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Identifying and prioritizing the effective factors on knowledge creation with the logarithmic fuzzy preference programming (LFPP) technique (Case study: Khuzestan Steel Company)

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Abstract

The purpose of this research was to identify and prioritize the effective factors of knowledge creation with the logarithmic fuzzy preference programming technique in Khuzestan Steel Company. The method of the present research was applied-exploratory. The statistical population included all managers and supervisors of Khuzestan Steel Company, 15 of whom were selected by snowball method. The data-gathering tool was a researcher-made questionnaire. Delphi techniques and logarithmic fuzzy preference programming were used in this research. Data analysis was done using SPSS and Gems software. Based on the Delphi technique, 8 factors and 36 sub-factors were identified. The results of the logarithmic fuzzy preference programming technique showed that in terms of the importance, culture (0.1852), structure (0.1712), motivational system (0.1464), individual competence (0.1356), information resources (0.1111), information technology (0.1043), leadership (0.0739) and organization processes (0.0723) are ranked first to eighth respectively.

Keywords: identification, prioritization, knowledge creation, logarithmic fuzzy preference programming technique, Khuzestan Steel Company
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1 Introduction

During the fourth industrial revolution, the competition between companies has become more intense [4]. Companies must quickly adapt to changes and react to these changes. In this way, paying attention to knowledge and knowledge creation can be a key solution for companies. Knowledge is a precious treasure for individuals and companies, and it is an essential efficient tool through which companies will be able to carry out their activities and achieve their goals [2]. Knowledge is an important long-term strategic resource for business survival, sustainability as well as growth [12]. Knowledge creation shows the ability to produce knowledge and its circulation in products, services and

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systems and the whole organization. A company should make a reasonable effort to search for appropriate knowledge and resources from inside and outside the company [3]. Creating knowledge creates a significant advantage for companies to win the competition and should be considered as an essential aspect of companies [8]. In order to achieve the level of knowledge creation in institutions, employees not only have the duty to acquire new knowledge, but it is also necessary to transfer the current evident and tacit knowledge in the form of new knowledge and to actively participate in the organization's knowledge creation. Although this knowledge creation seems to be a simple and trivial matter, in reality, most institutions face many problems in creating the procedures needed for knowledge creation [6].

Contrary to the issue that the creation of important knowledge in the structure of the organization is the creation of vision and strategic and key plans, learning dynamically and actively, responding to issues and introducing new knowledge into the body of institutions, the studies indicate that a large number of institutions do not consider the issue of knowledge creation as a fundamental strategy in their desired vision and objectives, or in case of using it, they face many mistakes and finally give up. This issue in steel companies, which is one of the largest formal social institutions in terms of volume, extent and variability of intellectual capital, even though they actively possess knowledge in their field of work and generally focus their key actions on learning, creating and expanding knowledge, it is extremely important. The lack of appropriate procedures and solutions in the field of creating new knowledge has turned this type of programming into a double intellectual burden and an exponential cost for managers. So; these companies should create an environment for the creation of knowledge among employees and make great efforts to identify the factors affecting the creation of knowledge.

There are many articles that discuss the factors influencing the creation of knowledge. In their research, Rahman Seresht and Habibi Badrabadi [17], identified eight indicators related to the structure, culture and characteristics of human resources and motivational systems, which are able to be effective in knowledge creation in a bureaucratic institution without codified knowledge systems. Mirkamali et al. [13] classified the variables related to knowledge creation in universities and scientific institutions into three components: support, individual and organization. Rezaei et al. [18] in the context of identifying the factors influencing the creation of individual knowledge in the dimension of organizational culture and strategy, identified 23 key factors influencing the creation of individual knowledge and categorized them into 2 areas of organizational culture and strategy. Koloniari et al. [9] investigated the influence of organizational, technological and personal factors on the creation of new knowledge and innovation. Dang and Le-Hoai [7] also examined the relationship between knowledge creation factors and the effectiveness of construction organizations.

The analysis and review of the studies carried out in the past shows that despite the identification of factors affecting the creation of knowledge in various activities, the evaluation of these factors in steel companies has received less attention and there is a theoretical gap in this field. Another thing that can be seen in the study of the theoretical framework is the lack of accuracy of the researchers to the cultural and local context of the institutions in identifying the effective factors of knowledge management. The studies conducted in different industries and sectors are based on the cultural and native context of that company or sector, and citing them in other organizations causes deviation in the results. Therefore, the factors affecting knowledge creation processes should be identified based on the local and cultural context of each country and region where the company operates, and in this way, it is not possible to rely only on the variables obtained from other studies. Therefore, it should be determined based on the appropriate methods, in this research, Delphi techniques and logarithmic fuzzy preference programming.

On the other hand, most of the studies conducted in this field are based on studies carried out in developed countries, which cannot be generalized to developing countries. In order to fill this gap, the current research aims to identify and prioritize the effective factors of knowledge creation and tries to achieve this goal through the logarithmic fuzzy preference programming technique. So, based on the mentioned explanations, the current research seeks to answer these questions: What are the effective factors on knowledge creation with logarithmic fuzzy preference planning technique in Khuzestan Steel Company? How are these factors prioritized?

