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Evaluating knowledge management failure factors using intuitionistic fuzzy FMEA approach

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Abstract The twenty-first century organizations are characterized by an emphasis on knowledge and information. Today's organizations also require the acquisition, management, and exploitation of knowledge and information in order to improve their own performance. In the current economy, the foundations of organizational competitiveness have turned former tangible and intangible resources into knowledge and the focus of information systems has also changed from information management to knowledge management. Besides, the most important step in the implementation of knowledge management is to examine the significant factors in this regard and to identify the causes of failure. Therefore, the present study evaluated knowledge management failure factors in an intuitionistic fuzzy environment as a case study in Khuzestan Oil and Gas Company. For this purpose, a series of failure factors affecting knowledge management in organizations were identified based on a review of the related literature and similar studies. Then, 16 failure factors in the implementation of knowledge management in the given organization were determined on the basis of interviews with company experts. According to the specified factors as well as the integration of multiple criteria decision-making techniques in an intuitionistic fuzzy environment, knowledge management failure factors in Khuzestan Oil and Gas Company were investigated. The results indicated that lack of management commitment and leadership was the most important factor affecting the failure of knowledge management in the given company.

Keywords Knowledge management · Failure mode and effects analysis (FMEA) · Intuitionistic fuzzy · Decision making

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1 Introduction

In the current world, competitive conditions and environments in most organizations are highly complex, variable, and wider than before so that the competitive vision changing as fast as possible and the competitive business environment are characterized today with uncertainty and lack of dynamicity [1]. In today's organization, different trends such as globalization, deregulation, technology integration, and intermediary elimination have been put forward as the latest challenges to management [2]. In the currently turbulent world, it is difficult for organizations to reach to the position of competitive advantage. In this respect, identifying the determining factors affecting the improvement in organizational performance allows us to utilize the specific resources and competencies of organizations better and to improve our abilities to seize the future opportunities through making strategic decisions [3]. At present, knowledge underlies the value-added of many modern businesses [4]. Accordingly, in a competitive business environment, successful management knowledge requires an organization with special capabilities. As a result, an organization must be able to create, transfer, store, recover, and utilize knowledge [5]. The theory based on organizational knowledge argues that organizational knowledge is an important strategic resource to take charge of an organization effectively. Thus, it makes the shared and tacit nature of organizational knowledge, knowledge transfer, knowledge proliferation, and knowledge imitation problematic and such a resource is known as a sustainable competitive advantage [6–9]. An organization implements knowledge management in order to improve productivity and provide effective methods to use its own intellectual properties. If management knowledge is endowed with successful competition, such a competition is not a choice rather a necessity for an organization anywhere in the world [10]. Although knowledge management can be an important resource for learning the factors contributing to success [11], most organizations may have such an advantage in some activities and be deprived from this benefit in other activities.

To give an example, if an organization has a complex storage mechanism but fails to produce or create knowledge, the storage mechanism is ineffective and there is no knowledge to store. Such an imbalance in each organization leads to problems among the five capabilities of knowledge [12]. Consequently, it is important for an organization to understand different obstacles of knowledge flow that can have an impact on development in the implementation of a knowledge management system. In this respect, an organization is required to examine the problems that are likely to happen in the implementation process of knowledge management [13]. This makes it possible for an organization to have enough power to implement knowledge management successfully through the exact review of the history of failures in this regard. It should be also noted that there are factors leading to failures in knowledge management projects. Such factors can inform managers of the wrong aspects of this process and even reveal issues that have been overlooked or intentionally distorted. Unawareness of managers regarding these factors can endanger management knowledge projects and finally waste organizational resources [14]. Therefore, evaluating the failure factors affecting knowledge management in organizations and planning to resolve them can provide appropriate conditions for the implementation of knowledge management in an organization. In the present study, a multiple criteria decision-making (MCDM) method in an intuitionistic fuzzy environment was proposed to evaluate knowledge management failure factors in organizations. In the given method, failure mode effects analysis (FMEA) technique with three factors of the power to prevent knowledge management failure factors, the occurrence rate of failure factors, and finally the severity of failure factors affecting the lack of success in implementa-

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tion of knowledge management was used to evaluate knowledge management failure factors in organizations. Using this method will provide a logical priority of knowledge management failure factors in organizations. This paper is organized as follows: Sect. 2 describes theoretical framework that contains: 1. knowledge management, 2. knowledge management failure, 3. knowledge management failure factors in organizations, 4. fuzzy FMEA, and 5. intuitionistic fuzzy set (IFS) then Sect. 3 provides proposed approach to evaluation knowledge management failure factors. Section 4 provides an numerical example. Finally, Sect. 5 shows results of our proposed model.

2 Theoretical foundations

2.1 Knowledge management

Today, knowledge has become an important issue in commerce and trade organizations. Researchers and scholars have also adopted different views toward it as they have become closer to knowledge management [15]. Different associations have been adopted for the term knowledge. In the past, knowledge implied words such as data, information, intelligence, skill, experience, expertise, idea, intuition, or insight and all the associations were linked to the frameworks in which the words were used [15]. With regard to different definitions proposed for knowledge, knowledge can be defined for example as information accompanied by experience, context, interpretation, and reflection [16]. Likewise, knowledge is emerged, stored, and used in the minds of individuals and organizations and it is established in organizations, procedures, practices, regulations, and documents [17].

As stated in definitions, there are different types of knowledge. Explicit knowledge may be captured in electronic knowledge repositories as well as management systems documents, while tacit and less documented knowledge can be distributed among the staff using specialized guide books as the interface between knowledge seekers and experienced personnel [18]. Accordingly, tacit knowledge is considered as personal knowledge and its coding and documentation is very difficult. This kind of knowledge that comes with experience is rooted in practices, procedures, commitments, values, and emotions of individuals and visualizes the values and beliefs of each person; therefore, its formalization and transfer to establish communications are very complicated [19]. On the other hand, explicit knowledge refers to the knowledge that can be easily interpreted and formalized in documents, guide books, and methods [20]. The emphasis of knowledge-based human capital is on a quest to discover the underlying assets in the minds of personnel individually which lead to the creation of human capital in organizations [21, 22]. When knowledge is combined with human capital, it is known as a valuable resource for an organization and allows it to improve its own competencies [9].

Therefore, knowledge-based human capital focuses on ensuring staff commitment as well as retention of motivated staff and their achievements in sharing knowledge [23–27]. Given that organizations have become more knowledge-based and there are costs spent on minds in place of manual workforce, the need to promote knowledge is on a rise; therefore, knowledge has been systematically treated like other tangible resources and explorations in the field of knowledge management are used in order to improve and strengthen competitiveness [28].

