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Modelling Knowledge Extraction to Make Value in Service Organizations

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Abstract

Purpose: This study aims to develop a model for an intelligent knowledge extraction map to create value in organizations, with a focus on the service sector.

Method: This is applied research. Ten influential components in knowledge extraction were identified through library study. The study sample was selected using the judgmental sampling method of five people. Using the Delphi technique, which is a qualitative approach, screening and evaluation of the identified components have been done. The interpretive structural model method was used to model the knowledge extraction map. The software used is EXCEL and MATLAB.

Findings: The findings show that intelligent measurement and organization of knowledge is in the second level. Five phases have been obtained for the

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initial steps of the Knowledge Extraction Model in service organizations. Intelligent measurement and organization of knowledge in the first phase, identifying external factors, identifying internal factors, and Identifying necessary actions in the second phase, Organization of knowledge processes, Organizing the necessary infrastructure in the third phase, Targeting knowledge and Smart knowledge strategy in the fourth phase, and finally Monitoring and updating knowledge, and Evaluating intelligent knowledge extraction in the fifth phase are the main steps in the knowledge extraction model.

Conclusion: To achieve success in the service sector, knowledge extraction is required to make managers able to decide better. To begin intelligent knowledge extraction, we need to follow five essential and initial steps to prepare the organization for this process.

Keywords: Knowledge Extraction, Knowledge Management, Intelligent Knowledge Extraction, Knowledge Extraction Model.

Introduction

With the advent of technologies and their exponential development, it is noticeable that all businesses have faced different transformations and phenomena. New technologies have disrupted traditional businesses, and just as they have forced traditional industries to change their way of performing, they have similarly given rise to new industries.

With the creation of new businesses and the provision of different services, internationalization has become a common trend in which its success adds value to them and facilitates competitive advantage. Hence, the service industry has to follow emerging technologies to achieve a sustainable competitive advantage.

Many business researchers consider knowledge to be one of the factors in achieving this competitive advantage (Levallet & Chan, 2019; Rupčić, 2017; Salunke, Weerawardena & McColl-Kennedy, 2019; Zieba, Bolisani, Paiola & Scarso, 2017). According to Nonaka and Konno (1998), knowledge is an intangible, borderless, and dynamic resource that has no value if not used when needed. Knowledge has become a critical asset in the business environment (Nonaka and Takeuchi, 1995; Davenport and Prusak, 2000; Oliva & Kotabe, 2019). Knowledge management has been presented in different models and frameworks for various goals (Muniz et al., 2021; Al-Ahbabi et al., 2017; Ruhanen & Cooper, 2004) which have different steps but have in common with the main steps of a proper process included: knowledge definition, knowledge acquisition, knowledge dissemination, knowledge storage, knowledge application, and knowledge assessment (Hoe & McShane, 2010; Oliva & Kotabe, 2019). Therefore, advent of industry 4 and the spread of smart digital technologies have also influenced the knowledge management process, and not only did it show how human resources work is changing, but the presence of these technologies also affects how organizations operate.

Knowledge extraction, as one of the main goals of knowledge management, seeks to extract knowledge from individuals and other resources to expand, share and reuse it (Akhavan & Abbasi, 2019). Knowledge extraction in a knowledge management system is in the second phase after knowledge analysis and identification. In a way that without knowledge extraction, it will not be possible to create a process and evaluate knowledge in the organization (Matos & Chalmeta, 2007). With the development of technology and business process intelligence, the goal of extracting knowledge as a new field, according to the type of resource and its characteristics, is to discover knowledge among its concepts and

data. In this study, we attempt to answer this question: what is an intelligent knowledge extraction model? What are the levels of this model in the service sector?

Literature Review

There have been studies in the area of knowledge management and its process. As mentioned, in this paper we are trying to present a model for knowledge extraction as a part of the first stage called knowledge acquisition. In the service industry, new knowledge is of particular importance. Employees at different levels of seniority are interested in acquiring new knowledge to do their job and achieve organizational goals. According to 5 levels of employees (top-level management, senior-level, middle-level, junior-level, and interns), top managers in organizations are most inclined to acquire new knowledge. Middle-level employees have the least desire to acquire new knowledge, which can be due to motivational reasons or a lack of knowledge transfer from higher-level employees (Misiūnaitė, 2021). Poor knowledge acquisition is an obstacle in the early stages of an organization's knowledge management process. This shows that the lack of resources containing the knowledge required by the organization can affect the whole process and necessitates the need to invest in the necessary actions in the acquisition and extraction of knowledge (Oliva & Kotabe, 2019). Many researchers have emphasized the importance of needs assessment as an important and fundamental step in the knowledge management process (Abusharekh et al., 2019; Cullom & Cullom, 2011; Chitra, K., & Senjith, 2020; Schulte et al., 2004; Rasmussen, L., & Hall, 2015); The importance of needs assessment and knowledge gap identification has also been highlighted in studies related to knowledge extraction (Rajsiri et al., 2008; Saura et al., 2019; Noori, 2012; Hudson, 2019).