2 Extracting factors and sub-factors effective on knowledge creation from literature review

Most of the knowledge management literature emphasizes the importance of knowledge. Knowledge has been related to the key organizational resource, economic resource and the only source of competitive advantage for organizations. Therefore, knowledge creation should be at the forefront of knowledge initiatives in organizations, because the creation of new knowledge assures them that they have a source of competitive advantage to create wealth and maintain continuous growth [16]. After reviewing the literature, the following factors and sub-factors were extracted:

Table 1: Factors and sub-factors affecting knowledge creation extracted from literature review

Row	Factor	Sub-Factor	Reference
1	Culture	Team work spirit in the company	[1, 5, 7, 9, 10, 13, 14, 17, 18, 20]
2		Attention to the environment outside the company	
3		Attention and trust among company members	
4		Risk-taking spirit in the company	
5		Learning and innovative spirit in the company	
6		Emphasis on collective and general goals against individual goals	
7		Criticism atmosphere in the company	
8		The value of asking questions and seeking knowledge	
9	Structure	Forming working groups	[5, 10, 11, 13, 15, 17, 18]
10		The possibility of informal communication	
11		Flexibility and dynamics of the structure	
12		Individual and work teams autonomy	
13		The use of work teams in addition to the bureaucratic structure	
14		Existence of social communication networks	
15		Existence of official positions to promote knowledge creation	
16	Motivational system	Giving material rewards for creating and sharing knowledge	[1, 13, 17, 20]
17		Provide feedback to employees	
18		Non-material rewards for creating and sharing knowledge	
19	Individual competence	Creativity of employees	[1, 5, 9, 10, 13, 17, 20]
20		Education of employees	
21		skill and expertise	
22		Emotional intelligence of employees	
23	Leadership	Providing perspective to employees	[9, 13, 14, 17, 19, 20]
24		Managers' support for the knowledge creation process in the organization	
25		Managers' use of cooperative management method	
26		Manager's reliance on his knowledge and skills as a power base	
27		Creating intellectual models and a common language among employees	
28	Organization processes	Providing opportunities to take initiatives	[9, 17]
29		Processes standardization	
30		Existence of formal processes for knowledge management	
31		The existence of a logical connection between the subsystems of the company	
32	Information technology	Technical capabilities of information technology	[5, 11, 13, 14, 17]
33		Provide feedback to employees	
34		Non-material rewards for creating and sharing knowledge	
35	Information resources	Providing information resources through libraries and document storage centers	[13, 14]
36		Intranet networks and video conferences in order to acquire, transfer and integrate knowledge	
37		Continuous and appropriate interaction between the company and the university	
38		Allocation of sufficient budget to research and development department	
39		The existence of well-equipped laboratories and workshops in the company	

3 Research methods

The present research is classified as a survey-descriptive study because it examines and recognizes the variables in the existing conditions, and based on the purpose, it is an applied research, and it's a case study in terms of type. As mentioned, Khuzestan Steel Company was selected as the research area. The purpose of the present research is to identify and prioritize the factors affecting the creation of knowledge using the logarithmic fuzzy preference programming technique in Khuzestan Steel Company. The statistical population discussed and evaluated in this research are all managers and supervisors of Khuzestan Steel Company with more than 10 years of experience and master's degrees. Because multi-criteria decision-making methods and procedures are used in the present study experts' opinions were used as well. The sample size was few and equal to 15 people. In this research, the snowball sampling method was used due to expert evaluation and the use of experts' opinions. In this research, a questionnaire was used. Even though the questionnaires of this study were extracted from the literature and the theoretical foundations of the research, but to increase the confidence level, using the Delphi technique, the questionnaires were distributed among 15 experts in two steps. The purpose of the design and distribution of these two questionnaires is to determine the importance of the factors and sub-factors suggested by the experts. In the primary and secondary questionnaires, the importance of each of the factors and sub-factors was measured using a nine-point scale (1-9). The first stage

questionnaire included 8 factors and 39 sub-factors and the second stage questionnaire included 8 factors and 36 sub-factors. In the next step, based on the logarithmic fuzzy preference programming technique, a questionnaire was prepared and distributed among the sample members. In terms of validity, the research questionnaire was presented and approved by 5 experts (supervisors and some company managers) in the first and second steps. The reliability of the first and second-step questionnaires was calculated using Cronbach's alpha 0.962 and 0.953, which indicates the reliability of the research questionnaire because Cronbach's alpha is more than 0.7. The reliability of the second-step questionnaire was also checked by calculating the inconsistency ratio. In this research, the inconsistency ratio of all decision-making pairwise matrices was calculated and it was below 0.1, which indicates the accuracy of the comparisons.

4 Research findings

To identify the effective factors on knowledge creation and finalize the factors identified and taken from previous studies, the opinions of experts were used based on the Delphi technique. Experts were asked for their opinions by sending a structured questionnaire with a 9-point Likert scale, consisting of 39 questions, with the participation of 15 people. The data collected in the first step showed the rejection of three sub-factors and in the second step, it proved the confirmation of all the factors (36 sub-factors) and thus the resulting consensus introduced 8 main factors and 36 sub-factors as important factors (test results and the consensus of the expert's opinions in the form of a one-sample t-test and the output of the software and the relevant tables are given below).