"Knowledge management" includes a very complex meaning compared to management of conditions and knowledge by itself [15]. In this respect, McElroy argued that primary measures taken by knowledge management has been considered in an exchange form and

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with emphasis on capturing knowledge and coding the existing knowledge, while the main focus of comprehensive knowledge management is not something like this [29]. As an instrument, the view of knowledge management allows an organization to increase its value and competitiveness with an emphasis on productivity, flexibility, and required creativity [16, 30].

Furthermore, knowledge management is a process comprised of a collection of activities related to creation/acquisition, storage/retention, transfer/distribution, and application/use of knowledge [19, 31]. There is another definition of knowledge management in which knowledge management is a series of processes by which an organization makes use of individual and collective intelligence to accomplish its own strategic goals [9].

Although various organizations with different positions put an emphasis on storing, sharing, applying, and creating knowledge; these activities should be considered as synergies not competitiveness at organizational level [32]. Organizations with their own capabilities should be prepared for preliminaries of knowledge management and use them efficiently in knowledge system. As well, knowledge management capability is the ability of an organization to influence the existing knowledge through continuous leaning in order to create new knowledge [33]. Thus, capability of knowledge management system refers not only to the ability to obtain knowledge and information but also organizational ability to retain knowledge and information in order to encourage the staff to use such an ability for effective work [34].

Gold et al. [35] also shed light on knowledge management capability with its knowledge infrastructures and knowledge management processes. Knowledge infrastructures include technology, structure, and culture; while knowledge processes contain organizational ability for knowledge acquisition, conversion, application, and retention. At the same time, to evaluate the infrastructures of effective knowledge, it is of utmost importance to rely on knowledge management processes which may lead to knowledge storage, conversion, and transfer [32].

Therefore, the purpose of knowledge management program is to establish a system that facilitates the processes of creation, collection, and transfer of knowledge as well as the application of business knowledge in an effective method. However, there is no comprehensive solution to implement knowledge management in an organization [36], so that many organizations have failed in its implementation.

2.2 Knowledge management failure

Different researchers grapple with the success or failure of knowledge management projects [37]. Despite concerns about the results of implementing knowledge management, as quoted by Storey and Barney [38], 80% of knowledge management projects have failed [39].

This indicates that most knowledge management projects end in failure. This issue can be big wake-up call for managers of organizations interested in implementation of knowledge management projects. Nevertheless, understanding the failure factors affecting knowledge management and how to manage the projects in order to prevent and avoid failures has become very important issues for all organizations involved in activities related to design and implementation of knowledge management [40]. Given that failures in systems are inevitable [41], organizations are required to check whether there is a strategic need for management or not at the initial steps in order to increase the success probability of knowledge management projects. The next step is to clarify whether the current process of working with organizational knowledge is sufficient and whether the organizational culture has readiness to accept procedural changes or not. As these issues are resolved, an organization can consider adequate infrastructures and make decisions regarding the need for a new system. When the

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appropriate solution is adopted, the system is required to be fully introduced to the entire organization so that each employee contributes to it [42]. For example, a case study of Nortel Network knowledge management project revealed that three issues have an impact on the success of knowledge management: (1) appropriate effectiveness of management in relation to participation, monitoring, and evaluation, project management, and leadership; (2) key resources like economic resources and multi-purpose skills; (3) use of technological opportunities. These factors together make it possible to have a completely defined process, an understanding of individuals' problems, and a successful presence of technology by which the success possibility of knowledge management project for an organization is established [43].

2.3 Knowledge management failure factors in organizations

The importance of knowledge management failures and preventive practices in this respect has led numerous studies to analyze and examine the knowledge management failure factors in organizations.

Deepa Ray [44], in a research study, highlighted the important issue of cultural obstacles in knowledge management processes. Among the cultural factors was the use of social media which could overcome failures in knowledge management systems. Managers require as the first step to understand different cultural dimensions as reinforcements of knowledge management process which can contribute to facilitated processes of knowledge management and assurance of knowledge management success through the appropriate use of social media. Therefore, it is a comprehensive view toward the creation of social media that provides for the development of knowledge management through integration of cultural visions [44].

In their study, Akhavan and Edalati [45] identified seven factors as the common factors affecting the success of knowledge management projects including: support of senior executives, introduction of the goals and objectives of knowledge management systems, implementation of numerous economic practices for knowledge transfer, motivational incentives for users of knowledge management, knowledge-oriented culture, organizational and technical infrastructures, and flexible cultural knowledge.

Overcoming the barriers to knowledge-sharing was identified by Hong et al. [46], in a literature review of theoretical and practical knowledge management, as the main factor of knowledge management success in organizations.

In this respect, most individual and social barriers bring about problems in effective knowledge-sharing and it is essential to minimize many of these obstacles as much as possible. Therefore, the obstacles to knowledge success were resolved through the removal of individual and social barriers to knowledge-sharing [46].

Chua and Lam [37] consciously examined three main failure factors affecting the stages of knowledge management project lifecycle that were to minimize the failure probability as follows:

a. Technological factors (complexity, inefficiency, and emphasis on technology maintenance costs).
b. Cultural factors (political factor, unwillingness to share knowledge, and lack of management commitment to knowledge management).
c. Content factors (structured factor, and lack of relationship between the contents of knowledge management needs of organizations) [37].

Rowley [47] in a study illustrated knowledge management failure factors including the fact that many of knowledge repositories were not well-organized or even the relationship

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between various repositories (ways of access to knowledge) were not clearly determined. He finally concluded that effective and efficient knowledge management required serious and significant changes in culture, values, organizational structure, as well as value and reward systems [47]. Based on the above issues and theoretical foundations, the most important knowledge management failure factors in organizations were summarized in the table below.

2.4 Fuzzy FMEA

Fuzzy FMEA provides a tool that works best with vague concepts and in the lack of sufficient information [103]. Using fuzzy theory is essential when dealing with some degrees of uncertainty in relationships among various criteria or when relations cannot be expressed in the form of definite numbers. Fuzzy FMEA has been applied by several earlier studies to assess risk [104]. For example, Chang et al. used grey theory for FMEA. Their study first used fuzzy expressions such as very low, low, medium, high, and very high to evaluate occurrence (O), severity (S), and detection (D), and then applied grey relational analysis to determine the risk ratings of potential causes. By performing the grey relational analysis, fuzzy expressions were converted to definitive values, and the lowest levels of O, S, and D were defined as the standard series. Data regarding these three factors for each potential cause were seen as comparative series, and grey relational coefficients and degree of grey relation were compared against the standard series under the rules of grey theory. The highest degree of grey relation indicated minimal effect of potential cause [105].

