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Research article

Research on the evaluation method of whole process engineering consulting service modes based on uncertain multiple-attribute group decision-making

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ABSTRACT

With the continuous development of the economy and society, the engineering construction industry has experienced rapid growth, and higher requirements have been put forward for engineering consulting services. Currently, most engineering consulting service enterprises in China only provide relevant consulting services for engineering construction at a certain stage, lacking overall planning and overall control over the entire lifecycle of engineering construction. In order to improve the scientific level of fixed assets investment decision-making and construction management, it is of great value to explore professional engineering consulting services covering the whole process of project construction in the project decision-making stage and implementation stage to achieve the optimization of project quality and economic benefits. The whole process engineering consulting service modes (ECSM) evaluation is a multiple-attribute group decision-making (MAGDM). Recently, the TODIM technique and MACONT technique was created to put forward MAGDM. The interval neutrosophic sets (INSs) are created as a tool for managing fuzzy information during the whole process ECSM evaluation. In this work, the interval neutrosophic number TODIM-MACONT (INN-TODIM-MACONT) technique is created to put forward the MAGDM under INSs. Finally, a numerical analysis for whole process ECSM evaluation is given to validate the proposed technique. The main contributions are outlined: (1) the TODIM and MACONT technique was enhanced under INSs; (2) Information Entropy is created to conduct the weight information under INSs. (3) the INN-TODIM-MACONT technique is created to implement the MAGDM under INSs; (4) a numerical example for whole process ECSM evaluation and some comparative analysis is created to verify the INN-TODIM-MACONT technique.

1. Introduction

Construction projects are special products with long cycles and complex situations. In traditional engineering construction, construction units need to stage bidding or commission engineering consulting units such as survey, design, supervision, project management, and cost to provide services for project organization and management, cost, technical and legal affairs, to ensure effective control and achievement of engineering construction project goals [1–3]. However, the management entities of engineering consulting

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services in each stage are relatively independent, with varying levels of service quality and strong professionalism and pertinence of services, lack of continuity and numerous coordinating units make it difficult for homeowners to conduct [4–6]. By developing full process engineering consulting services, various stages of consulting will be unified and created under one company. External coordination relationships will be transformed into internal management, and internal control measures will be taken to ensure the overall quality of consulting services in the project [7,8]. The continuity of the work process will be better, which can accelerate the project progress, shorten the project duration, and effectively put forward the separation of responsibilities among various engineering consulting units The contradiction of mutual disconnection reduces the workload and difficulty of homeowners participating in project coordination and management. Engineering construction projects are a work that consists of various stages of construction, and the quality of engineering consulting services in each stage affects the final quality and efficiency of the entire project [9–11]. At present, the selection of engineering consulting units by owners mainly relies on market bidding competition. The results of engineering consulting services in each stage are relatively independent, focusing on local areas, and cannot effectively consider the overall quality of the project [12–14]. Especially the quality of consulting services such as decision-making and design in early stages of the project has a crucial impact on the quality of consulting services in the later stages of construction management, investment control, and operation. The whole process engineering consulting service compensates for potential management gaps and deficiencies in the independent consulting model [15,16]. Due to its comprehensive consulting technology and talent, it enables seamless integration of various professional projects and improves project quality. And as one of the main responsible parties of the project, it can identify construction risks in investment, construction safety, construction technology and other aspects in advance, utilize the advantages of whole process management, formulate various risk prevention and control measures, strengthen risk control, and effectively reduce project construction risks [17–19]. After the establishment of an engineering construction project, in order to improve project decision-making, investment, and engineering quality, the construction unit needs to organize and equip professional talents to conduct the service content and service quality of each stage. On the one hand, it increases personnel management costs, and on the other hand, each stage of service needs to be separately contracted, increasing the cost of multiple bidding [20,21]. In the future, the cost of contract management and project coordination management will also correspondingly increase. The entire process of engineering consulting only requires a single bidding process, and the consulting services cover the entire construction process, reducing the investment of human resources by the owner and the daily management work of the project [22,23]. The entire process is a comprehensive consulting service, with the participation of relevant engineering cost and professional technical personnel throughout the process [24–26]. Through refined management and full process information mastery, the cost of each link is controlled in real time, and the engineering cost is reasonably controlled, effectively avoiding the impact of single investment decision estimation errors, unreasonable planning and design issues on engineering investment, reducing project construction costs, and improving project investment returns [27,28]. At present, there are numerous engineering consulting service enterprises in various stages, and severe homogenization has led to relatively insufficient business volume for most consulting enterprises. Many engineering consulting companies compete to lower their consulting fees in order to undertake business, leading to talent loss and seriously affecting the development momentum of the enterprise. They not only fail to provide high-quality services, but also fall into a vicious cycle of "low-fees inferior services" [29–31]. Engineering consulting enterprises can develop full process engineering consulting, establish a full lifecycle service management concept, innovate mechanisms, improve the consulting service management system, leverage the advantages and service quality of integrated consulting services from upstream to downstream, promote the transformation and upgrading of the engineering consulting service industry, enhance the overall strength and competitiveness of enterprise consulting services, reduce market adverse competition, and ensure the vitality of the consulting industry. In short, the full process engineering consulting service model of engineering project construction is a trend for the transformation and development of domestic engineering consulting enterprises in the future [32–34]. This is not only to meet the needs of the domestic engineering consulting service market, but also to cultivate a national strategic need for full process engineering consulting services that are in line with international standards. By further exploring the development of full process engineering consulting services, establishing a long-term management mechanism, creating the development environments, and enhancing the five core technology management capabilities of engineering consulting enterprises, including overall management ability, investment control ability, risk control ability, resource integration ability, and innovation ability, we believe that in the near future, more excellent engineering consulting enterprises in China will go abroad, moving towards the international stage [35].