According to the studied articles, researchers with regard to the basic components in knowledge management try to provide a map of knowledge extraction according to the components that affect this process. Knowledge strategy is one of the most important factors in starting a knowledge process that includes organizational knowledge strategy and goals (Zhang et al., 2007; Adams & Graham, 2017; Brix, 2017; Vuori & Okkonen, 2012; Ansari et al., 2016), Relationship between organizational knowledge and business strategies (Neves et al., 2022; Forlianoet al., 2022; Vajpayee & Ramachandran, 2019), identifying solutions to the knowledge gap (Wibowo et al., 2018; Haave & Vold, 2018; Wang et al., 2018), Senior

Management Support (Sensuse et al., 2018; Ghomi & Barzinpour, 2018), Knowledge Map Architecture (Al Hakim & Sensuse, 2018) Al Hakim & Sensuse, 2019), identifying business values (Ansari, 2019; Kader Alomari et al., 2020). Influential components in the knowledge management process include change management (Levy, 2021; Akhavan et al., 2021; Zelenkov, 2018), process reengineering (Mohiddin et al., 2021; Nkurunziza et al., 2021; Keshanchi et al., 2021), project management (Arbabi et al., 2021; Anwar & Abdullah, 2021; Ranf & Herman, 2018; Piraquive et al., 2015), document management (Khan et al., 2015; Skelton, 2015; Sazonova & Syreishchikova, 2021; Faradillah et al., 2020), information management (Edwards, 2022; Mahrinasari et al., 2021; Opele & Okunoye, 2019), and knowledge/information quality (FanLin, 2010; DuBois, 2021; Cheng & Chang, 2013) are under one main dimension called identifying the required measures that can be effective in the knowledge extraction process.

Identifying external factors in effective management can be done through modeling (Kalpič & Bernus, 2006; Girard & McIntyre, 2010), keeping pace with global knowledge and change (Othman & Alshamsi, 2021), competitive environment (Acosta-Prado et al., 2021; Wickramasinghe, 2003; Ermine, 2000), environmental and external needs assessment (Van Wart, 2014). On the other hand, identification of internal factors such as organizational processes (Haslinda & Sarinah, 2009; Sanchez, 2006; Urpia et al., 2020; Qi & Chau, 2018), teamwork (Hamzeh, 2018; Alvarenga et al., 2020; Mazilescu., 2008; Razmeritaet al., 2016; Plotnikova, 2020; Luger, 2005; Esterhuizen et al., 2012; Ullah & Harib, 2006), organizational communication (Gebus & Leiviskä, 2009; Ansari et al., 2019), knowledge education (Vuori & Okkonen, 2012; Lansu et al., 2020), motivation and reward (Kadhim et al., 2014; Mooney & Bunescu, 2005; Razmerita et al., 2016; Bi et al., 2017; Gebus & Leiviskä, 2009; Brix, 2017; Neumann & Xu, 2004), expert associations (Hasirchi et al., 2021) are also noteworthy.

To perform a purposeful and useful knowledge extraction, organizing the necessary infrastructure is essential. Organizational Structure and Processes (Tang et al., 2008; Md Dahalin et al., 2015; Kadhim & Alam, 2012; Fernandez, 2020), Information Technology / Knowledge Extraction Systems (Kanellopoulos, et al., 2011; Md Dahalin, Z. et al., 2015), security (Xu et al., 2004; Guterres et al., 2019), information technology management (Al-Harkan et al., 2010), education and learning (Zhang et al., 2009) ; Vuori & Okkonen, 2012; Neumann & Xu, 2004; Goby et al.,

2016), Organizational Culture (Kanellopoulos et al., 2011; Razmerita et al., 2016; Bi et al., 2017; Mooney & Bunescu, 2005 Kim et al., 2012), financial and temporal resources (Onojeharho et al., 2015; Tedmori, 2008), organizational rules and regulations (Blanc et al., 2012) are some of the issues raised in this dimension.

