that, particularly for certain natural risk factors, these negative effects can be uncontrollable. Therefore, because of the detrimental effects of risk factors, the outcome is inconsistent with the project's features.

If $s \in 0$ and 0.87, then the remarkable degree of failure program is FM_2, it means that FM_2 (improper risk likelihood assessment) is the key of the risk assessment systems. The outcome is inconsistent with the features of this PPP project are seen in two ways. First, improper estimates of the negative effects of risk factors may directly contribute to project funding failure in this project. Improper risk assessments may affect the private sector's probability of investment, trigger risk management failures, and even cause project schedule delays. Besides, improper estimates of the probabilities of risk factors should be altered based on the alteration of recognition in the process of risk management. Nevertheless, if experts offer improper evaluations of the negative effects of risks, it is strenuous to adjust the negative effects. Hence, FM_2 (improper risk probability assessments) may not be the primary component of risk management in constructing the Siberian gas pipeline project.

5.5. Proportional Investigation.

Following the above comparisons, the ranking orders of alternatives are given in Table 10. Using various methods, different ranking orders are calculated.

As the result of the biprojection method with P-LTWHs, FM_3 (negative outcomes of incorrect assessment) is the most significant one in the process of risk management. Under the Risk Management Rules [44], it can be clarified that risk assessments are the basis for risk allocation and that proper risk negative impact assessments are the basis for risk assessment. Simultaneously, improper assessments of the negative effects of the risk could lead to a time delay for the project, even leading to the project's failure [45]. Regarding the above reasons, it is beneficial for experts to analyze FM_3 in order to make a rescue plan. Hence, in comparison to other failure modes, the significant one under the characteristics of the Power of Siberia gas pipeline metro new airport line project is the failure mode FM_3. As a consequence of the biprojection mechanism with LTWHs, FM_2 (improper assessments of risks' probabilities) and FM_4 (unreasonable risk allocation among partners) are remarkable. However, FM_3 is the most important one for the risk management process of the PPP project among the FM_2, FM_3, and FM_4 [46].

Therefore, when expressing failure modes with LTWHs, the findings are inconsistent with the PPP project characteristics. With P-LTWHs, as a result of the VIKOR process, FM_5 (during the phases of project bidding and project development, unfair risk allocation of negative results) is the big one FM_2 is the most important one in the project's operational stage? The outcomes are consistent with the risk-management environment. This implies that decision-makers do not have reliable access to the degree of risk incidence in the project's viability [47]. The basic failure mode, therefore, is FM_3 when compared with others; there are two reasons for this: specifically, the unfair risk distribution of negative effects can impact the bidding process and the construction process, even as the PPP project is delayed [45]. Besides, the importance of FM_2 is based on FM_3 because FM_3 may cause risk management failure, contributing to project failure during the project's service stage [48]. The negative effects of risk factors, the limitations of risk assessments, and unrealistic risk likelihood assessments may

Table 9: The utility and regret vectors of each alternative with the VIKOR.

X_i	X_1	X_2	X_3	X_4	X_5
S_i	5.2137	1.5321	1.554	1.5938	0.8761
T_i	3.3416	0.0674	5.082	0.0745	0.0945

Table 10: The levels of the order of the diverse method of NFMEA.

Methods		All alternatives ranking
Bi-projection with P-LTWHs		$FM_3 > FM_5 > FM_1 > FM_2 > FM_4$
Bi-projection with P-LTWHs	$s \in 0$ and 0.98	$FM_2 \sim FM_4 > FM_1 > FM_3 > FM_5$
	$s \in 0, 0.98,$ and 2	$FM_5 > FM_2 \sim FM_4 > FM_1 > FM_3$
VIKOR with P-LTWHs	$u \in 0$ and 0.87	$FM_5 > FM_2 \sim FM_4 > FM_3 > FM_1$
	$u \in 0$ and 0.87	$FM_2 > FM_4 \sim FM_5 > FM_3 > FM_1$

contribute to risk management failure. Simultaneously, the unequal distribution of risk may be triggered by FM_3; the project could even fail [48]. FM_3 is, therefore, the primary one that needs to be handled in the PPP project.

It is evident that, in comparison to the biprojection method with LTWHs or the VIKOR method with P-LTWHs during risk management, the proposed biprojection method with P-LTWHs is a better tool to determine failure modes. Firstly, because of the possibility of linguistic information, the complex linguistic words, P-LTWHs, show the assessment information and consider the weakened hedges of linguistic information. However, the biprojection system with LTWHs may have distinctly such modes of failure. Still, it may not follow the characteristics of the current airport line project to develop the Power of Siberia gas pipeline metro. With P-LTWHs, the VIKOR approach may have those failure modes distinctly, but the key failure modes cannot be selected. The biprojection method with P-LTWHs is the best tool for expressing linguistic knowledge and coping with risk management instead of the biprojection method with LTWHs' and P-LTWHs' VIKOR method.

6. Conclusions

Given the importance of risk management in PPP projects, this paper proposed a novel FMEA concept to deal with PPP projects' P-LTWHs-based risk management problems. Other methods have been contrasted with the proposed technique. Therefore, the main contributions of this paper are seen in two aspects: first, the complex linguistic expressions, P-LTWHs, were suggested in the theoretical aspect to articulate the judgments of decision-makers, which not only take into account the hesitant information with weakened hedges but also the likelihood of the linguistic information. Secondly, the biprojection technique was used in a PPP project to rate risk management problem failure modes in the functional context. Ranking risk management failure modes will help decision-makers make better decisions, increase risk management effectiveness, and decrease the degree of risk severity. The proposed approach is, however, subject to certain limitations. The natural language scales are, in the first place, constrained in certain respects.

Furthermore, it is important to analyze more comprehensively the analyses of these failure modes.

Since the P-LTWHs model is best applicable to risk management problems, these constraints pose some open questions for future study.

(1) Natural language scales need to be extended based on fuzzy logic or the theory of D-S. For example, using the Gaussian distribution function, calculating the weights of the FMEA team members could be altered.

(2) Experts can not only use PLTSs or P-LTWHs to communicate their points of view in the decision-making process. Therefore, instead of a single form of the word, hybrid linguistic expressions might be a better tool. Hence, the study of hybrid linguistic expressions is an important subject.

(3) For instance, by using the score function and/or the accuracy function, the comparison method of different P-LTWHs could be improved.

Data Availability

Data used in this paper are available on these websites "http://www.xinhuanet.com," "https://www.nsenergybusiness.com/," "https://www.sustainalytics.com/," and "http://www.obor.nea.gov.cn."

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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