Table 2: One-sample t-test related to the identified factors (first and second steps)

Sub-factor	Delphi technique – step1					Delphi technique – step2			
	Mean	standard deviation	t-statistics	significance level	Result	standard deviation	t-statistics	significance level	Result
Team work spirit in the company	7.60	1.05	9.53	0.000	✓	0.94	11.52	0.000	✓
Attention to the environment outside the company	4.86	1.18	0.43	0.670	—	—	—	—	—
Attention and trust among company members	7	1.69	4.58	0.000	✓	1.33	8.57	0.000	✓
Risk-taking spirit in the company	7.13	1.24	6.63	0.000	✓	1.11	8.12	0.000	✓
Learning and innovative spirit in the company	7.73	1.79	5.90	0.000	✓	1.25	9.26	0.000	✓
Emphasis on collective and general goals against individual goals	6.93	1.57	4.74	0.000	✓	1.14	7.43	0.000	✓
Criticism atmosphere in the company	4.86	1.30	0.39	0.698	–	–	–	–	–
The value of asking questions and seeking knowledge	7.06	1.75	4.57	0.000	✓	1.54	5.85	0.000	✓
Forming working groups	7.06	1.70	4.68	0.000	✓	1.48	5.907	0.000	✓
The possibility of informal communication	6.13	2.44	2.15	0.046	✓	1.76	3.36	0.005	✓
Flexibility and dynamics of the structure	4.80	1.69	0.45	0.493	–	–	–	–	–
Individual and work teams autonomy	6.46	1.12	5.04	0.000	✓	0.89	7.17	0.000	✓
The use of work teams in addition to the bureaucratic structure	6.66	1.98	3.24	0.006	✓	1.62	4.61	0.000	✓
Existence of social communication networks	6.93	2.28	3.28	0.005	✓	1.66	5.26	0.000	✓
Existence of official positions to promote knowledge creation	6.06	1.90	2.16	0.048	✓	1.40	3.86	0.002	✓
Giving material rewards for creating and sharing knowledge	6.46	2.53	2.24	0.042	✓	1.92	3.76	0.000	✓
Provide feedback to employees	6.73	2.08	3.21	0.006	✓	1.45	5.67	0.000	✓
Non-material rewards for creating and sharing knowledge	6.26	2.28	2.14	0.049	✓	1.67	3.85	0.000	✓
Creativity of employees	7.20	1.69	5.01	0.000	✓	1.45	6.55	0.000	✓
Education of employees	6.26	1.66	2.94	0.011	✓	1.29	4.77	0.000	✓

Skill and expertise	7.40	1.72	5.39	0.000	✓	1.16	9.10	0.000	✓
Emotional intelligence of employees	6.46	1.45	3.89	0.002	✓	1.26	5.51	0.000	✓
Providing perspective to employees	7	1.36	5.68	0.000	✓	0.97	9.26	0.000	✓
Managers' support for the knowledge creation process in the organization	7.13	2.09	3.93	0.001	✓	1.59	5.82	0.000	✓
Managers' use of cooperative management method	6.40	2.26	2.39	0.031	✓	1.69	4.10	0.001	✓
Manager's reliance on his knowledge and skills as a power base	5.93	1.28	2.81	0.036	✓	2	2.31	0.036	✓
Creating intellectual models and a common language among employees	6.40	1.99	2.72	0.017	✓	1.61	4.32	0.001	✓
Providing opportunities to take initiatives	6.40	1.88	2.88	0.012	✓	1.48	4.51	0.000	✓
Processes standardization	7.20	1.61	5.28	0.000	✓	0.91	10.21	0.000	✓
Existence of formal processes for knowledge management	7.06	1.90	4.19	0.001	✓	1.29	7.15	0.000	✓
The existence of a logical connection between the subsystems of the company	7.06	0.88	9.05	0.000	✓	0.73	12.61	0.000	✓
Technical capabilities of information technology	7.13	1.76	4.67	0.000	✓	1.06	9.01	0.000	✓
System capabilities of information technology	7.06	1.75	4.57	0.000	✓	1.05	8.80	0.000	✓
Expansion of new and practical technologies and software	6.93	1.79	4.18	0.001	✓	1.16	7.54	0.000	✓
Providing information resources through libraries and document storage centers	6.20	2.30	2.016	0.043	✓	1.99	2.97	0.010	✓
Intranet networks and video conferences in order to acquire, transfer and integrate knowledge	6.26	2.21	2.21	0.044	✓	1.88	3.29	0.005	✓
Continuous and appropriate interaction between the company and the university	6.86	2.16	3.33	0.005	✓	1.69	5.01	0.000	✓
Allocation of sufficient budget to research and development department	6.80	2	3.47	0.004	✓	1.50	5.48	0.000	✓
The existence of well-equipped laboratories and workshops in the company	7.20	1.89	4.49	0.001	✓	1.24	7.87	0.000	✓