Braglia et al. also proposed a multi-criteria decision-making approach called fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for failure mode, effects and criticality analysis (FMECA). As a well-known multi-criteria decision-making method, TOPSIS is based on the idea that the best decision should have minimum distance from the positive ideal and maximum distance from the negative ideal. The fuzzy TOPSIS approach provides the possibility of evaluating risk factors (O, S, and D) and their relative importance using triangular fuzzy numbers [106]. Bowles and Peláez [107] proposed a fuzzy logic-based approach to prioritize failures in a FMEA system. This approach used verbal expressions to describe O, S, D, and the risks of failure. In this approach, the relationships between risk and O, S, and D were described using fuzzy if–then rules obtained from experts' opinion. Garcia et al. [108] proposed a fuzzy data envelopment analysis approach combined with fuzzy sets to determine the rating of failure modes. Chen and Kuo calculated fuzzy risk priority number (RPN) by using fuzzy-ordered weighted geometric averaging (FOWGA) operator [109]. Similarly, Wang et al. proposed a new definition for fuzzy RPN by using fuzzy weighted geometric mean (FWGM).

Fuzzy RPN can also be calculated using alpha-cut sets, linear programming model and defuzzification through center of gravity method, to obtain the final ranking of failure modes [110]. Kutlu and Ekmekcioglu [111] proposed a hybrid approach based on TOPSIS and AHP in a fuzzy setup to analyze failure modes. Their study used the fuzzy analytical hierarchy process (AHP) method to determine the weight of risk factors. After assigning the weights and generating the failure items decision matrix for risk factors, fuzzy TOPSIS was performed to prioritize the failure modes. The study by Liu et al. [112] developed a model based on fuzzy Vlse Kriterijumsk Optimizacija Kompromisno Resenje (VIKOR) techniques to assess and prioritize risk factors. It used linguistic terms and corresponding fuzzy numbers to determine the weight of risk factors based on expert opinions. Then, the fuzzy-ordered weighted decision matrix for factors of failure modes was calculated and the VIKOR technique was used to prioritize failure modes. In another attempt, Kumru and YildizKumru [113] investigated the applications of fuzzy FMEA to improve procurement processes of a hospital. They concluded

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that fuzzy FMEA technique could properly solve problems associated with traditional FMEA and could be useful for exploring potential failure modes and their effects. Finally, the study by Rafie and Samimi [114] proposed a hybrid approach comprising fuzzy rules and neural network to evaluate the RPN in FMEA. It used fuzzy rules to determine severity (S) and detection (D), while occurrence (O) was determined using neural network.

2.5 Intuitionistic fuzzy set (IFS)

Intuitionistic fuzzy set (IFS) is one of the generalizations from the fuzzy sets theory [115]. Out of several higher-order fuzzy sets, IFS has been found to be more capable of dealing with vagueness. First introduced by Atanassov [116], IFS can be viewed as an alternative approach to conventional fuzzy set in dealing with cases with insufficient information. Fuzzy sets only consider the degree of acceptance, whereas IFS is characterized by both a membership function and a non-membership function so that the sum of both values is less than one [117]. Intuitionistic fuzzy sets have been used across different fields of science, including the studies by Atanassov [117–120], Atanassov and Gargov [121], Szmidt and Kacprzyk [122], Buhaescu [123], Ban [124], Deschrijver and Kerre [125], and Stoyanova [126].

Definition 1 Assume reference set. In this case, set A which is a subset of X is an Atanassov's intuitionistic fuzzy set defined as below:

$$A = \{\prec x, u_A(x), \nu_A(x) \succ \forall x \in X\} \tag{1}$$

In the above definition, $u_A(x)$, $v_A(x)$ are degree of membership and non-membership, respectively, which are defined as $u_A(x)$:$x \to [0, 1]$, $v_A(x) \to [0, 1]$ and satisfy $0 \le u_{ij}(x) + v_{ij}(x) \le 1$. In addition, for each $x \epsilon X$, intuitionistic index π_x is defined as $\pi_x = 1 - u_x - v_x$ [117].

Definition 2 Based on Atanassov, $(u_{ij}(x), v_{ij}(x), \pi_{ij}(x))$ is an intuitionistic fuzzy number that satisfies the following conditions:

$$\mu_{ij}(x) \in [0, 1], \nu_{ij}(x) \in [0, 1], \pi_{ij}(x) \in [0, 1], 0 \le \mu_{ij}(x) + \nu_{ij}(x) \le 1, \pi_{ij}(x) = 1 - \mu_{ij}(x) - \nu_{ij}(x) \tag{2}$$

Although intuitionistic fuzzy number is similar (in appearance) to triangular fuzzy number (a, b, c), it is quite different. Triangular fuzzy number is a convex normal fuzzy set with a membership function in which ($a \prec b \prec c$), whereas an intuitionistic fuzzy number is a point in three-dimensional space constructed by axes $u_{ij}(x)$, $v_{ij}(x)$, $\pi_{ij}(x)$ [127]. Atanassov and Gargov [121] and Gau and Buehrer [128] have described intuitionistic fuzzy number (0.50, 0.20, 0.30) as a scenario where votes in favor of adoption are 0.5, votes against it are 0.2 and abstained votes are 0.30. In this context, the following relationship holds true:

$$\mu_{ij}^{\beta}(x) + v_{ij}^{\beta}(x) \le 1, 0 \le \mu_{ij}^{\alpha}(x) \le \mu_{ij}^{\beta}(x) \le 1, 0 \le v_{ij}^{\alpha}(x) \le v_{ij}^{\beta}(x) \le 1 \tag{3}$$

These numbers are better suited to deal with uncertainty and provide a more logical mathematical framework to deal with inexact facts and incomplete information [129]. Some of the operators and relationships between these numbers are provided as the following. For simplicity's sake, these numbers are expressed as $[u_{ij}(x), v_{ij}(x), \pi_{ij}(x)]$ where $u_{ij}(x)$, v_{ij}(x) and $\pi_{ij}(x)$ are numbers in the range of [0,1].

Definition 3 Assume intuitionistic fuzzy numbers $A = \{\langle x, \mu_A(x), v_A(x) \mid x \in X\rangle\}$, $A_1 = \{\langle x, \mu_{A1}(x), v_{A1}(x) \mid x \in X\rangle\}$,

$A_2 = \{\langle x, \mu_{A2}(x), v_{A2}(x) \mid x \in X \rangle\}$, and the real number n. According to De et al. (2000) and Atanassov (1986) the following relationships are defined [117, 130]:

$$\bar{A} = \{\langle x, v_A(x), \ \mu_A(x) \mid x \in X \rangle\} \tag{4}$$

$$A_1 \cap A_2 = \left\{\left\langle x, \min\left\{\mu_{A_1}(x), \mu_{A_2}(x)\right\}, \max\left\{v_{A_1}(x), v_{A_2}(x)\right\} \mid x \in X \right\rangle\right\} \tag{5}$$

$$A_1 \cup A_2 = \left\{\left\langle x, \max\left\{\mu_{A_1}(x), \mu_{A_2}(x)\right\}, \min\left\{v_{A_1}(x), v_{A_2}(x)\right\} \mid x \in X \right\rangle\right\} \tag{6}$$

$$A_1 + A_2 = \left\{\left\langle x, \mu_{A_1}(x) + \mu_{A_2}(x) - \mu_{A_1}(x) \times \mu_{A_2}(x), v_{A_1}(x) \times v_{A_2}(x) \;\middle|\; x \in X \right\rangle\right\} \tag{7}$$

$$A_1 \times A_2 = \left\{\left\langle x, \mu_{A_1}(x) \times \mu_{A_2}(x), v_{A_1}(x) + v_{A_2}(x) - v_{A_1}(x) \times v_{A_2}(x) \;\middle|\; x \in X \right\rangle\right\} \tag{8}$$

$$nA = \left\{\left\langle x, 1 - (1 - \mu_A(x))^n, (v_A(x))^n \;\middle|\; x \in X \right\rangle\right\} \tag{9}$$

$$A^n = \left\{\left\langle x, (\mu_A(x))^n, 1 - (1 - v_A(x))^n \;\middle|\; x \in X \right\rangle\right\} \tag{10}$$

where n is a Positive integer.