In terms of measuring and organizing knowledge, we can evaluate performance (Zhao et al., 2012; Wang et al., 2005; Tedmori & Jackson, 2012), knowledge extraction (Sabou & Fernandez, 2012), and applied knowledge satisfaction (Plyasunov et al., 2017).

Monitoring and updating knowledge is also very important in the knowledge extraction process. In this case, components such as social software (Mazilescu, 2008; Zhang et al., 2009; Goby et al., 2016; Razmerita et al., 2016; Bi et al., 2017; Md Dahalin et al., 2015), information and communication technology (Internet, software and hardware tailored to the type of company) (Kanellopoulos et al., 2011; Md Dahalin et al., 2015), technological infrastructure (Neumann & Xu, et al., 2016); Omona et al., 2010), Semantic Web (Virtual Discussion, Types of Social Network Sharing) (Shoelh et al., 2019), Knowledge Management Systems (Neumann & Xu, et al., 2004; Zhang et. al., 2009), the usability of new technology in the analysis of large data (Kadhim et al., 2014; Mooney & Bunescu, 2005), the application of artificial intelligence (Kadhim & Alam, 2012; Kim et al., 2012), and the application of data mining (Bi et al., 2017) should be noted.

Organizing knowledge processes can also help in the decision-making process of knowledge extraction strategies. In this dimension, we can look at different types of knowledge (Plotnikova et al., 2020; Nezafati et al., 2014), knowledge management processes (Neumann & Xu, et al., 2004; Alvarenga et al., 2020), and knowledge dimensions such as tracking, representation, flow, map, audit, ontology, classification, clustering, etc. (Kanellopoulos et al., 2011; Md Dahalin et al., 2015).

Knowledge targeting can facilitate the knowledge extraction process and speed up decision-making (Neumann & Xu, et al., 2004; Mazilescu, 2008; Kadhim et al., 2014), the power to face challenges (Md Dahalin et al., 2015; Kadhim & Alam, 2012), the use of intelligent knowledge in decision making (dynamics) (Neumann & Xu, et al., 2004; Mooney & Bunescu, 2005), and creativity and innovation (Razmerita et al., 2016; Bi et al., 2017; Gebus & Leiviskä, 2009). There are different techniques to evaluate knowledge extraction. in some studies, some tools have been mentioned such as ConceptNet which is one of the most popular

commonsense KGs and is widely used for evaluating knowledge extraction (Hao et al., 2022). GERBIL is an effort of the knowledge extraction community to enhance the evaluation of knowledge extraction systems (Tiddi, 2020).

There are very few articles in the literature on knowledge extraction maps. For example, Hiob, N., & Lessmann (2017) used knowledge map tools such as cTAKES (Aggarwal & Reddy 2015) to extract concepts from clinical texts by applying SecTag algorithm which identifies notes section headers; and it helps reduce false positives. To be able to design a proper knowledge extraction map we have to pay attention to required infrastructures (Tang et al., 2008; Md Dahalin et al., 2015). The literature shows there is no research on knowledge extraction map which can assist professionals to follow the steps of designing algorithms to achieve the critical knowledge of the organization. As knowledge extraction is an essential stage of knowledge acquisition, after reviewing research we present a knowledge extraction model which can help organizations and industries in the essential and initial steps to prepare themselves for this process.

Method

The research approach is qualitative and has an exploratory nature. By using the library technique and studying the literature precisely, the present research identifies the factors affecting knowledge extraction in organizations that lead to value increase. The Delphi study can be used as a tool for research (Okoli & Pawlowski, 2004; Abd Rahman, 2015). So, using the Delphi method, the conceptual model proceeded to the consensus stage on components. These factors were identified after examining them, removing repetitive components, and integrating similar ones. Then it was provided to experts and professors and asked to be declared the importance of each factor.

The number of experts in Delphi studies ranges from 3 to 30 (Chen et al., 2022). There is no predetermined optimal number of experts in Delphi studies. According to Powell (2003), the representativeness of the panel is based on the quality of the experts rather than the number of itself (Rosa et al., 2021). So the population in this research is the 5 experts and professionals in the field of knowledge managements, who were selected by a judgmental sampling method. First, using the Delphi technique, screening and evaluation of the identified components have been done. In the following, modeling has been done using the interpretive structural

model (ISM) method. The software used are EXCEL and MATLAB.

Findings

In this study, a total of 10 main components have been identified by studying the research literature.