In the first step, three sub-factors had an average of less than 5 and were removed from the questionnaire. Next, for weighting and prioritizing the proposed factors and sub-factors, the fuzzy preference programming technique was used. In this technique, according to the research hierarchy tree, to explain the preference of each line compared to the higher level, a questionnaire of pairwise comparisons was designed and provided to the experts. After filling in the pairwise comparison questionnaire, the geometric mean was used to summarize the experts' opinions, and at the same time, verbal expressions were used to explain the experts' preferences, which were converted into triangular fuzzy numbers. Then, the results of the questionnaires were analyzed by Gems software, and finally, the prioritization of factors and sub-factors was obtained. Table 3 shows the fuzzy geometric mean of the questionnaire pairwise comparisons matrix of the main factors of the research:

According to Table 3, fuzzy numbers were entered into the GEMS software based on the logarithmic fuzzy preference programming technique.

$$Minimize\ j = (-1)^2 + M \sum_{i=1}^{8} \sum_{j=2}^{7} (\delta_{ij}^2 + \square_{ij}^2)$$

$$x_1 - x_2 - \ln\ln\left(\frac{1.11}{0.77}\right) + \delta_{12} \geq \ln 0.77$$

$$-x_1 + x_2 - \ln\ln\left(\frac{1.61}{1.11}\right) + \delta_{12} \geq -\ln 1.61$$

Table 3: Pairwise comparison matrix of the main research factors

Factors	Culture	Structure	Motivational system	Individual competence	Leadership	Organization processes	Information technology	Information resource
Culture	(1,1,1)	(1.61,1.11,0.77)	(1.85,1.35,0.95)	(1.94,1.39,0.97)	(2.74,2.07,1.45)	(2.50,1.84,1.29)	(2.29,1.72,1.25)	(2.19,1.62,1.14)
Structure		(1,1,1)	(1.66,1.18,0.82)	(1.74,1.26,0.90)	(2.44,1.86,1.32)	(2.22,1.65,1.18)	(2.19,1.62,1.14)	(2.15,1.58,1.09)
Motivational system			(1,1,1)	(1.66,1.18,0.82)	(2.12,1.61,1.15)	(1.88,1.38,0.98)	(1.85,1.35,0.95)	(1.82,1.31,0.91)
Individual competence				(1,1,1)	(2.06,1.55,1.10)	(1.85,1.35,0.95)	(1.69,1.25,0.91)	(1.79,1.29,0.88)
Leadership					(1,1,1)	(1.57,1.14,0.81)	(1.12,0.80,0.57)	(1.09,0.79,0.57)
Organization processes						(1,1,1)	(1.01,0.72,0.53)	(1.01,0.72,0.53)
Information technology							(1,1,1)	(1.26,0.91,0.66)
Information resource								(1,1,1)

$$
\begin{aligned}
x_1 - x_3 - \ln\ln\left(\frac{1.35}{0.95}\right) + \delta_{13} &\geq \ln 0.95 \\
-x_1 + x_3 - \ln\ln\left(\frac{1.85}{1.35}\right) + \delta_{13} &\geq -\ln 1.85 \\
x_1 - x_4 - \ln\ln\left(\frac{1.39}{0.97}\right) + \delta_{14} &\geq \ln 0.97 \\
-x_1 + x_4 - \ln\ln\left(\frac{1.94}{1.39}\right) + \delta_{14} &\geq -\ln 1.94 \\
&\vdots \\
x_7 - x_8 - \ln\ln\left(\frac{0.91}{0.66}\right) + \delta_{78} &\geq \ln 0.66 \\
-x_7 + x_8 - \ln\ln\left(\frac{1.26}{0.91}\right) + \delta_{78} &\geq -\ln 1.26
\end{aligned}
$$

In the above model, the X_i's correspond to each of the main research factors ($i = 1, 2, 3, ..., 8$). In the following, the results of GEMS software are given in table 4 while being normalized:

Table 4: Prioritization of the main research factors

Factors	**Weight**	**Priority**
Culture	0.1852	1
Structure	0.1712	2
Motivational system	0.1464	3
Individual competence	0.1356	4
Leadership	0.0739	5
Organization processes	0.0723	6
Information technology	0.1043	7
Information resource	0.1111	8

According to the results obtained in the above table, the "culture" factor with a weight of 0.1852 is in the first rank and the "organization processes" factor is in the last rank with a weight of 0.0723.

The weighting and prioritization of sub-factors are as follows:

5 Conclusion

Knowledge is a type of fundamental asset that any institution, by considering and taking into account, can surpass its competitors and achieve a sustainable competitive advantage. In the current situation today, due to the tight competition between production and economic institutions, paying special attention to this fundamental capital will be very useful for institutions. But it should be kept in mind that this valuable investment needs to be managed