Decision making refers to analysis process where people select from some alternative options in order to obtain a certain aim [36–40]. MADM is the process in which decision-makers select the optimal solution based on the attribute values of a limited feasible alternative solution [41–44]. In MADM problems, due to the increasing complexity and uncertainty of things, as well as the limitations of human cognitive level, decision-makers often find it difficult to describe the attributes of things with accurate numerical values [45–49]. Therefore, more and more scholars are applying the idea of fuzzy sets to MADM [50–54]. Since then, many scholars have created in-depth research on MADM [55–59]. Due to the ambiguity of human thought and the complexity of objective things, it is difficult for people to evaluate objective things with precise numbers. Zadeh [60] creatively proposed the fuzzy sets (FSs) theory to handle fuzzy information. Atanassov [61] further proposed the intuitionistic fuzzy sets (IFSs) that includes both membership and non-membership degrees, which adds a non-membership function compared to FSs. However, IFSs did not take into account uncertain membership degrees. In order to find a more precise expression method, Smarandache [62] further proposed the neutrosophic sets (NSs). Wang et al. [63] proposed the interval NSs (INSs). Ye [64] put forward the similarity measures between INSs with applications in MADM. Ye [65] put forward some correlation Coefficients of interval Neutrosophic hesitant fuzzy sets for MADM. Peng and Dai [66] put forward some algorithms for interval neutrosophic MADM based on MABAC technique, similarity measure and EDAS technique. Nie, Liu and Han [67] put forward the interval neutrosophic stochastic MADM method with cumulative prospect theory and generalized Shapley function. Meng, Wang and Xu [68] put forward the Interval neutrosophic preference relations for virtual enterprise partner selection. Peng and Dai [69] put forward the interval neutrosophic reducible weighted MSM technique for internet of medical things industry evaluation. Dong et al. [70] put forward the distance, similarity and entropy technique of dynamic interval-valued neutrosophic soft sets. Kakati [71] put forward the interval neutrosophic Einstein prioritized normalized weighted GBM technique for MADM. Yazdani et al. [72] put forward the interval valued neutrosophic MADM structure for sustainable supplier selection. Zhang et al. [73] put forward the CPT-TODIM technique for interval neutrosophic MAGDM for third-party logistics service providers selection.

The whole process ECSM evaluation is MAGDM. Recently, the TODIM model [74] and MACONT model [75–77] was created for MAGDM issues. The interval NSs (INSs) [63] are created as a tool for managing uncertain information during the whole process ECSM evaluation. Until now, no or few techniques were created on information entropy and TODIM-MACONT technique with INSs. Therefore, an integrated interval neutrosophic number TODIM-MACONT (INN-TODIM-MACONT) model is created to put up with the MAGDM issues. Finally, a numerical example for whole process ECSM evaluation is created to validate the proposed technique. The main research goals and motivations are outlined: (1) the TODIM and MACONT was enhanced under INSs; (2) Information Entropy is created to conduct the weight information under INSs. (3) the INN-TODIM-MACONT technique is created to implement the MAGDM under INSs; (4) a numerical example for whole process ECSM evaluation and comparative analysis is created to verify the INN-TODIM-MACONT.

The research framework is created below. In Sect. 2, the INSs is created. In Sect. 3, INN-TODIM-MACONT is created under INSs with entropy. Sect. 4 created an illustrative example for whole process ECSM evaluation and comparative analysis. Some conclusions are created in Sect. 5.

2. Preliminaries

Wang et al. [78] created the SVNSs.

Definition 1. [78]. The SVNSs KA in Φ is created in Eq. (1):

$$KA = \{(x, KT_A(x), KI_A(x), KF_A(x)) | x \in \Phi\} \tag{1}$$

where the $KT_A(x), KI_A(x), KF_A(x)$ conducts the truth-membership, indeterminacy-membership and falsity-membership, $KT_A(x), KI_A(x), KF_A(x) \in [0,1]$ and satisfies $0 \leq KT_A(x) + KI_A(x) + KF_A(x) \leq 3$.

Wang et al. [63] created the INSs.

Definition 2. [63]. The INSs KA in Θ is created in Eq. (2):

$$KA = \{(\phi, KT_A(\phi), KI_A(\phi), KF_A(\phi)) | \phi \in \Theta\} \tag{2}$$

where the $KT_A(\phi), KI_A(\phi), KF_A(\phi)$ conducts the truth-membership, indeterminacy-membership and falsity-membership, $KT_A(\phi), KI_A(\phi), KF_A(\phi) \subseteq [0,1]$ and $0 \leq \sup KT_A(\phi) + \sup KI_A(\phi) + \sup KF_A(\phi) \leq 3$.

The interval neutrosophic number (INN) is created as $KA = (KT_A, KI_A, KF_A) = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$, where $KT_A, KI_A, KF_A \subseteq [0\ ,\ 1]$, and $0 \leq KTR_A + KIR_A + KFR_A \leq 3$.

Definition 3. [79]. Let $KA = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$ be INN, the score value is created in Eq. (3):

$$SV(KA) = \frac{(2 + KTL_A - KIL_A - KFL_A) + (2 + KTR_A - KIR_A - KFR_A)}{6}, SV(KA) \in [0,1]. \tag{3}$$

Definition 4. [79]. Let $KA = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$ be INN, the accuracy value is created in Eq. (4):

$$AV(KA) = \frac{2 + (KTL_A + KTR_A) - (KFL_A + KFR_A)}{4}, AV(KA) \in [0,1]\ . \tag{4}$$

Huang et al. [80] created the order for INNs.

Definition 5. [79]. Let $KA = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$ and $KB = ([KTL_B, KTR_B], [KIL_B, KR_B], [KFL_B, KFR_B])$ be INNs, $SV(KA) = \frac{(2+KTL_A-KIL_A-KFL_A)+(2+KTR_A-KIR_A-KFR_A)}{6}$ and $SV(KB) = \frac{(2+KTL_B-KIL_B-KFL_B)+(2+KTR_B-KIR_B-KFR_B)}{6}$, and $AV(KA) = \frac{2+(KTL_A+KTR_A)-(KFL_A+KFR_A)}{4}$ and $AV(KB) = \frac{(KTL_B+KTR_B)-(KFL_B+KFR_B)}{2}$, then if $SV(KA) < SV(KB)$, then $KA < KB$; if $SV(KA) = SV(KB)$, then (1) if $AV(KA) = AV(KB)$, then $KA = KB$; (2) if $AV(KA) < AV(KB)$, then $KA < KB$.