Table 1. Identified components in the studied sources

Component	Sources	
Monitoring and updating knowledge	(Mazilescu, 2008); (Zhang et al., 2009); (Goby et al., 2016); (Razmerita et al., 2016); (Bi et al., 2017); (Md Dahalin et al., 2015); (Kanellopoulos et al., 2011); (Neumann & Xu, et al., 2016); (Omona et al., 2010); (Shoelh et al., 2019); (Neumann & Xu, et al., 2004); (Kadhim et al., 2014); (Mooney & Bunescu, 2005); (Kadhim & Alam, 2012); (Kim et al., 2012); (Bi et al., 2017).	- Social software - Information and communication technology (Internet, software and hardware tailored to the type of company) - Technological infrastructure - Semantic Web (Virtual Discussion, Types of Social Network Sharing) - Knowledge Management Systems - Usability of new technology in the analysis of large data - Application of artificial intelligence - Application of data mining
Intelligent measurement and organization of knowledge	(Zhao et al., 2012); (Wang et al., 2005); (Tedmori & Jackson, 2012); (Sabou & Fernandez, 2012); (Plyasunov et al., 2017).	- Evaluate performance - Knowledge extraction - Applied knowledge satisfaction
Targeting knowledge	(Neumann & Xu, et al., 2004); (Mazilescu, 2008; Kadhim et al., 2014), (Md Dahalin et al., 2015); (Kadhim & Alam, 2012), (Neumann & Xu, et al., 2004); (Mooney & Bunescu, 2005),	- The power to face challenges - The use of intelligent knowledge in decision making (dynamics)

	(Razmerita et al., 2016); (Bi et al., 2017); (Gebus & Leiviskä, 2009).	- Creativity and innovation
Smart knowledge strategy	(Zhang et al., 2007); (Adams & Graham, 2017); (Brix, 2017); (Vuori & Okkonen, 2012); (Ansari et al., 2016), (Neves et al., 2022); (Forliano et al., 2022); (Vajpayee & Ramachandran, 2019), (Wibowo et al., 2018); (Haave & Vold, 2018); (Wang et al., 2018), (Sensuse et al., 2018); (Ghomi & Barzinpour, 2018), (Al Hakim & Sensuse, 2018); (Al Hakim & Sensuse, 2019), (Ansari, 2019); (Kader Alomari et al., 2020) (Levy, 2021); (Akhavan et al., 2021); (Zelenkov, 2018), (Mohiddin et al., 2021); (Nkurunziza et al., 2021); (Keshanchi et al., 2021), (Arbabi et al., 2021); (Anwar & Abdullah, 2021); (Ranf & Herman, 2018); (Piraquive et al., 2015), (Khan et al., 2015); (Skelton, 2015); (Sazonova & Syreishchikova, 2021); (Faradillah et al., 2020), (Edwards, 2022); (Mahrinasari et al., 2021); (Opele & Okunoye, 2019), (FanLin, 2010; DuBois, 2021); (Cheng & Chang, 2013)	- Organizational knowledge strategy and goals - Relationship between organizational knowledge and business strategies - Identifying solutions to the knowledge gap - Senior Management Support - Knowledge Map Architecture - Identifying business values - Change management - Process reengineering - Project management - Document management - Information management - Knowledge /information quality
Organization of knowledge processes	(Plotnikova et al., 2020); (Nezafati et al., 2014), (Neumann & Xu, et al., 2004; Alvarenga et al., 2020), and (Kanellopoulos et al., 2011); (Md Dahalin et al., 2015).	- Different types of knowledge - Knowledge management processes - Knowledge dimensions such as tracking, representation, flow, map, audit, ontology, classification, clustering, etc.