3 Development of a model for the evaluation of risk factors based on the FMEA model in an intuitionistic fuzzy environment

A review of the methods used in knowledge management suggests that few studies were conducted on the areas of success, failure, and implementation of knowledge management. For instance, Coakes et al. [131] examined failure or success in knowledge management systems. Akhavan and Pezeshkan [14] examined the failure factors of knowledge management. Alan frost [51] discussed the failure factors of knowledge management. In this regard, Dufour and Steane [132], Outahar et al. [133], Raub and Wittich [134], Shaw and Edwards [135], and Shakerian et al. [136] conducted studies on the implementation of knowledge management. In the studies conducted, the causes of failure, success and the implementation of knowledge management were further addressed. Few studies have evaluated these causes. Evaluating the causes of failure of knowledge management and identifying its main causes can be more effective for organizations that intend to implement knowledge management. Several methods were proposed by researchers to evaluate the causes of failure, such as multi-criteria decision-making techniques [131–136].

The existing models focus further on the current status of the causes of knowledge management failure in organizations. But a more appropriate approach can be preventing the causes of knowledge management failures in organizations. Therefore, it is necessary to identify these causes, which are considered to be a failure in the implementation of knowledge management, and to evaluate and prioritize them in a codified and scientific way. The FMEA technique, the purpose of which is to analyze failure and prioritize potential failure states by computing the RPN index, allows the goal to be met. This technique can provide measures to reduce the chances of knowledge management failure in the organization, and also helps users identify the key design features and processes that require specific control. In this section, using this FMEA technique, attempts are made to develop an appropriate methodology for assessing the causes of knowledge management failure.

There are lots of discussions regarding the issue that the risk factors of failure occurrence (O), failure severity (S), and failure discoverability (D) cannot be precisely evaluated. Since linguistic evaluations are conducted in a relative mode by individuals, it can be assumed that the theory of intuitionistic fuzzy collections is appropriate to deal with the ambiguity of such evaluations and lead to more accurate results. Therefore, the group decision-making

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Table 1 The most important knowledge management failure factors

Factors	References
Bureaucracy	[48–52]
Gap between knowledge and awareness	[53]
Uncertainty in terms of received knowledge resource	[54–60]
Fear of job security	[59, 60]
Differences at experience level (personal understanding of accessibility)	[59]
Time restrictions	[56, 59, 61]
Insufficient experience of new system of information technology	[59, 62–64]
Fear of losing leadership	[50, 56, 59, 65]
Lack of motivations	[50, 55, 56, 59, 62, 66–68]
Poor communication skills	[50, 51, 57, 59, 69]
Lack of transparency and proper rewards	[49, 56, 62, 70–72]
Lack of management orientation to knowledge-sharing	[37, 56, 59, 70]
Information waste	[73–75]
Inappropriate organizational strategy, process, and structure	[51, 56, 59, 76–79]
Lack of management support	[50, 51, 59]
Employee turnover	[50, 51, 59, 62–64]
Shortage of financial resources	[37, 38, 51, 79–82]
Lack of proportionality between knowledge and important organizational goals	[50, 75]
No management commitment and leadership	[37, 51, 79, 83–85]
Ambiguity in perceived knowledge	[56, 70, 86]
Lack of enough and appropriate skill	[37, 51]
Lack of participation and competitiveness among the staff	[37, 51]
High power distance	[52, 53, 55, 70, 87–89]
Various personal characteristics	[49, 59, 61, 63, 64, 90, 91]
Emphasis on individualism instead of group work	[52, 63, 91]
Unrealistic expectations of IT staff (misunderstanding of technology)	[37, 59, 62, 64, 92, 93]
Lack of social networks in project	[94–101]
Uncertainty avoidance	[50–52, 56, 72, 102]

model proposed in the present study by using TOPSIS technique was delineated in order to evaluate failure items based on the FMEA model in an intuitionistic fuzzy environment. Table 1 shows linguistic expressions and their corresponding intuitionistic fuzzy numbers used in the present study to evaluate risk factors. Accordingly, it was assumed that there was n failure items $FM_i(1, \ldots, n)$ which were evaluated by an FMEA team composed of k members $TM_k(1, \ldots, k)$ and in $C = \{O, S, D\}$ risk factors according to the intuitionistic fuzzy linguistic variables inserted in this table.

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Table 2 Intuitionistic fuzzy linguistic variables

Chance discovery		Failure intensity		Failure event	
Fuzzy number	Verbal expression	Fuzzy number	Verbal expression	Fuzzy number	Verbal expression
(1, 0)	Absolutely impossible	(1, 0)	Hazardous without warning	(0.9, 0.1)	Very much
(0.9, 0.1)	Very unlikely	(0.9, 0.1)	High-risk warnings	(0.75, 0.2)	Much
(0.8, 0.1)	Unlikely	(0.8, 0.1)	Very much	(0.5, 0.45)	Average
(0.7, 0.2)	Very low	(0.7, 0.2)	Much	(0.35, 0.6)	Low
(0.6, 0.3)	Low	(0.6, 0.3)	Average	(0.1, 0.9)	Very low
(0.5, 0.4)	Average	(0.5, 0.4)	Low		
(0.4, 0.5)	Relatively high	(0.4, 0.5)	Very low		
(0.25, 0.6)	High	(0.25, 0.6)	Inconsiderable		
(0.1, 0.75)	Very high	(0.1, 0.75)	Very inconsiderable		
(0.1, 0.9)	Absolutely possible	(0.1, 0.9)	None		

According to the mentioned evaluations, the steps of intuitionistic fuzzy TOPSIS for the evaluation of failure items based on risk factors were discussed.