Definition 6. [81]. Let $KA = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$ and $KB = ([KTL_B, KTR_B], [KIL_B, KR_B], [KFL_B, KFR_B])$ be INNs, the operations are created:

$$(1)\ KA \oplus KB = \begin{pmatrix} (KTL_A + KTL_B - KTL_A KTL_B, KTR_A + KTR_B - KTR_A KTR_B), \\ [KIL_A KIL_B, KIR_A KIR_B], [KFL_A KFL_B, KFR_A KFR_B] \end{pmatrix};$$

$$(2)\ KA \otimes KB = \begin{pmatrix} [KTL_A KTL_B, KTR_A KTR_B], \\ [KIL_A + KIL_B - KIL_A KIL_B, KIR_A + KIR_B - KIR_A KIR_B], \\ [KFL_A + KFL_B - KFL_A KFL_B, KFR_A + KFR_B - KFR_A KFR_B] \end{pmatrix};$$

$$(3)\ \xi KA = \begin{pmatrix} \left[1-(1-KTL_A)^{\xi}, 1-(1-KTR_A)^{\xi}\right], \\ \left[(KIL_A)^{\xi}, (KIR_A)^{\xi}\right], \left[(KFL_A)^{\xi}, (KFR_A)^{\xi}\right] \end{pmatrix}, \xi > 0;$$

$$(4)\ (KA)^{\xi} = \begin{pmatrix} \left[(KTL_A)^{\xi}, (KTR_A)^{\xi}\right], \left[(KIL_A)^{\xi}, (KIR_A)^{\xi}\right], \\ \left[1-(1-KFL_A)^{\xi}, 1-(1-KFR_A)^{\xi}\right] \end{pmatrix}, \xi > 0.$$

Definition 7. [64]. Let $KA = ([KTL_A, KTR_A], [KIL_A, KIR_A], [KFL_A, KFR_A])$ and $KB = ([KTL_B, KTR_B], [KIL_B, KR_B], [KFL_B, KFR_B])$, then the Hamming distance is created in Eq. (5):

$$HD(KA, KB) = \frac{1}{6}\begin{pmatrix} |KTL_A - KTL_B| + |KTR_A - KTR_B| + |KIL_A - KIL_B| + \\ |KIR_A - KIR_B| + |KFL_A - KFL_B| + |KFR_A - KFR_B| \end{pmatrix} \tag{5}$$

The INNWA and INNWG operator [81] are created:

Definition 8. [81]. Let $KA_j = \left(\left[KTL_j, KTR_j\right], \left[KIL_j, KIR_j\right], \left[KFL_j, KFR_j\right]\right)$ be INNs, the INNWA technique is created in Eq. (6):

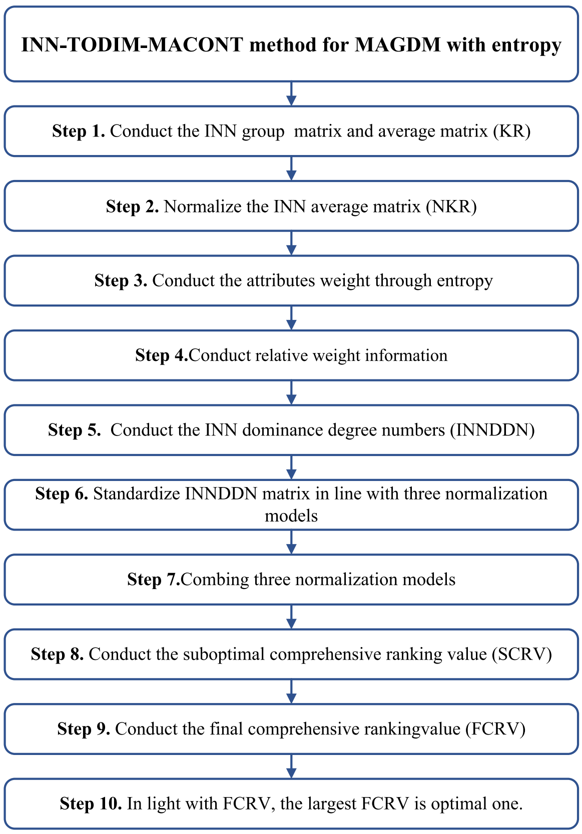

Fig. 1. INN-TODIM-MACONT method for MAGDM with entropy.

$$\begin{aligned}&\text{INNWA}(KA_1, KA_2, \ldots, KA_n)\\&= kw_1KA_1 \oplus kw_2KA_2 \ldots \oplus kw_nKA_n = \overset{n}{\underset{j=1}{\oplus}} kw_jKA_j\\&= \left(\begin{array}{l}\left[1-\prod_{j=1}^{n}\left(1-KTL_{ij}\right)^{kw_j}, 1-\prod_{j=1}^{n}\left(1-KTR_{ij}\right)^{kw_j}\right],\\ \left[\prod_{j=1}^{n}\left(KFL_{ij}\right)^{kw_j}, \prod_{j=1}^{n}\left(KFR_{ij}\right)^{kw_j}\right], \left[\prod_{j=1}^{n}\left(KTL_{ij}\right)^{kw_j}, \prod_{j=1}^{n}\left(KTR_{ij}\right)^{kw_j}\right]\end{array}\right)\end{aligned} \tag{6}$$

where $kw = (kw_1, kw_2, ..., kw_n)^T$ be weight of KA_j, $kw_j > 0, \sum_{j=1}^{n} kw_j = 1$.

Definition 9. [81]. Let $KA_j = \left([KTL_j, KTR_j], [KIL_j, KIR_j], [KFL_j, KFR_j]\right)$ be INNs, the INNWG operator is created in Eq. (7):

$$\begin{aligned}&\text{INNWG}(KA_1, KA_2, \ldots, KA_n)\\&= (KA_1)^{kw_1} \otimes (KA_2)^{kw_2}, \ldots \otimes (KA_n)^{kw_n} = \overset{n}{\underset{j=1}{\otimes}} (KA_j)^{kw_j}\\&= \left(\begin{array}{l}\left[\prod_{j=1}^{n}\left(KTL_{ij}\right)^{kw_j}, \prod_{j=1}^{n}\left(KTR_{ij}\right)^{kw_j}\right],\\ \left[1-\prod_{j=1}^{n}\left(1-KFL_{ij}\right)^{kw_j}, 1-\prod_{j=1}^{n}\left(1-KFR_{ij}\right)^{kw_j}\right],\\ \left[1-\prod_{j=1}^{n}\left(1-KTL_{ij}\right)^{kw_j}, 1-\prod_{j=1}^{n}\left(1-KTR_{ij}\right)^{kw_j}\right]\end{array}\right)\end{aligned} \tag{7}$$

where $kw = (kw_1, kw_2, ..., kw_n)^T$ be weight of KA_j, $kw_j > 0, \sum_{j=1}^{n} kw_j = 1$.

3. INN-TODIM-MACONT mthod for MAGDM with entropy weight

3.1. INN-MAGDM issues

The INN-TODIM-MACONT model is created for MAGDM. Let $KA = \{KA_1, KA_2, \cdots, KA_m\}$ be alternatives, and attributes sets $KG = \{KG_1, KG_2, \cdots, KG_n\}$ with weight $k\omega$, where $k\omega_j \in [0, 1]$, $\sum_{j=1}^{n} k\omega_j = 1$ and experts $KE = \{KE_1, KE_2, \cdots, KE_q\}$ with weight t kw, where $kw_j \in [0, 1]$, $\sum_{j=1}^{n} kw_j = 1$.