Organizing the necessary infrastructure for intelligent knowledge extraction	(Tang et al., 2008); (Md Dahalin et al., 2015); (Kadhim & Alam, 2012); (Fernandez, 2020), (Kanellopoulos, et al., 2011); (Md Dahalin, Z. et al., 2015), (Xu et al., 2004); (Guterres et al., 2019), (Al-Harkan et al., 2010), (Zhang et al., 2009); (Vuori & Okkonen, 2012); (Neumann & Xu, 2004); (Goby et al., 2016), (Kanellopoulos et al., 2011); Razmerita et al., 2016); (Bi et al., 2017); (Mooney & Bunescu, 2005); (Kim et al., 2012), (Onojeharho et al., 2015); Tedmori, 2008), (Blanc et al., 2012)	- Organizational Structure and Processes - Information Technology /Knowledge Extraction Systems - Security - Information technology management - Education and learning - Organizational Culture - Financial and temporal resources - Organizational rules and regulations
Identifying necessary actions	(Abusharekh et al., 2019); (Cullom & Cullom, 2011); (Chitra, K., & Senjith, 2020); (Schulte et al., 2004); (Rasmussen, L., & Hall, 2015); (Rajsiri et al., 2008); (Saura et al., 2019); (Noori, 2012); (Hudson, 2019).	- Needs assessment - Needs assessment and knowledge gap identification
Identifying internal factors	(Haslinda & Sarinah, 2009); (Sanchez, 2006); (Urpia et al., 2020); (Qi & Chau, 2018), (Hamzeh, 2018); (Alvarenga et al., 2020); (Mazilescu., 2008); (Razmeritaet al., 2016); (Plotnikova, 2020); (Luger, 2005); (Esterhuizen et al., 2012); (Ullah & Harib, 2006), (Gebus & Leiviskä, 2009); (Ansari et al., 2019), (Vuori & Okkonen, 2012); (Lansu et al., 2020), (Kadhim et al., 2014); (Mooney & Bunescu, 2005); (Razmerita et al., 2016); (Bi et al., 2017); (Gebus & Leiviskä, 2009); (Brix, 2017; Neumann & Xu, 2004), (Hasirchi et al., 2021)	- Organizational processes - Team work - Organizational communication - Knowledge education - Motivation and reward - Expert associations

Identifying external factors	(Kalpič & Bernus, 2006); (Girard & McIntyre, 2010), (Othman & Alshamsi, 2021), (Acosta-Prado et al., 2021); (Wickramasinghe, 2003); (Ermine, 2000), (Van Wart, 2014).	- Keeping pace with global knowledge and change - Competitive environment - Environmental and external needs assessment
Evaluating intelligent knowledge extraction	(Hao et al., 2022); (Tiddi, 2020)	- Knowledge graphs tools such ConceptNet, GERBIL, etc.

In the following, the Delphi technique was used to ensure the authenticity of the identified dimensions and components and determine the validity of these components, and answer the research questions. The Delphi method was carried out as follows.

Table 2. Delphi analysis of identified components

Component	Average	Standard deviation	Condition
Monitoring and updating knowledge	6.50	0.80	confirmation
Intelligent measurement and organization of knowledge	7.00	1.17	confirmation
Targeting knowledge	6.00	1.02	confirmation
Smart knowledge strategy	5.50	0.75	confirmation
Organization of knowledge processes	6.00	0.98	confirmation
Organizing the necessary infrastructure for intelligent knowledge extraction	7.00	0.80	confirmation
Identifying necessary actions	6.00	0.49	confirmation
Identifying internal factors	6.00	0.75	confirmation
Identifying external factors	6.00	0.75	confirmation
Evaluating intelligent knowledge extraction	6.50	0.80	confirmation
number of samples	5		
Kendall statistics	0.669		
Chi-square statistic	129.18		
Degrees of freedom	9		
probability level	0.000		

Based on the results obtained in the Delphi technique, all of them are above 5. Therefore, no component was removed and all were approved. Kendall's

statistic is also 0.669 and it is confirmed, so Delphi is confirmed in the first round.

In the following, the Interpretive Structural Modeling (ISM) method was used in the MICMAC software for data analysis. Designing an Interpretive Structural Model (ISM) is a method to study the effect of each variable on other variables; This design is a comprehensive approach to measuring communication and is used to develop the framework of the model so that the general objectives of the research are possible.

The first step in ISM is to calculate the internal relationships of the indicators. Experts' viewpoints are used to reflect the internal relationships between indicators. The research components were coded in Table 3.

Table 3. Coding of identified components

Variable	Signs
Monitoring and updating knowledge	C1
Intelligent measurement and organization of knowledge	C2
Targeting knowledge	C3
Smart knowledge strategy	C4
Organization of knowledge processes	C5
Organizing the necessary infrastructure for intelligent knowledge extraction	C6
Identifying necessary actions	C7
Identifying internal factors	C8
Identifying external factors	C9
Evaluating intelligent knowledge extraction	C10

The matrix obtained in this step shows that a variable has an effect on which variables and which variables are affected by it. Conventionally, symbols like Table 4 are used to identify the relationship pattern of elements.