Step 1: determining the weight of decision-makers As stated, it was assumed that the decision-making team was based on k members in a way that the importance of each decision-maker was illustrated based on linguistic expressions and intuitionistic fuzzy numbers in Table 2. In addition, it was assumed that $D_k = \{\mu_k, v_k, \pi_k\}$ was an intuitionistic fuzzy number for the kth ranking of a decision-maker, then the weight of the kth decision-maker was calculated as follows:

$$\lambda_k = \left(\mu_k + \pi_k\left(\frac{\mu_k}{\mu_k + v_k}\right)\right) \Big/ \sum_{k=1}^{l}\left(\mu_k + \pi_k\left(\frac{\mu_k}{\mu_k + v_k}\right)\right)$$

$$\sum_{k=1}^{l} \lambda_k = 1 \tag{11}$$

Step 2: developing an aggregated matrix of intuitionistic fuzzy decision making based on decision-makers' opinions It was assumed that $R^{(k)} = (r_{ij}{}^{k})_{m\times n}$ was the matrix of intuitionistic fuzzy decision making for each decision-maker and $\lambda = \{\lambda_1, \lambda_2, \lambda_3, \ldots, \lambda_k\}$ was the weight of each decision-maker, in a way that $\sum_{k=1}^{l} \lambda_k = 1$, $\lambda_k \in [0, 1]$ is established. In the process of group decision making, there was a need to aggregate all the individual decisions in the format of an aggregated matrix of intuitionistic fuzzy decision making. To this end, the IFWA operator presented by Xu [137] can be employed. Therefore, there is $R = (r_{ij}{}^{k})_{m\times n}$ as follows:

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$$
\begin{aligned}
r_{ij} &= \mathrm{IFWA}_{\lambda}\left(r_{ij}^{(1)}, r_{ij}^{(2)}, \ldots, r_{ij}^{(l)}\right) \\
&= \lambda_1 r_{ij}^{(1)} \oplus \lambda_2 r_{ij}^{(2)} \oplus \lambda_3 r_{ij}^{(3)} \oplus \cdots \oplus \lambda_l r_{ij}^{(l)} \\
&= \left[1 - \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(1-\mu_{ij}^{(k)}\right)^{\lambda_k} - \prod_{k=1}^{l}\left(v_{ij}^{(k)}\right)^{\lambda_k}\right]
\end{aligned} \tag{12}
$$

So that, $r_{ij} = \left(\mu_{A_i}\left(x_j\right), v_{A_i}\left(x_j\right), \pi_{A_i}\left(x_j\right)\right) (i = 1, 2, \ldots, m,\ j = 1, 2, \ldots, n)$
The aggregated matrix of intuitionistic fuzzy decision making is illustrated as follows:

$$
R = \begin{bmatrix}
\left(\mu_{FM_1}(O), v_{FM_1}(O), \pi_{FM_1}(O)\right) & \left(\mu_{FM_1}(S), v_{FM_1}(S), \pi_{FM_1}(S)\right) & \left(\mu_{FM_1}(D), v_{FM_1}(D), \pi_{FM_1}(D)\right) \\
\left(\mu_{FM2}(O), v_{FM2}(O), \pi_{FM2}(O)\right) & \left(\mu_{FM2}(S), v_{FM2}(S), \pi_{FM2}(S)\right) & \left(\mu_{FM2}(D), v_{FM2}(D), \pi_{FM2}(D)\right) \\
\left(\mu_{FM3}(O), v_{FM3}(O), \pi_{FM3}(O)\right) & \left(\mu_{FM3}(S), v_{FM3}(S), \pi_{FM3}(S)\right) & \left(\mu_{FM3}(D), v_{FM3}(D), \pi_{FM3}(D)\right) \\
\vdots & \ddots & \vdots \\
\left(\mu_{FM_n}(O), v_{FM_n}(O), \pi_{FM_n}(O)\right) & \left(\mu_{FM_n}(S), v_{FM_n}(S), \pi_{FM_n}(S)\right) & \left(\mu_{FM_n}(D), v_{FM_n}(D), \pi_{FM_n}(D)\right)
\end{bmatrix}
\rightarrow \begin{bmatrix}
r_{1O} & r_{1S} & r_{1D} \\
r_{2O} & r_{2S} & r_{2D} \\
r_{3O} & r_{3S} & r_{3D} \\
\vdots & \ddots & \vdots \\
r_{nO} & r_{nS} & r_{nD}
\end{bmatrix}
$$

Step 3: specifying the weight of risk factors The main objection to the traditional FMEA technique is that the weights of risk factors are considered equal in such a way that different amounts for risk factors make it possible to create the same RPN. Therefore, the weight of each risk factor should be determined. It was assumed that each decision-maker expressed their opinions in terms of the importance of each risk factor (O, S, D) by using linguistic expressions illustrated in Table 2. If $w_j{}^k = (\mu_j{}^{(k)}, v_j{}^{(k)}, \pi_j{}^{(k)})$ was the intuitionistic fuzzy number assigned to the jth criterion on the basis of the …th decision-maker, then the weight of risk factors using the IFWA operator was calculated as follows:

$$
\begin{aligned}
w_j &= IFWA_{\lambda}\left(w_j^{(1)}, w_j^{(2)}, \ldots, w_j^{(l)}\right) \\
&= \lambda_1 w_j^{(1)} \oplus \lambda_2 w_j^{(2)} \oplus \lambda_3 w_j^{(3)} \oplus \cdots \oplus \lambda_l w_j^{(l)} \\
&= \left[1 - \prod_{k=1}^{l}\left(1-\mu_j^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(v_j^{(k)}\right)^{\lambda_k}, \prod_{k=1}^{l}\left(1-\mu_j^{(k)}\right)^{\lambda_k} - \prod_{k=1}^{l}\left(v_j^{(k)}\right)^{\lambda_k}\right] \\
W &= \left[w_1, w_2, w_3, \ldots, w_j\right] \\
w_j &= \left(\mu_j, v_j, \pi_j\right) (j = 1, 2, \ldots, n)
\end{aligned} \tag{13}
$$

Step 4: establishing a weighted aggregated intuitionistic fuzzy matrix Following the determination of the weight of each risk factors (W) as well as the aggregated matrix of intuitionistic fuzzy decision making, the weighted aggregated matrix of intuitionistic fuzzy decision making was obtained based on the following equation [117]:

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$$R \otimes W = \left\{ \left\langle c, \mu_{FM_i}(c) \times \mu_W(c), v_{FM_i}(c) \times v_W(c) - v_{FM_i}(c) \times v_W(c) \,|x \in X \right\rangle \right\}. \tag{14}$$

$$\pi_{FM_iW}(c) = 1 - v_{FM_i}(c) - v_W(c) - \mu_{FM_i}(c).\mu_W(c) + v_{FM_i}(c).v_W(c) \tag{15}$$