Then, INN-TODIM-MACONT technique is created for MAGDM. The detailed steps are created (See Fig. 1):

Step 1. Conduct the INN-matrix $KR^{(t)} = \left[KR_{ij}^{(t)}\right]_{m\times n} = \left(\left[KTL_{ij}^{(t)}, KTR_{ij}^{(t)}\right], \left[KIL_{ij}^{(t)}, KIR_{ij}^{(t)}\right], \left[KFL_{ij}^{(t)}, KFR_{ij}^{(t)}\right]\right)_{m\times n}$ and average matrix $KR = [KR_{ij}]_{m\times n}$ in Eqs. (8) and (9):

$$KR = \left[KR_{ij}^{(t)}\right]_{m\times n} = \begin{array}{c} \\ KA_1 \\ KA_2 \\ \vdots \\ KA_m \end{array}\begin{array}{c} \begin{array}{cccc} KG_1 & KG_2 & \ldots & KG_n \end{array} \\ \begin{bmatrix} KR_{11}^{(t)} & KR_{12}^{(t)} & \ldots & KR_{1n}^{(t)} \\ KR_{21}^{(t)} & KR_{22}^{(t)} & \ldots & KR_{2n}^{(t)} \\ \vdots & \vdots & \vdots & \vdots \\ KR_{m1}^{(t)} & KR_{m2}^{(t)} & \ldots & KR_{mn}^{(t)} \end{bmatrix}\end{array} \tag{8}$$

$$KR = [KR_{ij}]_{m\times n} = \begin{array}{c} \\ KA_1 \\ KA_2 \\ \vdots \\ KA_m \end{array}\begin{array}{c} \begin{array}{cccc} KG_1 & KG_2 & \ldots & KG_n \end{array} \\ \begin{bmatrix} KR_{11} & KR_{12} & \ldots & KR_{1n} \\ KR_{21} & KR_{22} & \ldots & KR_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ KR_{m1} & KR_{m2} & \ldots & KR_{mn} \end{bmatrix}\end{array} \tag{9}$$

in light with INNWA technique,

The $KR = [KR_{ij}]_{m\times n} = \left([KTL_{ij}, KTR_{ij}], [KIL_{ij}, KIR_{ij}], [KFL_{ij}, KFR_{ij}]\right)_{m\times n}$ is created in Eq. (10):

$$KR_{ij} = kw_1 KR_{ij}^{(1)} \oplus kw_2 KR_{ij}^{(2)} \oplus \cdots \oplus kw_q KR_{ij}^{(q)} = \left(\begin{array}{l} \left[1 - \prod_{t=1}^{q} \left(KTL_{ij}^{(t)} \right)^{kw_j}, 1 - \prod_{t=1}^{q} \left(KTR_{ij}^{(t)} \right)^{kw_j} \right], \\ \left[\prod_{t=1}^{q} \left(KFL_{ij}^{(t)} \right)^{kw_j}, \prod_{t=1}^{q} \left(KFR_{ij}^{(t)} \right)^{kw_j} \right], \\ \left[\prod_{t=1}^{q} \left(1 - KTL_{ij}^{(t)} \right)^{kw_j}, \prod_{t=1}^{q} \left(1 - KTR_{ij}^{(t)} \right)^{kw_j} \right] \end{array} \right) \tag{10}$$

Step 2. Normalize the $KR = [KR_{ij}]_{m \times n}$ into $NKR = [NKR_{ij}]_{m \times n}$ in Eq. (11).

Aimed at benefit attributes:

$$\begin{aligned} NKR_{ij} &= ([NKTL_{ij}, NKTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) \\ &= KR_{ij} = ([KTL_{ij}, KTR_{ij}], [KIL_{ij}, KIR_{ij}], [KFL_{ij}, KFR_{ij}]) \end{aligned} \tag{11}$$

Aimed at cost attributes in Eq. (12):

$$\begin{aligned} NKR_{ij} &= ([NKTL_{ij}, NKTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) \\ &= ([KFL_{ij}, KFR_{ij}], [KIL_{ij}, KIR_{ij}], [KTL_{ij}, KTR_{ij}]) \end{aligned} \tag{12}$$

3.2. Conduct the attributes weight through entropy

Step 3. Conduct the attributes weight through entropy.

Entropy [82] is created to derive weight information. The normalized INN-matrix $INNR_{ij}$ is created in Eq. (13):

$$INNR_{ij} = \frac{\frac{AV([NKTL_{ij}, NTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) + 1}{SV([NKTL_{ij}, NTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) + 1}}{\sum_{i=1}^{m} \left(\frac{AV([NKTL_{ij}, NTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) + 1}{SV([NKTL_{ij}, NTR_{ij}], [NKIL_{ij}, NKIR_{ij}], [NKFL_{ij}, NKFR_{ij}]) + 1} \right)}, \tag{13}$$

then, the INNR Shannon entropy $INNRSE = (INNRSE_1, INNRSE_2, \cdots, INNRSE_n)$ is created in Eq. (14):

$$INNRSE_j = -\frac{1}{\ln m} \sum_{i=1}^{m} INNR_{ij} \ln INNR_{ij} \tag{14}$$

and $INNR_{ij} \ln INNR_{ij} = 0$ if $INNR_{ij} = 0$.

Then, the weights $k\omega = (k\omega_1, k\omega_2, \cdots, k\omega_n)$ is created in Eq. (15):

$$k\omega_j = \frac{1 - INNRSE_j}{\sum_{j=1}^{n} (1 - INNRSE_j)}, j = 1, 2, \cdots, n. \tag{15}$$

3.3. INN-TODIM-MACONT method for MAGDM

The INN-TODIM-MACONT is created for MAGDM.

Step 4. Conduct relative weight values of KG_j in Eq. (16):

$$rk\omega_j = k\omega_j \Big/ \max_j k\omega_j, \tag{16}$$

Step 5. Conduct the INN dominance degree numbers (INNDDN).

(1)The INNDDN of KA_i over KA_t for KG_j is created in Eq. (17):

$$INNDDN_j(KA_i, KA_t) = \begin{cases} \dfrac{rkw_j \times \left(HD\left(NKR_{ij}, NKR_{tj}\right)\right)^{\alpha}}{\sum_{j=1}^{n} rsw_j} & \text{if } SV\left(NKR_{ij}\right) > SV\left(NKR_{tj}\right) \\ 0 & \text{if } SV\left(NKR_{ij}\right) = SV\left(NKR_{tj}\right) \\ -\dfrac{1}{\theta} \dfrac{\sum_{j=1}^{n} rk\omega_j \times \left(HD\left(NKR_{ij}, NKR_{tj}\right)\right)^{\beta}}{rk\omega_j} & \text{if } SV\left(NKR_{ij}\right) < SV\left(NKR_{tj}\right) \end{cases} \tag{17}$$

The θ, α, β is created in light with Ref. [83].