Table 5: Weighting and prioritization of research factors and sub-factors

Row	Factors	Weight	Priority	Sub-Factor	Weight	Priority
1	Culture	0.1852	1	Team work spirit in the company	0.2014	2
2				Attention to the environment outside the company	0.136	4
3				Risk-taking spirit in the company	0.1798	3
4				Learning and innovative spirit in the company	0.2433	1
5				Emphasis on collective and general goals against individual goals	0.1038	6
6				The value of asking questions and seeking knowledge	0.1358	5
7	Structure	0.1712	2	Forming working groups	0.2388	1
8				The possibility of informal communication	0.1359	5
9				Individual and work teams autonomy	0.1596	4
10				The use of work teams in addition to the bureaucratic structure	0.1836	3
11				Existence of social communication networks	0.1885	2
12				Existence of official positions to promote knowledge creation	0.0936	6
13	Motivational system	0.1464	3	Giving material rewards for creating and sharing knowledge	0.35	2
14				Provide feedback to employees	0.368	1
15				Non-material rewards for creating and sharing knowledge	0.282	3
16	Individual competence	0.1356	4	Creativity of employees	0.2843	2
17				Education of employees	0.1801	4
18				skill and expertise	0.2991	1
19				Emotional intelligence of employees	0.2365	3
20	Leadership	0.0739	7	Providing perspective to employees	0.2371	2
21				Managers' support for the knowledge creation process in the organization	0.2397	1
22				Managers' use of cooperative management method	0.1908	4
23				Manager's reliance on his knowledge and skills as a power base	0.1448	5
24				Creating intellectual models and a common language among employees	0.1976	3
25	Organization processes	0.0723	8	Providing opportunities to take initiatives	0.1993	4
26				Processes standardization	0.2835	1
27				Existence of formal processes for knowledge management	0.2456	3
28				The existence of a logical connection between the subsystems of the company	0.2776	2
29	Information technology	0.1043	6	Technical capabilities of information technology	0.402	1
30				System capabilities of information technology	0.323	2
31				Expansion of new and practical technologies and software	0.275	3
32	Information resources	0.1111	5	Providing information resources through libraries and document storage centers	0.1462	5
33				Intranet networks and video conferences in order to acquire, transfer and integrate knowledge	0.1942	4
34				Continuous and appropriate interaction between the company and the university	0.2160	2
35				Allocation of sufficient budget to research and development department	0.2023	3
36				The existence of well-equipped laboratories and workshops in the company	0.2414	1

optimally. Therefore, a variable with the content of managing knowledge was created. Among important and basic procedures in organizational knowledge management, we can mention the creation of new knowledge or knowledge creation. Considering the key role of modern knowledge in the survival and expansion of institutions, at some times the role of knowledge creation becomes more important for the organization than the use of existing knowledge. New and fresh knowledge enables institutions to expand their capabilities and use their resources optimally and appropriately. Therefore, the realization of concepts such as continuous improvement, organizational development, gaining a sustainable competitive advantage and innovation depends on the continuity of the knowledge-creation process in the organization. This issue seems simple from a conceptual aspect, but in practice, many organizations face difficulties in creating the necessary platforms for creating knowledge and producing effective knowledge. This can be seen as a result of managers' lack of familiarity with the effective factors of knowledge creation in organizations and the impact of each of these factors on the aforementioned process. Therefore, considering the importance and role of the knowledge creation process on the effectiveness and growth of Khuzestan Steel Company and creating added value, this research tries to study these factors, and by reviewing the literature on the subject and conducting studies,

provide as much as possible the effective factors on knowledge creation in the organization and finally present the new factors that are effective on the knowledge creation in the organization and present a new classification of these effective factors on the knowledge creation process. This research was carried out to answer the following questions. The results are as follows:

- What are the factors affecting the creation of knowledge in Khuzestan Steel Company?

  In order to answer the question, first, based on the literature review, 8 factors and 39 sub-factors were extracted, and then a questionnaire was designed and distributed among the sample members. Finally, 8 factors and 36 sub-factors were confirmed.

- What is the weighting of the factors affecting the creation of knowledge in Khuzestan Steel Company?
- What is the prioritization of the affective factors on knowledge creation in Khuzestan Steel Company?

To weigh and prioritize the factors identified in the previous step, a questionnaire based on the logarithmic fuzzy preference programming technique was distributed among the sample members. The results of this section are as follows:

According to the results, the culture factor with a weight of 0.1852 is the first effective factor in knowledge creation at Khuzestan Steel Company. Also, among the sub-factors of culture, the sub-factor "learning and innovation spirit in the company" is ranked first with a weight of 0.2433 and the sub-factor "emphasis on collective and general goals versus individual goals" is ranked last with a weight of 0.1038. The results of the research are in line with Rahman Seresht and Habibi Badrabadi [17], Mirkamali et al. [13], Rezaei et al. [18], Abbas et al. [1], Koloniari et al. [9], Dang and Le-Hoai [7] and Koloniari et al. [10]. Many organizations view knowledge creation as a technical program that contains specific strategies, structures, processes and standards. However, they often forget the very powerful element of culture in the implementation of knowledge creation. Culture can significantly improve or hinder the success of knowledge-creation actions. The importance of culture in knowledge creation is due to the fact that a significant part of knowledge as culture has been learned from past generations. Therefore, organizations need to examine the culture before dealing with the implementation of knowledge creation. The organization can create a culture that promotes knowledge sharing, which is important for the success of the organization. In other words, better cultural and operational tools are needed for knowledge-creating organizations.