Then, the weighted aggregated matrix of intuitionistic fuzzy decision is shown as follows:

$$R = \begin{bmatrix} (\mu_{FM_1W}(O), v_{FM_1W}(O), \pi_{FM_1W}(O)) & (\mu_{FM_1W}(S), v_{FM_1W}(S), \pi_{FM_1W}(S)) & (\mu_{FM_1W}(D), v_{FM_1W}(D), \pi_{FM_1W}(D)) \\ (\mu_{FM2W}(O), v_{FM2W}(O), \pi_{FM2W}(O)) & (\mu_{FM2W}(S), v_{FM2W}(S), \pi_{FM2W}(S)) & (\mu_{FM2W}(D), v_{FM2W}(D), \pi_{FM2W}(D)) \\ (\mu_{FM3W}(O), v_{FM3W}(O), \pi_{FM3W}(O)) & (\mu_{FM3W}(S), v_{FM3W}(S), \pi_{FM3W}(S)) & (\mu_{FM3W}(D), v_{FM3W}(D), \pi_{FM3W}(D)) \\ \vdots & \ddots & \vdots \\ (\mu_{FM_nW}(O), v_{FM_nW}(O), \pi_{FM_nW}(O)) & (\mu_{FM_nW}(S), v_{FM_nW}(S), \pi_{FM_nW}(S)) & (\mu_{FM_nW}(D), v_{FM_nW}(D), \pi_{FM_nW}(D)) \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} r'_{1O} & r'_{1S} & r'_{1D} \\ r'_{2O} & r'_{2S} & r'_{2D} \\ r'_{3O} & r'_{3S} & r'_{3D} \\ \vdots & \ddots & \vdots \\ r'_{nO} & r'_{nS} & r'_{nD} \end{bmatrix}$$

Thus, $r'_{ij} = \left(\mu'_{ij}, v'_{ij}, \pi'_{ij}\right) = (\mu_{FMW}(c), v_{FMW}(c), \pi_{FMW}(c))$ the elements of the aggregated matrix of intuitionistic fuzzy decision making were weighted.

Step 5: determining the intuitionistic fuzzy positive and negative ideal amounts It was assumed that J_1 and J_2 were the criteria in terms of earnings and costs, respectively. If FM^+ and FM^- were, respectively, the solutions to intuitionistic fuzzy positive ideal amounts and negative ideal amounts, then FM^+ and FM^- were obtained as follows:

$$\begin{aligned} FM^+ &= \left(\mu_{FM+W}(c_j), v_{FM+W}(c_j)\right) \\ FM^- &= \left(\mu_{FM-W}(c_j), v_{FM-W}(c_j)\right) \end{aligned} \tag{16}$$

So that:

$$\mu_{FM^+W}(c_j) = \left(\left\langle \max_i \mu_{FM_i.W}(c_j) \,\middle|\, j \in J_1 \right\rangle, \left\langle \min_i \mu_{FM_i.W}(c_j) \,\middle|\, j \in J_2 \right\rangle \right) \tag{17}$$

$$v_{FM^+W}(c_j) = \left(\left\langle \min_i v_{FM_i.W}(c_j) \,\middle|\, j \in J_1 \right\rangle, \left\langle \max_i v_{FM_i.W}(c_j) \,\middle|\, j \in J_2 \right\rangle \right) \tag{18}$$

$$\mu_{FM^-W}(c_j) = \left(\left\langle \min_i \mu_{FM_i.W}(c_j) \,\middle|\, j \in J_1 \right\rangle, \left\langle \max_i \mu_{FM_i.W}(c_j) \,\middle|\, j \in J_2 \right\rangle \right) \tag{19}$$

$$v_{FM^-W}(c_j) = \left(\left\langle \max_i v_{FM_i.W}(c_j) \,\middle|\, j \in J_1 \right\rangle, \left\langle \min_i v_{FM_i.W}(c_j) \,\middle|\, j \in J_2 \right\rangle \right) \tag{20}$$

Step 6: calculating the distance between failure items through positive and negative ideals To calculate the distance between two intuitionistic fuzzy numbers, different methods have been suggested by Atanassov [119], Szmidt and Kacprzyk [122], and Grzegorzewski [138] including the Hamming distance, the Euclidean Distance, and the Normalized Distance which could be used in this respect. The distance of the ith failure item from the positive and negative ideals was shown by S^+ and S^-, respectively, and the Normalized Euclidean Distance was employed in the present study for their calculations, thus:

$$S^+ = \sqrt{\frac{1}{2n} \sum_{j=1}^{n} \left[\left(\mu_{FM_i.W}(c_j) - \mu_{FM^+W}(c_j)\right)^2 + \left(v_{FM_i.W}(c_j) - v_{FM^+W}(c_j)\right)^2 + \left(\pi_{FM_i.W}(c_j) - \pi_{FM^+W}(c_j)\right)^2 \right]} \tag{21}$$

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$$S^{-}=\sqrt{\frac{1}{2n}\sum_{j=1}^{n}\left[\left(\mu_{FM_i.W}\left(c_j\right)-\mu_{FM^{-}W}\left(c_j\right)\right)^2+\left(v_{FM_i.W}\left(c_j\right)-v_{FM^{-}W}\left(c_j\right)\right)^2+\left(\pi_{FM_i.W}\left(c_j\right)-\pi_{FM^{-}W}\left(c_j\right)\right)^2\right]} \tag{22}$$

Step 7: calculating the relative proximity ratio to intuitive ideal Given the intuitionistic fuzzy positive ideal solution FM^{+}, the relative proximity ratio of the failure item FM_i was defined as follows:

$$C_{i^+}={S_{i^-}}\big/{S_{i^+}+S_{i^-}}, \quad 0\le C_{i^+}\le 1 \tag{23}$$

Step 8: rating the failure items Following the determination of relative proximity ratio for each failure item, the failure items can be rated based on the amounts of C_{i^+} in a descending order. In other words, a failure item with a greater C_{i^+} is of higher priority in this respect.

4 Numerical example

The findings of the evaluation of knowledge management failure items according to the proposed model were as follows. The research model was implemented in Khuzestan Oil and Gas Company. Based on research studies [50, 51, 53, 59, 60, 63, 64, 72, 74, 88, 94] and surveys of five experts of company, in total 16 knowledge management failure items were specified which are shown in Table 3.