(2)The $INNDDN_j(KA_i)$ for KG_j is created:

$$INNDDN_j(KA_i) = \left[INNDDN_j(KA_i, KA_t)\right]_{m\times m}$$

$$= \begin{matrix} & KA_1 & KA_2 & \cdots & KA_m \\ KA_1 & 0 & INNDDN_j(KA_1, KA_2) & \cdots & INNDDN_j(KA_1, KA_m) \\ KA_2 & INNDDN_j(KA_2, KA_1) & 0 & \cdots & INNDDN_j(KA_2, KA_m) \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ KA_m & INNDDN_j(KA_m, KA_1) & INNDDN_j(KA_m, KA_2) & \cdots & 0 \end{matrix}$$

(3)Conduct the overall INNDDN of alternative KA_i for other ones for KG_j in Eq. (18):

$$INNDDN_j(KA_i) = \sum_{t=1}^{m} INNDDN_j(KA_i, KA_t) \tag{18}$$

The overall INNDDN is created in Eq. (19):

$$INNDDN = \left(INNDDN_{ij}\right)_{m\times n}$$
$$= \begin{bmatrix} & KG_1 & KG_2 & \cdots & KG_n \\ KA_1 & \sum_{t=1}^{m} INNDDN_1(KA_1, KA_t) & \sum_{t=1}^{m} INNDDN_2(KA_1, KA_t) & \cdots & \sum_{t=1}^{m} INNDDN_n(KA_1, KA_t) \\ KA_2 & \sum_{t=1}^{m} INNDDN_1(KA_2, KA_t) & \sum_{t=1}^{m} INNDDN_2(KA_2, KA_t) & \cdots & \sum_{t=1}^{m} INNDDN_n(KA_2, KA_t) \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ KA_m & \sum_{t=1}^{m} INNDDN_1(KA_m, KA_t) & \sum_{t=1}^{m} INNDDN_2(KA_m, KA_t) & \cdots & \sum_{t=1}^{m} INNDDN_n(KA_m, KA_t) \end{bmatrix} \tag{19}$$

Step 6. Standardize INNDDN matrix through employing three different normalization models in Eq. (20)- Eq. (23):

$$INNPIS_j = \max_{j=1}^{n} INNDDN_{ij}, INNNIS_j = \min_{j=1}^{n} INNDDN_{ij} \tag{20}$$

$$NINNDDN_{ij}^{(1)} = \begin{cases} \dfrac{INNDDN_{ij} - INNNIS_j}{INNPIS_j - INNNIS_j}, for\ \ benefit\ \ attribute \\ \dfrac{INNDDN_{ij} - INNPIS_j}{INNNIS_j - INNPIS_j}, for\ \ \cos t\ \ attribute \end{cases} \tag{21}$$

$$NINNDDN_{ij}^{(2)} = \begin{cases} \dfrac{e^{INNDDN_{ij}}}{\sum_{i=1}^{m} e^{INNDDN_{ij}}_{ij}}, for\ \ benefit\ \ attribute \\ \dfrac{1/e^{INNDDN_{ij}}}{\sum_{i=1}^{m} (1/e^{INNDDN_{ij}})}, for\ \ benefit\ \ attribute \end{cases} \tag{22}$$

$$NINNDDN_{ij}^{(3)} = \begin{cases} \dfrac{e^{INNDDN_{ij}}}{\max_i (e^{INNDDN_{ij}})}, for\ \ benefit\ \ attribute \\ \dfrac{\min_i (e^{INNDDN_{ij}})}{e^{INNDDN_{ij}}}, for\ \ \cos t\ \ attribute \end{cases} \tag{23}$$

Step 7. Combining three normalization models in Eq. (24):

$$NINNDDN_{ij} = \lambda NINNDDN_{ij}^{(1)} + \mu NINNDDN_{ij}^{(2)} + (1-\lambda-\mu) NINNDDN_{ij}^{(3)} \tag{24}$$

where $0 \le \lambda, \mu \le 1$.

Step 8. Conduct the suboptimal comprehensive ranking value (SCRV) in Eq. (25)-Eq. (26):

$$SCRV_i^{(1)} = \delta \frac{KQ_i^{(1)}}{\sqrt{\sum_{i=1}^{m}\left(KQ_i^{(1)}\right)^2}} + (1-\delta)\frac{KQ_i^{(2)}}{\sqrt{\sum_{i=1}^{m}\left(KQ_i^{(2)}\right)^2}} \tag{25}$$

where, $KQ_i^{(1)} = \sum_{j=1}^{n} k\omega_j \left(NINNDDN_{ij} - \frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij}\right)$, $KQ_i^{(2)} = \frac{\prod_{kx\times k\gamma=1}^{n}\left(\frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij} - NINNDDN_{ij}\right)^{k\omega_j}}{\prod_{kx\times k\eta=1}^{n}\left(NINNDDN_{ij} - \frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij}\right)^{k\omega_j}}$,

$$SCRV_i^{(2)} = \left(\begin{array}{l}\theta \max_j \left(k\omega_j\left(NINNDDN_{ij} - \frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij}\right)\right) \\ +(1-\theta)\min_j \left(k\omega_j\left(NINNDDN_{ij} - \frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij}\right)\right)\end{array}\right) \tag{26}$$

where $kx \times k\gamma (kx \times k\gamma = 1, 2, \cdots, n)$ is the attributes that meet $\frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij} \ge NINNDDN_{ij}$, and $kx \times k\eta (kx \times k\eta = 1, 2, \cdots, n)$ is the attributes that meet $NINNDDN_{ij} \ge \frac{1}{m}\sum_{i=1}^{m} NINNDDN_{ij}$. δ and $\theta (0 \le \delta, \theta \le 1)$ are parameters information.

Step 9. Create the final comprehensive ranking value (FCRV) in Eq. (27):

$$FCRV_i = \frac{1}{2}\left(SCRV_i^{(1)} + \frac{SCRV_i^{(2)}}{\sqrt{\sum_{i=1}^{m}\left(SCRV_i^{(2)}\right)^2}}\right), i = 1, 2, \cdots, m. \tag{27}$$

Step 10. In light with FCRV, the largest FCRV is optimal choice.