According to the results, the factor "structure" with a weight of 0.1712 is the second most effective factor in knowledge creation at Khuzestan Steel Company. Also, among the sub-factors of the "structure", the sub-factor "Forming working groups" with a weight of 0.2388 is in the first rank and the sub-factor "Existence of official positions to promote knowledge creation" is in the last rank with a weight of 0.0936. The results of the research are in line with Nasehifar et al. [15], Rahman Seresht and Habibi Badrabadi [17], Mirkamali et al. [13], Rezaei et al. [18], Bahrami et al. [5], and Lee and Lee [11]. "Structure" is one of these effective factors in the creation of knowledge, which has been mentioned in various studies. The two-way relationship between the organization's structure and culture has made the structure, along with the organization's culture, a vital factor in the success of the organization's knowledge processes. That is why, from the point of view of experts, creating a suitable and flexible structure with few hierarchical levels and communication is considered one of the essentials for the success of knowledge creation in organizations.

According to the results, the factor "motivational system" with a weight of 0.1464 is the third most effective factor in knowledge creation in Khuzestan Steel Company. Also, among the sub-factors of the "motivational system", the sub-factor "providing feedback to employees" with a weight of 0.368 ranks first and the sub-factor "non-material rewards for creating and sharing knowledge" with a weight of 0.282 ranks last. The results of the research are consistent with Rahman Seresht and Habibi Badrabadi [17], Mirkamali et al. [13]. In some organizations, it is usual to create knowledge, but in others, this old attitude that knowledge is power still rules. Many enlightened organizations have started strategies with the aim of changing these outdated attitudes. They have used various motivational factors to show that they are determined and serious in the field of knowledge creation in their organization. For example, some of them have considered recognition and reward programs for people who seek to create new knowledge, which include recognition in the company, inclusion in the newsletter, and significant financial rewards. Some other companies evaluate their employees on the basis of how much they have participated in knowledge-creation activities, and they consider promotions or special holidays for them.

According to the results, the factor "individual competence" with a weight of 0.1356 is the fourth effective factor in knowledge creation at Khuzestan Steel Company. Also, among the sub-factors of individual competence, the sub-factor "Skills and Expertise" with a weight of 0.2991 ranks first and the sub-factor "Education of employees" with a weight of 0.1801 ranks last. The results of the research are in line with Rahman Seresht and Habibi Badrabadi [17],

Mirkamali et al. [13], Bahrami et al. [5], Teerajetgul and Charoenngam [20], Abbas et al. [1], and Koloniari et al. [10]. Reviewing successful studies shows that individual competence to create knowledge enables the achievement of goals in the organization; Therefore, the creation of knowledge is considered vital for organizations, and thinking and creative people will be able to create better things by understanding the principles of knowledge levels. With the creation of knowledge, the expenses of the organization will be significantly reduced, but if people neglect this matter, they will witness the upward trend of the expenses of the organization due to the repetition of past experiences.

According to the results, the factor "information resources" with a weight of 0.1111 is the fifth most effective factor in knowledge creation in Khuzestan Steel Company. Also, among the sub-factors of information resources, the sub-factor "the existence of well-equipped laboratories and workshops in the company" with a weight of 0.2414 ranks first and the sub-factor " Providing information resources through libraries and document storage centers" with a weight of 0.2414 0.1462 is in the last rank. The results of the research are in line with Mirkamali et al. [13]. The types of information technology resources have different characteristics that lead to different results and effectiveness. Different levels of knowledge creation can be produced by information infrastructure and business partners. From a technical point of view, knowledge creation processes are supported by infrastructures, techniques and systems, and the organization's technical systems determine how knowledge is acquired, shared and stored. In addition, several researchers argue that the company should have an effective software package and use information sources to increase the ability to create knowledge.

According to the results, the factor "information technology" with a weight of 0.1043 is the sixth most effective factor in knowledge creation in Khuzestan Steel Company. Also, among the sub-factors of information technology, the sub-factor "technical capabilities of information technology" with a weight of 0.402 is in first place and the sub-factor "expansion of new and practical technologies and software" is in last place with a weight of 0.275. The results of the research are in line with Rahman Seresht and Habibi Badrabadi [17], Mirkamali et al. [13], Najafi Hazarjaribi and Nowrozi [14], Bahrami et al. [5], Koloniari et al. [10] and Lee and Lee [11]. Information technology leads to the creation of more codified and transferable knowledge, and in this sense, it will lead to innovation in products and processes. Also, the use of information and communication technologies in knowledge management processes increases the competitive advantage of the organization. An increase in competitive advantage will be accompanied by an increase in the value of the product portfolio, which will lead to the survival and continuous progress of the organization. It will also result in faster, more efficient and more profitable growth for the organization. Therefore, the members of the organization can gradually speed up the decoding, retrieval and creation of new knowledge by using information technology.