Following the determination of management knowledge failure items, research questionnaires were designed and distributed among experts. The results of evaluating management knowledge failure items according to the opinions of five experts are shown in Table 4. The

Table 3 Knowledge management failure items in Khuzestan Oil And Gas Company

	Items
A1	Lack of participation and competitiveness among the staff
A2	Insufficient experience of new system of information technology
A3	Differences at experience level (personal understanding of accessibility)
A4	Time restrictions
A5	Poor communication skills
A6	Lack of management orientation to knowledge-sharing
A7	No management commitment and leadership
A8	Inappropriate organizational strategy, process, and structure
A9	Lack of management support
A10	Shortage of financial resources
A11	Uncertainty in terms of received knowledge resource
A12	Gap between knowledge and awareness
A13	Ambiguity in perceived knowledge
A14	Lack of enough and appropriate skill
A15	Lack of proportionality between knowledge and important organizational goals
A16	Emphasis on individualism instead of group work

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Table 4 Evaluation of failure items through intuitionistic fuzzy numbers

Items	O	S	D
D_1			
A1	(0.75, 0.2, 0.05)	(0.6, 0.3, 0.1)	(0.4, 0.5, 0.1)
A2	(0.5, 0.45, 0.05)	(0.6, 0.3, 0.1)	(0.4, 0.5, 0.1)
D_2			
A1	(0.75, 0.2, 0.05)	(0.6, 0.3, 0.1)	(0.4, 0.5, 0.1)
A2	(0.5, 0.45, 0.05)	(0.6, 0.3, 0.1)	(0.4, 0.5, 0.1)
D_3			
A1	(0.9, 0.1, 0)	(0.9, 0.1, 0)	(0.1, 0.9, 0)
A2	(0.9, 0.1, 0)	(0.7, 0.2, 0.1)	(0.5, 0.4, 0.1)
D_4			
A1	(0.9, 0.1, 0)	(0.8, 0.1, 0.1)	(0.4, 0.5, 0.1)
A2	(0.75, 0.2, 0.05)	(0.7, 0.2, 0.1)	(0.25, 0.6, 0.15)
D_5			
A1	(0.9, 0.1, 0)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)
A2	(0.75, 0.2, 0.05)	(0.8, 0.1, 0.1)	(0.25, 0.6, 0.15)

results are obtained based on the conversion of linguistic expressions inserted in Table 2 into their corresponding intuitionistic fuzzy numbers.

Step 1: determining the weight of decision-makers According to Eq. (11), the values of λ_k for decision-makers were determined as follows.

$$\lambda_k = \left| \begin{array}{lllll} K_1 & K_2 & K_3 & K_4 & K_5 \\ 0.3 & 0.1751 & 0.263 & 0.263 & 0.299 \end{array} \right|$$

Step 2: developing an aggregated matrix of intuitionistic fuzzy decision making based on decision-makers' opinions According to the weights obtained for each decision-maker and Eq. (12), the aggregated matrix of decision-makers' opinions (r_{ij}) was established as follows.

Step 3: determining the weight of risk factors According to the matrix in Table 5 and Eq. (13), the weight of each risk factor was specified as follows.

$$W_j = \left| \begin{array}{lll} \text{O} & \text{S} & \text{D} \\ (0.842, 0.14, 0.018) & (0.882, 0.104, 0.015) & (0.864, 0.116, 0.02) \end{array} \right|$$

Step 4: developing a weighted aggregated intuitionistic fuzzy matrix Through multiplying the weighted vector of risk factors by matrix r_{ij}, the weighted aggregated intuitionistic fuzzy matrix for the evaluation of management knowledge failure items $R \otimes W$ is determined according to Eqs. (14) and (15) as follows.

Step 5: determining the intuitionistic fuzzy positive and negative ideal amounts According to the findings in Table 6 as well as Eqs. (16) and (20), the values of intuitionistic fuzzy positive and negative ideals were delineated as follows.

	O	S	D
$FM^+ =$	(0.777, 0.2, 0.023)	(0.882, 0.104, 0.015)	(0.516, 0.37, 0.114)
$FM^- =$	(0.512, 0.43, 0.059)	(0.529, 0.357, 0.114)	(0.272, 0.599, 0.129)

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Table 5 Aggregation of decision-makers' opinions

Items	*O*	*S*	*D*
A1	(0.922, 0.07, 0.008)	(0.857, 0.085, 0.059)	(0.535, 0.36, 0.105)
A2	(0.82, 0.151, 0.029)	(0.788, 0.122, 0.091)	(0.444, 0.424, 0.132)
A3	(0.919, 0.079, 0.003)	(0.884, 0.085, 0.032)	(0.319, 0.546, 0.135)
A4	(0.877, 0.116, 0.007)	(0.774, 0.171, 0.055)	(0.315, 0.525, 0.161)
A5	(0.882, 0.104, 0.015)	(0.782, 0.122, 0.097)	(0.563, 0.307, 0.13)
A6	(0.756, 0.195, 0.049)	(0.737, 0.169, 0.094)	(0.569, 0.309, 0.122)
A7	(0.901, 0.084, 0.015)	(1, 0, 0)	(0.597, 0.288, 0.116)
A8	(0.608, 0.337, 0.056)	(0.641, 0.247, 0.112)	(0.512, 0.37, 0.118)
A9	(0.736, 0.212, 0.051)	(0.6, 0.283, 0.117)	(0.454, 0.447, 0.099)
A10	(0.84, 0.131, 0.028)	(0.806, 0.139, 0.055)	(0.397, 0.484, 0.119)
A11	(0.919, 0.072, 0.009)	(0.809, 0.101, 0.09)	(0.556, 0.324, 0.12)
A12	(0.812, 0.173, 0.016)	(0.699, 0.205, 0.096)	(0.425, 0.465, 0.11)
A13	(0.81, 0.162, 0.029)	(0.672, 0.226, 0.102)	(0.539, 0.345, 0.116)
A14	(0.756, 0.195, 0.049)	(0.718, 0.188, 0.094)	(0.458, 0.443, 0.099)
A15	(0.791, 0.182, 0.027)	(0.794, 0.113, 0.093)	(0.319, 0.531, 0.15)
A16	(0.897, 0.094, 0.009)	(0.792, 0.113, 0.095)	(0.544, 0.339, 0.117)

Step 6: calculating the distance between knowledge management failure items through positive and negative ideals and determining the relative proximity ratio to intuitive ideal According to Eqs. (21) and (22), the distance for each management knowledge failure item with positive and negative ideals and the amount of proximity ratio are presented in Table 7.