4. Numerical example and comparative analysis

4.1. Numerical example

With the diversified needs of various domestic investment entities, the engineering consulting market has become more diversified. Currently, fragmented engineering consulting services are difficult to meet the needs of construction project owners or investors. In order to meet market demand, a new engineering consulting model that integrates and coordinates overall project organization, management, technology and other resources in terms of time and space has gradually been explored and developed, and has been recognized and praised by owners. This model provides integrated, scientific, and professional engineering comprehensive consulting services covering the entire life cycle of engineering project construction. Through scientific and effective organizational arrangements, it mobilizes the enthusiasm of engineering organizations, improves efficiency, reduces the work coordination, communication, and responsibility risks that owners must participate in the entire process of construction projects, and provides owners with higher quality and better integrated services. In order to promote the transformation and development of engineering consulting enterprises, the national construction regulatory department proposed to cultivate full process engineering consulting in 2017, and successively issued relevant guidance directions and suggestions. In 2019, various provinces and cities implemented work plans for full process engineering consulting services, encouraging the market-oriented development of various forms of full process engineering consulting services, guiding the healthy development of full process engineering consulting services, accelerating the market-oriented development of full process engineering consulting services, and moving from pilot to market. From the perspective of the needs of the national development strategy, with the promotion of the “the Belt and Road” strategy, domestic construction enterprises have gradually gone out of the country and made certain achievements, but there are few enterprises that provide comprehensive whole process engineering consulting services such as technology, management and economy for international construction enterprises. In order to promote domestic engineering consulting and management enterprises to go global, Chinese engineering consulting

Table 1
Linguistic scales and INNs.

Linguistic Terms	INNs
Exceedingly Terrible-KET	([0.05,0.2], [0.6,0.7], [0.75,0.9])
Very Terrible-KVT	([0.15,0.30], [0.50,0.60], [0.65,0.80])
Terrible-KST	([0.25,0.40], [0.40,0.50], [0.55,0.70])
Medium-KM	([0.40,0.60], [0.10,0.20], [0.40,0.60])
Well-KW	([0.45,0.60], [0.30,0.40], [0.25,0.50])
Very Well-KVW	([0.65,0.80], [0.50,0.60], [0.15,0.30])
Exceedingly Well-KEW	([0.75,0.90], [0.60,0.70], [0.05,0.20])

Table 2
Evaluation information by KE_1.

	KG_1	KG_2	KG_3	KG_4
KA_1	KVT	KM	KVW	KW
KA_2	KM	KVT	KVT	KT
KA_3	KM	KT	KT	KM
KA_4	KVT	KVW	KT	KM
KA_5	KVW	KW	KM	KW

enterprises need to draw on advanced international engineering consulting models and successful experiences, face challenges in unprecedented changes, seize rare opportunities, actively explore the whole process engineering consulting organization model, innovate systems and improve measures, and cultivate full process consulting enterprises with international competitiveness and influence. The whole process ECSM evaluation is a MAGDM issue. Therefore, the whole process ECSM evaluation is created to verify the technique developed. There are five whole process ECSM $KA_i (i = 1, 2, 3, 4, 5)$ to choose in light with four attributes: ①KG_1 is the resource integration for whole process engineering consulting service; ②KG_2 is talent team construction cost for whole process engineering consulting service; ③KG_3 is management of rules and regulations for whole process engineering consulting service; ④KG_4 is s work ability for whole process engineering consulting service. The talent team construction cost (KG_2) is cost attribute. The five possible whole process ECSM $KA_i (i = 1, 2, 3, 4, 5)$ are to be assessed with linguistic scales (See Table 1 [84]) with four criteria by three experts $KE^{(t)} (t = 1, 2, 3)$ with weight values $(0.35, 0.30, 0.35)$.

The INN-TODIM-MACONT is created to put forward the whole process ECSM evaluation.

Step 1. Create the INN matrix (See Tables 2–4).

Then in light with INNWA technique, the $KR = [KR_{ij}]_{5\times4}$ is created (See Table 5).

Step 2. Normalize the $KR = [KR_{ij}]_{5\times4}$ into $NKR = [NKR_{ij}]_{5\times4}$ (Table 6).

Step 3. Create the weight: $k\omega_1 = 0.2599, k\omega_2 = 0.3620, k\omega_3 = 0.1912, k\omega_4 = 0.1869$.

Step 4. Create the relative weight: $rk\omega = (0.7180, 1.0000, 0.5282, 0.5163)$

Step 5. Obtain the $INNDDN = (NNDDN_{ij})_{5\times4}$ (Table 7):

Step 6. Standardize INNDDN through three normalization models (Tables 8–10):

Step 7. Combing three kinds of normalization models (Table 11):

Step 8. Create the SCRV (See Table 12):

Step 9. Conduct the FCRV for every alternative (Table 13):

Step 10. The order is created: $KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$, and thus the optimal whole process engineering consulting service mode is KA_4.

4.2. Comparative analysis

Then, the INN-TODIM-MACONT technique is compared with INNWA(INN weighted average) operator [81] and INNWG (INN weighted geometric) operator [81], INN-VIKOR technique [85], INN-CODAS technique [86], INN-EDAS technique [84] and INN-TODIM [87]. The comparative results are created in Table 14.

From detailed analysis, it could be known that these techniques' order is slightly different. However, these techniques have same optimal whole process engineering consulting service mode and worst whole process engineering consulting service mode and This verifies the INN-TODIM-MACONT technique is reasonable. Thus, the main advantages of INN-TODIM-MACONT technique are outlined: (1) the proposed INN-TODIM-MACONT technique not only conducts the uncertainty for MAGDM, but also conducts the psychological behavior during the whole process ECSM evaluation. (2) the INN-TODIM-MACONT conducts the behavior of TODIM and MACONT as MAGDM when these two models are hybridized during the whole process ECSM evaluation. The limitations of the

Table 3
Evaluation information by KE_2.

	KG_1	KG_2	KG_3	KG_4
KA_1	KM	KT	KW	KVW
KA_2	KW	KVW	KVT	KVW
KA_3	KM	KW	KVW	KVT
KA_4	KW	KVW	KW	KM
KA_5	KVT	KVT	KM	KT

Table 4
Evaluation information by KE_3.

	KG_1	KG_2	KG_3	KG_4
KA_1	KVW	KT	KVT	KM
KA_2	KM	KVW	KT	KW
KA_3	KVT	KM	KVW	KW
KA_4	KVT	KVW	KM	KW
KA_5	KVW	KW	KM	KT

Table 5
The $KR = [KR_{ij}]_{5\times4}$.