According to the results, the factor "leadership" with a weight of 0.0739 is the seventh effective factor in knowledge creation at Khuzestan Steel Company. Also, among the sub-factors of leadership, the sub-factor "Managers' support for the knowledge creation process in the organization" with a weight of 0.2397 ranks first and the sub-factor "Manager's reliance on his knowledge and skills as a power base" with a weight of 0.1448 ranks last. The results of the research are in line with Rahman Seresht and Habibi Badrabadi [17], Mirkamali et al. [13], Najafi Hazarjaribi and Nowrozi [14], Teerajetgul and Charoenngam [20], Song et al. [19] and Koloniari et al. [9]. Leadership behaviour is another important factor and has a great impact on the effectiveness of the organization's knowledge. On one hand, the leaders can allow the participants to cultivate and support their knowledge skills with the help of individual knowledge sources, or this is an easier way to gain knowledge. Leadership is a necessary condition for development and encouragement for innovation purposes in companies. Competitive advantages for these companies are to develop new products and exploit this knowledge.

According to the results, the factor "organization processes" with a weight of 0.0723 is the eighth most effective factor in knowledge creation in Khuzestan Steel Company. Also, among the sub-factors of the organization's processes, the sub-factor "Processes standardization" with a weight of 0.2835 is in the first place and the sub-factor "Providing opportunities to take initiatives" with a weight of 0.1993 is in the last place. The research results are in line with Rahman Seresht and Habibi Badrabadi [17] and Koloniari et al. [9]. Managing organizational processes is an approach that seems necessary for all companies. Because in this way they can maintain their competitive advantage evaluate organizational requirements and limitations from different angles and benefit from it to achieve their goals. In all business processes, the role of employees and knowledge is very important and as two key sources, it has a significant effect on the effectiveness of the process. Accordingly, the information related to each process should be registered, managed and upgraded regularly in order to help the company's progress and continuous development in the best possible way. When organizations cannot record the knowledge related to the process, the probability of failure and rework in the processes increases. The main solution to improve processes is to pay attention to organizational knowledge, and this is achieved through knowledge management tools and techniques such as knowledge creation. In addition to the concepts of process management, the organization's employees should also learn knowledge management

in order to use knowledge management methods and approaches to redesign organizational processes.

According to the factors extracted from the research, the following suggestions are presented:

- Culture
  - Strengthening the spirit of cooperation and teamwork to promote the desire to create knowledge
  - Supporting creative plans and opinions of employees
  - Promoting the spirit of questioning and seeking knowledge among employees
  - Spreading risk-taking spirit among employees
  - Valuing collective and team goals
  - Paying attention to creating an atmosphere based on trust between employees and managers
- Structure
  - Using different types of social networks in the company (for this purpose, it is suggested that the organization provide this opportunity for employees to become members of virtual work groups through the organization's communication software and also the organization's portal, and expand their social networks)
  - Development of the knowledge creation process by paying attention to knowledge creation within the official structure of the company (in this regard, the company should not only consider a specific structural unit for studies, but should also have a position in other specialized units and departments of the company as much as possible be considered official for the experts who are responsible for registering and transferring the knowledge of the mentioned unit)
  - Reducing the formality and entrusting the implementation of laws to employees
  - Establishing flexibility at company levels
  - Decreasing formality and putting people into practice
  - Giving appropriate authority and corresponding to the description of the duties and responsibilities of the employees and allowing the independence and freedom of action of the employees in order to perform the tasks more optimally.
  - Redesigning the company structure based on collaborative strategies and employee support
- Motivational system
  - Providing payments and benefits based on employees' participation and their value in knowledge creation processes
  - Creating incentive and punishment systems, in order to eliminate discrimination and inappropriate relationships of people in the workplace
  - Establishing a promotion system in the company and promoting people based on their competence and giving rewards for good and valuable works
  - Implementing a performance-based reward system along with clarifying and systematizing the reward system, improving financial conditions and possibilities
- Individual competence
  - Providing appropriate rewards for superior performance and skill of employees
  - Increasing the level of creativity and commitment of people towards the organization through an efficient performance management system
  - Creating a knowledge base of the best experiences
  - Holding various in-service training courses and workshops for all employees in the field of emotional intelligence
  - Placing written resources with applicable and practical instructions at the disposal of employees in the field of training components related to emotional intelligence.
  - Considering the expertise and education at the time of hiring employees

- Leadership
  - Involving employees in the company's decision-making and planning
  - Company managers seriously support employees and encourage their new ideas in order to be more willing to create, preserve and maintain knowledge
  - Managers should trust employees and support them in order to make employees more willing to create knowledge
  - Forming a working group consisting of experienced experts for planning in line with the implementation of management and creation and storage and eliminating its obstacles.
- Organization processes
  - Considering formal and written processes for knowledge management and especially knowledge creation
  - Trying to standardize organizational procedures
  - Providing opportunities to adopt initiative and creativity, especially in academic fields
- Information technology
  - Creating appropriate hardware and software infrastructures to support knowledge creation activities
  - Trying to use up-to-date technologies and systems
  - Outsourcing information technology projects in order to provide the best system services needed
  - Signing contracts with specialized companies with world-class knowledge in the field of information technology
  - Participation of employees in national and international conferences in the field of information technology
  - Applying motivational strategies in order to reduce resistance to change in the use of information technology in scientific procedures.
- Information sources
  - Creation of equipped laboratories and workshops and up-to-date facilities in the company
  - Allocation of appropriate and periodic costs for research and development activities in the company
  - Using the experiences of universities and employing elite people in the company
  - Providing up-to-date information sources and articles to employees through libraries and document storage centers
  - Use of video conference and face-to-face lectures in order to acquire, transfer and integrate knowledge
  - Developing the required information systems and expanding the use of decision support systems for managers
  - Implementation and expansion of information systems in all sections and departments

Finally also:

- It is suggested that Khuzestan Steel Company uses the factors and sub-factors proposed in this research as a tool for creating knowledge and, according to the importance and priority of each factor and sub-factor, prepare its foundations.
- It is suggested that the knowledge management unit conducts necessary studies and research in the field of knowledge management models and its dimensions, especially knowledge creation.