5 Conclusion

Knowledge management refers to efforts made systematically to find, organize, and make the intangible capitals of organizations accessible and also to strengthen the culture of continuous learning and knowledge-sharing in organizations. Focusing on knowledge management and making huge investments in information technology, most organizations are to have access to the advantages of knowledge management [139]. In this respect, successful implementation of knowledge management requires a comprehensive view to different organizational factors. The major challenge of organizations is to understand knowledge management and how to implement it. Today, the biggest dream of organizations is to define an appropriate knowledge management system and its administration in an effective manner. However, the success in this respect (implementation of knowledge management) is only possible though the identification of key success or failure factors. To this end, the present study evaluated the failure factors in knowledge management. In most existing methods in the field of evaluation of management knowledge failure factors, the evaluation of importance or the conditions of these components have been merely examined. However, a more appropriate approach can prevent failure factors affecting the implementation of knowledge management in organizations. Therefore, the use of a codified and scientific method to evaluate and rate knowledge

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Table 6 Weighted aggregated intuitionistic fuzzy matrix for the evaluation of management knowledge failure items $R \otimes W$

Items	O	S	D
A1	(0.777, 0.2, 0.023)	(0.756, 0.179, 0.065)	(0.462, 0.435, 0.103)
A2	(0.69, 0.27, 0.039)	(0.694, 0.213, 0.093)	(0.383, 0.491, 0.125)
A3	(0.774, 0.208, 0.018)	(0.779, 0.179, 0.042)	(0.276, 0.599, 0.125)
A4	(0.738, 0.24, 0.021)	(0.683, 0.257, 0.061)	(0.272, 0.58, 0.148)
A5	(0.743, 0.229, 0.028)	(0.689, 0.213, 0.098)	(0.486, 0.388, 0.126)
A6	(0.637, 0.308, 0.055)	(0.65, 0.255, 0.095)	(0.491, 0.389, 0.119)
A7	(0.759, 0.212, 0.029)	(0.882, 0.104, 0.015)	(0.516, 0.37, 0.114)
A8	(0.512, 0.43, 0.059)	(0.565, 0.325, 0.11)	(0.443, 0.443, 0.114)
A9	(0.62, 0.323, 0.057)	(0.529, 0.357, 0.114)	(0.392, 0.511, 0.096)
A10	(0.708, 0.253, 0.039)	(0.711, 0.228, 0.061)	(0.343, 0.544, 0.113)
A11	(0.774, 0.202, 0.024)	(0.713, 0.194, 0.092)	(0.481, 0.403, 0.117)
A12	(0.684, 0.289, 0.028)	(0.616, 0.287, 0.097)	(0.367, 0.527, 0.105)
A13	(0.682, 0.279, 0.039)	(0.592, 0.306, 0.102)	(0.466, 0.421, 0.113)
A14	(0.637, 0.308, 0.055)	(0.633, 0.272, 0.095)	(0.395, 0.508, 0.096)
A15	(0.666, 0.297, 0.037)	(0.7, 0.205, 0.095)	(0.275, 0.585, 0.139)
A16	(0.755, 0.221, 0.023)	(0.698, 0.205, 0.097)	(0.47, 0.416, 0.114)

Table 7 The results of distance between management knowledge failure items and positive and negative ideals

	Failure items	${S_i}^+$	${S_i}^-$	C_i	Rank
A1	Lack of participation and competitiveness among the staff	0.07	0.48	0.87	2
A2	Insufficient experience of new system of information technology	0.13	0.44	0.77	6
A3	Differences at experience level (personal understanding of accessibility)	0.15	0.48	0.77	7
A4	Time restrictions	0.17	0.43	0.72	11
A5	Poor communication skills	0.1	0.45	0.82	5
A6	Lack of management orientation to knowledge-sharing	0.14	0.42	0.75	9
A7	No management commitment and leadership	0.01	0.52	0.98	1
A8	Inappropriate organizational strategy, process, and structure	0.22	0.39	0.64	16
A9	Lack of management support	0.21	0.38	0.64	15
A10	Shortage of financial resources	0.14	0.45	0.76	8
A11	Uncertainty in terms of received knowledge resource	0.09	0.46	0.84	3
A12	Gap between knowledge and awareness	0.17	0.42	0.71	14
A13	Ambiguity in perceived knowledge	0.16	0.41	0.72	10
A14	Lack of enough and appropriate skill	0.16	0.42	0.72	12
A15	Lack of proportionality between knowledge and important organizational goals	0.17	0.44	0.72	13
A16	Emphasis on individualism instead of group work	0.1	0.45	0.82	4

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management failure factors can provide appropriate conditions for the implementation of knowledge management in organizations. In order to determinate the priority of knowledge management failure factors, items such as the power to prevent failure factors in knowledge management, the occurrence rate of failure factors, and finally the severity of failure factors affecting the implementation of knowledge management should be taken into account. Given this procedure, the FMEA technique has had great and important applications in promoting the quality of products and services. Accordingly and given the existing uncertainties in quantitative evaluations conducted by individuals, a group decision-making approach in an intuitionistic fuzzy environment was proposed in the present study using the FMEA technique in order to evaluate knowledge management failure factors in the form of a case study in Khuzestan Oil and Gas Company. In the theory of intuitionistic fuzzy collection, not only a membership degree but also a non-membership degree is assigned to each member; in this way, the uncertainty and ambiguity in the decision-making can be associated with the issue. This would lead a decision-making matrix with evaluation endowed with higher degrees of accuracy and credibility and subsequently a more effective and efficient decision making. In the proposed approach, at first, 15 failure factors in the implementation of knowledge management in an organization were determined through the review of the related literature as well as similar studies and surveys of experts in Khuzestan Oil and Gas Company. In the next step, the weight of decision-makers and risk factors was calculated according to linguistic expressions and intuitionistic fuzzy numbers. Then, the aggregated matrix of decision-makers' opinions was calculated based on the weights obtained and the principles of intuitionistic fuzzy numbers. After that, the weight of each risk factor was determined by using the aggregation of experts' opinions in the form of intuitionistic fuzzy numbers. Finally, a decision-making matrix was established and evaluations were conducted for the amounts of risk factors for each failure factor in the format of intuitionistic fuzzy numbers as well as the use of TOPSIS technique in order to determine the most important failure factors in the implementation of knowledge management in Khuzestan Oil and Gas Company as follows:

- Lack of management commitment and leadership
- No participation and competitiveness among the staff
- Uncertainty about received knowledge resources

The results of the present study indicated that improvements in the implementation of knowledge management in Khuzestan Oil and Gas Company required encouraging the managers and the staff to be committed in the implementation of knowledge management by explaining the goals, mission, and vision of knowledge management and arguing the results in terms of the implementation of knowledge management in organizations. Moreover, the delegation of authority and responsibility to the staff in the implementation process of knowledge management could lead to their participation. This study's innovation is use of intuitionistic fuzzy decision-making techniques in FMEA techniques to assess and prioritize the failure items. The use of intuitionistic group decision making, on the one hand, can relieve ambiguities in evaluation failure component with evaluation the degree of membership and non-membership. On the other hand, the traditional FMEA has been criticized for a variety of reasons that resolve with proposed approach in this paper. Some of which are listed as follows:

- Different combinations of O, S, and D may produce exactly the same value of RPN, but their hidden risk implications may be totally different.

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- The relative importance among O, S, and D is not taken into consideration. The three risk factors are assumed to be equally important. This may not be the case when considering a practical application of FMEA.
- The mathematical formula for calculating RPN is questionable and debatable. There is no rationale as to why O, S, and D should be multiplied to produce the RPN.

In the present study, combination of TOPSIS and FMEA techniques is used to prioritize knowledge management failure factors and it was suggested to employ other group decision-making techniques in the future studies in order to evaluate management knowledge failure factors in an intuitionistic fuzzy environment.

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