	KG_1	KG_2
KA_1	([0.69, 0.72], [0.45, 0.54], [0.39, 0.45])	([0.75, 0.85], [0.43, 0.52], [0.42, 0.46])
KA_2	([0.75, 0.83], [0.37, 0.51], [0.46, 0.49])	([0.83, 0.92], [0.56, 0.69], [0.48, 0.53])
KA_3	([0.63, 0.71], [0.48, 0.53], [0.38, 0.50])	([0.62, 0.75], [0.68, 0.73], [0.46, 0.59])
KA_4	([0.56, 0.70], [0.44, 0.56], [0.43, 0.52])	([0.69, 0.76], [0.32, 0.45], [0.53, 0.64])
KA_5	([0.67, 0.72], [0.49, 0.54], [0.56, 0.57])	([0.82, 0.89], [0.67, 0.76], [0.57, 0.62])
	KG_3	KG_4
KA_1	([0.58, 0.80], [0.44, 0.55], [0.57, 0.65])	([0.65, 0.73], [0.49, 0.52], [0.47, 0.56])
KA_2	([0.78, 0.86], [0.36, 0.43], [0.56, 0.64])	([0.85, 0.92], [0.28, 0.36], [0.45, 0.57])
KA_3	([0.59, 0.64], [0.42, 0.46], [0.63, 0.67])	([0.63, 0.75], [0.49, 0.57], [0.44, 0.69])
KA_4	([0.65, 0.74], [0.47, 0.59], [0.61, 0.64])	([0.67, 0.81], [0.54, 0.65], [0.41, 0.54])
KA_5	([0.64, 0.76], [0.46, 0.53], [0.58, 0.76])	([0.59, 0.71], [0.45, 0.54], [0.36, 0.57])

Table 6
The $NKR = [NKR_{ij}]_{5\times4}$.

	KG_1	KG_2
KA_1	([0.69, 0.72], [0.45, 0.54], [0.39, 0.45])	([0.42, 0.46], [0.43, 0.52], [0.75, 0.85])
KA_2	([0.75, 0.83], [0.37, 0.51], [0.46, 0.49])	([0.48, 0.53], [0.56, 0.69], [0.83, 0.92])
KA_3	([0.63, 0.71], [0.48, 0.53], [0.38, 0.50])	([0.46, 0.59], [0.68, 0.73], [0.62, 0.75])
KA_4	([0.56, 0.70], [0.44, 0.56], [0.43, 0.52])	([0.53, 0.64], [0.32, 0.45], [0.69, 0.76])
KA_5	([0.67, 0.72], [0.49, 0.54], [0.56, 0.57])	([0.57, 0.62], [0.67, 0.76], [0.82, 0.89])
	KG_3	KG_4
KA_1	([0.58, 0.80], [0.44, 0.55], [0.57, 0.65])	([0.65, 0.73], [0.49, 0.52], [0.47, 0.56])
KA_2	([0.78, 0.86], [0.36, 0.43], [0.56, 0.64])	([0.85, 0.92], [0.28, 0.36], [0.45, 0.57])
KA_3	([0.59, 0.64], [0.42, 0.46], [0.63, 0.67])	([0.63, 0.75], [0.49, 0.57], [0.44, 0.69])
KA_4	([0.65, 0.74], [0.47, 0.59], [0.61, 0.64])	([0.67, 0.81], [0.54, 0.65], [0.41, 0.54])
KA_5	([0.64, 0.76], [0.46, 0.53], [0.58, 0.76])	([0.59, 0.71], [0.45, 0.54], [0.36, 0.57])

proposed INN-TODIM-MACONT technique fail to conduct consensus for whole process ECSM evaluation under INSs.

Based upon the analysis, the propounded INN-TODIM-MACONT technique based on entropy technique possesses different managerial implications for whole process ECSM evaluation, and provides a more rational technique for actual applications: (1) the propounded INN-TODIM-MACONT implements the proposed INNs, which allow experts to depict their indeterminacy through using the INNs. In this way, the INN-TODIM-MACONT technique could overcome the uncertainty during the whole process ECSM evaluation. (2) At present, the entire process engineering consulting services are still in the initial development stage. When both parties negotiate related business, there are "Guiding Opinions" and contract template guidelines on the policy of the entire process engineering consulting services, but there is a lack of mature contract templates, such as the problem of defining the rights and responsibilities of contracts involving multiple parties, performance clauses, dispute resolution clauses, etc., which are not detailed enough; And the consulting fee standards can be referenced, but there is a lack of mature market mechanisms for pricing. (3) for consulting service enterprises, the entire process of engineering consulting covers the entire lifecycle, and project management requires technical composite talents with knowledge and experience in legal, technical, financial, and other fields. Long term segmented consulting has resulted in professionals being limited to understanding the technical and business requirements of their respective

Table 7
The overall dominance degree matrix $INNDDN = (NNDDN_{ij})_{5\times4}$.

	KG_1	KG_2	KG_3	KG_4
KA_1	−0.4822	−0.0387	−1.2310	−1.3977
KA_2	0.2666	−0.4849	0.8283	−0.7736
KA_3	−1.5116	0.3956	0.8558	−2.2633
KA_4	−0.2059	0.7735	−0.4818	1.3303
KA_5	0.2258	0.1664	−1.0956	−2.5195

Table 8
The $NINNDDN_{ij}^{(1)}$.

	KG_1	KG_2	KG_3	KG_4
KA_1	0.5789	0.3546	0.0000	0.2914
KA_2	1.0000	0.0000	0.9868	0.4535
KA_3	0.0000	0.6997	1.0000	0.0665
KA_4	0.7343	1.0000	0.3590	1.0000
KA_5	0.9771	0.5176	0.0649	0.0000

Table 9
The $NINNDDN_{ij}^{(2)}$.

	KG_1	KG_2	KG_3	KG_4
KA_1	0.1466	0.1501	0.0496	0.0529
KA_2	0.3100	0.0960	0.3889	0.0987
KA_3	0.0524	0.2317	0.3998	0.0222
KA_4	0.1933	0.3380	0.1049	0.8090
KA_5	0.2977	0.1842	0.0568	0.0172

fields, with isolated knowledge areas and obvious technical barriers between stages. There is a lack of full process consulting talents with global coordination ability and comprehensive quality. (4) The whole process consulting service is the integration of consulting services at various stages into a unified whole, comprehensively considering. However, most engineering consulting enterprises have incomplete business qualifications and are difficult to fully cover, and some engineering technology consulting services are weak and lack relevant talents, resulting in an imbalance of consulting technology strength at each stage, making it difficult to achieve the core capabilities of the whole process engineering consulting. Therefore, a large amount of funds needs to be invested in cultivating and developing. It is unpredictable whether the entire process of business will increase in increment and the benefits it will bring in the future. Therefore, the constraints of qualifications and the uncertainty of investment returns hinder the further development of engineering consulting services throughout the entire process.