References

[1] F. Abbas, A. Rasheed, U. Habiba, and I. Shahzad, *Factors promoting knowledge sharing & knowledge creation in banking sector of Pakistan*, Manage. Sci. Lett. **3** (2013), no. 2, 405–414.

[2] S. Abualoush, K. Bataineh, and A.A. Alrowwad, *The role of knowledge management process and intellectual capital as intermediary variables between knowledge management infrastructure and organization performance*, Interdiscipl. J. Inf. Knowledge Manag. **13** (2018), 279.

[3] N. Agrawal, *Modeling enablers of knowledge management process using multi criteria decision making approach*, VINE J. Inf. Knowledge Manag. Syst. **51** (2020), no. 3, 389–417.

[4] J. Antunes, A. Pinto, P. Reis, and C. Henriques, *Industry 4.0: A challenge of competition*, Millenium–J. Educ. Technol. Health **6** (2018), no. 2, 89–97.

[5] M. Bahrami, S. Rahimi, and A. Zare, *Investigating the relationship between knowledge enabling factors and knowledge creation among public library librarians*, Library Inf. Res. J. **10** (2019), no. 1, 35–54.

[6] A. Bavakhani, S. Rezai Sharifabadi, A. Ghaibi, and M. Najafi, *Development of organizational knowledge creation model in Iranian knowledge-based companies*, Library Inf. Sci. **23** (2019), no. 1, 121–150.

[7] C.N. Dang and L. Le-Hoai, *Relating knowledge creation factors to construction organizations' effectiveness: Empirical study*, J. Eng. Design Technol. **17** (2019), no. 3, 515–536.

[8] D. Hidayat and E. Abdurachman, *The roles of gamification, knowledge creation, and entrepreneurial orientation towards firm performance*, Int. J. Innov. Stud. **6** (2022), no. 4, 229–237.

[9] M. Koloniari, E. Vraimaki, and K. Fassoulis, *Fostering innovation in academic libraries through knowledge creation*, J. Acad. Librarian. **44** (2018), no. 6, 793–804.

[10] M. Koloniari, E. Vraimaki, and K. Fassoulis, *Factors affecting knowledge creation in academic libraries*, J. Librarian. Inf. Sci. **51** (2019), no. 1, 20–33.

[11] J. Lee and J. Lee, *Enablers of postacquisition joint knowledge creation: evidence from joint patenting in high-tech mergers and acquisitions*, J. Knowledge Manag. **26** (2022), no. 3, 743–762.

[12] S. Mariano and Y. Awazu, *Artifacts in knowledge management research: A systematic literature review and future research directions*, J. Knowledge Manag. **20** (2016), no. 6, 1333–1352.

[13] S.M. Mirkamali, M.R. Hamidizadeh, and F. Naranji Sani, *Factors related to knowledge creation in universities: a qualitative research*, Quart. J. Res. Plann. Higher Educ. **21** (2014), no. 4, 121–147.

[14] H. Najafi Hezarjaribi and S.A. Nowrozi, *Transmission of agricultural research findings with an emphasis on the components of knowledge creation and distance education technology*, New Approach. Educ. Manag. **8** (2016), no. 31, 293–308.

[15] V. Nasehifar, M. Habibi Badrabadi, and A. Habibi Badrabadi, *Structural factors affecting innovation and knowledge creation in organizations (case study of the country's tax affairs organization)*, Tax Res. Paper **18** (2010), no. 9, 123–142.

[16] N.S. Pei, *Enhancing knowledge creation in organizations*, Commun. IBIMA **3** (2008), no. 2, 1–6.

[17] H. Rahman Seresht and M. Habibi Badrabadi, *Factors affecting the creation of knowledge in the country's tax affairs organization*, Tax Res. Paper **20** (2011), no. 13, 191–210.

[18] D. Rezaei, H. Hasani, A.M. Mahdavi, and M. Mojarradi, *Identifying the effective factors on the creation of individual knowledge in the dimension of organizational culture and strategy*, Second Nat. Conf. Manag. Human. Res. Iran, Tehran, 2015, pp. 1–18.

[19] J.H. Song, S.H. Bae, S. Park, and H.K. Kim, *Influential factors for knowledge creation practices of CTE teachers: Mutual impact of perceived school support, transformational leadership, and work engagement*, Asia Pacific Educ. Rev. **14** (2013), no. 4, 467–482.

[20] W. Teerajetgul and C. Charoenngam, *Factors inducing knowledge creation: empirical evidence from Thai construction projects*, Engin. Construct. Architec. Manag. **13** (2006), no. 6, 584–599.