Table 10
The $NINNDDN_{ij}^{(3)}$.

	KG_1	KG_2	KG_3	KG_4
KA_1	0.4729	0.4439	0.1241	0.0653
KA_2	1.0000	0.2841	0.9728	0.1220
KA_3	0.1689	0.6853	1.0000	0.0275
KA_4	0.6234	1.0000	0.2625	1.0000
KA_5	0.9601	0.5450	0.1421	0.0213

Table 11
The $NINNDDN_{ij}$.

	KG_1	KG_2	KG_3	KG_4
KA_1	0.3995	0.3162	0.0579	0.1365
KA_2	0.7700	0.1267	0.7828	0.2247
KA_3	0.0738	0.5389	0.7999	0.0388
KA_4	0.5170	0.7793	0.2421	0.9363
KA_5	0.7449	0.4156	0.0879	0.0128

Table 12
The $SCRV_i^{(1)}$ and $SCRV_i^{(2)}$.

	$KQ_i^{(1)}$	$KQ_i^{(2)}$	$SCRV_i^{(1)}$	$SCRV_i^{(2)}$
KA_1	−0.2315	0.8506	−0.0638	−0.0063
KA_2	−0.0040	0.8565	0.2164	0.0158
KA_3	0.0849	0.1501	0.1339	0.0234
KA_4	0.3226	1.1864	0.7061	0.0874
KA_5	−0.0634	0.8252	0.1352	0.0097

5. Conclusion

Generally speaking, the lifecycle of a project is relatively long, and its coverage and required expertise are comprehensive. At the same time, the external market and policy environment are constantly changing. The author believes that the main needs of the owner of entire process engineering consulting service are that, on the basis of legality and compliance, the construction standards of the investment project meet the requirements, the investment process is more efficient, the investment and project implementation process is safer and more efficient, and the construction and operation cycles of the project are more reasonable; Further down to the operational level, specifically, project planning should be scientific, investment research should be truthful, planning should be reasonable, project initiation should be compliant, bidding agency should be fair, open, and transparent, survey and design should meet actual needs and standards, supervision and cost should be objective, fair, and compliant, project management should be efficient and safe, and project operation should produce stable output. Therefore, overall, the owner's needs for full process engineering consulting are long-term (the entire lifecycle is generally several years to several decades), cross stage (including the entire project lifecycle), cross professional (including various specialties in engineering construction), and dynamic (changing with the influence of environmental and policy factors). However, existing engineering consulting companies are generally not large in scale, and the engineering consulting industry is severely segmented according to the consulting services they provide. At the same time, there are significant barriers in each stage of the project lifecycle, and there is a lack of communication and exchange. This has led to traditional consulting companies adopting functional or project-based project consulting organizational forms. Although it can also put forward the phased needs of most consulting projects, in terms of long-term mechanisms, comprehensive capabilities There are relative deficiencies and deficiencies in the dynamic adjustment mechanism and growth potential, which cannot meet the needs of the entire process engineering consulting services. Therefore, it is necessary to further improve its organizational structure model to better adapt to the needs and development of the entire process engineering consulting. The whole process ECSM evaluation is a MAGDM. Recently, the TODIM and MACONT was created to put forward MAGDM. The INSs are created as a tool for managing fuzzy information during the whole process ECSM evaluation. In this work, the INN-TODIM-MACONT is created to put forward the MAGDM under INSs. Finally, a numerical analysis for whole process ECSM evaluation is given to validate the proposed technique. The main contributions are outlined: (1) the TODIM and MACONT was enhanced under INSs; (2) Information Entropy is created to conduct the weight information under INSs. (3) the INN-TODIM-MACONT is created to implement the MAGDM under INSs; (4) a numerical example for whole process ECSM evaluation and comparative analysis is created to verify the INN-TODIM-MACONT.

There may be some potential research limitations, which was further created the for whole process ECSM evaluation: (1) It is a worthwhile research content to conduct consensus [88–92] for whole process ECSM evaluation under INSs; (2) It is also worthwhile research interests to conduct regret theory for whole process ECSM evaluation under INSs [93–96]; (3) In subsequent research

Table 13
The FCRV.

Alternative	FCRV	Order
KA_1	−0.0659	5
KA_2	0.1935	3
KA_3	0.1933	2
KA_4	0.8251	1
KA_5	0.1200	4

Table 14
Ordering of the different techniques.

	Order
INNWA operator [81]	$KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$
INNWG operator [81]	$KA_4 \succ KA_3 \succ KA_5 \succ KA_2 \succ KA_1$
INN-VIKOR technique [85]	$KA_4 \succ KA_3 \succ KA_5 \succ KA_2 \succ KA_1$
INN-CODAS technique [86]	$KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$
INN-EDAS technique [84]	$KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$
INN-TODIM technique [87]	$KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$
INN-TODIM-MACONT technique	$KA_4 \succ KA_3 \succ KA_2 \succ KA_5 \succ KA_1$

contents, the integration of TODIM with different fuzzy techniques could be created for whole process ECSM evaluation. (4) In response to the shortage of engineering consulting talents throughout the entire process, consulting companies can utilize their own advantages to rotate employees within departments such as internal operations, legal affairs, and technical consulting, or attract outstanding external leading talents, focusing on cultivating composite talents with legal, technical, and management skills, creating a team that not only combines knowledge in the fields of early consulting, design and cost, bidding, and supervision, but also in communication, decision-making A talent team with diverse abilities such as leadership, providing in-depth and precise refinement services for project management. (5) In situations where the qualifications of enterprises are not complete and the financial strength is insufficient, for the entire process of enterprise development engineering consulting services, internal resource integration should be carried out according to their own business scope, and their diversified professional advantages should be leveraged to extend to other stages of consulting technical services. In the early stage of the entire process development, priority should be given to using a combination of two or more consulting business models to explore and develop the entire process consulting business, gain experience, and expand the market. If future conditions permit, a full industry chain consulting service model can be developed through resource integration or mergers and acquisitions among enterprises.

CRediT authorship contribution statement

Xia Wang: Methodology. **Yingxia Hou:** Data curation. **Jing Peng:** Resources, Investigation. **Jiekun Hu:** Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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