Table 2- Modes and signs used in expressing the relationship of the identified indicators

O	X	A	V
No relationship	Two-way relationship	Variable j affects i	Variable i affects j

The structural self-interaction matrix (SSIM) consists of the dimensions and indicators of the study and their comparison using four modes of

conceptual relations. The resulting information is formed based on the summation ISM method and the final SSIM. According to the signs listed in Table 1, the SSIM will be in Table 5**.**

Table 5. Structural self-interaction matrix of SSIM

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1		A	A	A	A	A	A	A	A	X
C2			V	V	V	V	V	V	V	V
C3				X	A	A	A	A	A	V
C4					A	A	A	A	A	V
C5						X	A	A	A	V
C6							A	A	A	V
C7								X	X	V
C8									X	V
C9										V
C10										

The received matrix is obtained by transforming the SSIM into a two-valued matrix of zero and one. In the received matrix, the principal diameter is equal to one. Therefore, the received matrix of the ISM technique is presented in Table 6.

Table 6. Received matrix of identified indicators

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	1	0	0	0	0	0	0	0	0	1
C2	1	1	1	1	1	1	1	1	1	1
C3	1	0	1	1	0	0	0	0	0	1
C4	1	0	1	1	0	0	0	0	0	1
C5	1	0	1	1	1	1	0	0	0	1
C6	1	0	1	1	1	1	0	0	0	1
C7	1	0	1	1	1	1	1	1	1	1
C8	1	0	1	1	1	1	1	1	1	1

C9	1	0	1	1	1	1	1	1	1	1
C10	1	0	0	0	0	0	0	0	0	1

The method of obtaining the accessibility matrix is by using Euler's theory, in which we add the adjacency matrix to the unit matrix.

Table 7. The final access matrix of the identified indicators

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	1	0	0	0	0	0	0	0	0	1
C2	1	1	1	1	1	1	1	1	1	1
C3	1	0	1	1	0	0	0	0	0	1
C4	1	0	1	1	0	0	0	0	0	1
C5	1	0	1	1	1	1	0	0	0	1
C6	1	0	1	1	1	1	0	0	0	1
C7	1	0	1	1	1	1	1	1	1	1
C8	1	0	1	1	1	1	1	1	1	1
C9	1	0	1	1	1	1	1	1	1	1
C10	1	0	0	0	0	0	0	0	0	1

Determining relationships and leveling dimensions and indicators

To determine the relationships and leveling of the criteria, the set of outputs and the set of inputs for each criterion should be extracted from the received matrix.

- Access set (row elements, outputs, or effects): Variables that can be accessed through this variable.
- Prerequisite set (column elements, inputs, or effects): variables through which this variable can be reached.

The set of outputs includes the criterion itself and the criteria that are affected by it. The set of inputs includes the criterion itself and the criteria that affect it. Then, the set of two-way relations of the criteria is determined.

Table 8. Set of inputs and outputs (effects) for each variable

Symbol	Impact	Effectiveness
C1	2	10
C2	10	1
C3	4	8
C4	4	8
C5	6	6
C6	6	6
C7	9	4
C8	9	4
C9	9	4
C10	2	10

For the C_i variable, the access set (output or effects) includes the variables that can be reached through the C_i variable. The prerequisite set (inputs or effects) includes the variables through which the variable C_i can be reached.

After determining the achievement set and the prerequisite set, the subscription of the two sets is calculated. The first variable for which the commonality of the two sets equals the attainable set (outputs) will be the first level. Therefore, the elements of the first level will have the most influence on the model. After determining the level, remove the criterion whose level is known from the whole set and re-form the set of inputs and outputs, and the next variable level is obtained.

Table 9. Determining the first level in the ISM hierarchy

Symbol	Input	Output	Unity	Level
C1	C1-C2-C3-*C4*-C5-C6-C7-C8-C9-C10	C1-C10	C1-C10	5
C2	C2	C1-C2-C3-*C4*-C5-C6-C7-C8-C9-C10	C2	1
C3	C2-C3-C4-C5-C6-C7-C8-C9	C1-C3-C4-C10	C3-C4	4
C4	C2-C3-C4-C5-C6-C7-C8-C9	C1-C3-C4-C10	C3-C4	4
C5	C2-C5-C6-C7-C8-C9	C1-C3-C4-C5-C6-C10	C5-C6	3
C6	C2-C5-C6-C7-C8-C9	C1-C3-C4-C5-C6-C10	C5-C6	3
C7	C2-C7-C8-C9	C1-C3-C4-C5-C6-C7-C8-C9-C10	C7-C8-C9	2
C8	C2-C7-C8-C9	C1-C3-C4-C5-C6-C7-C8-C9-C10	C7-C8-C9	2

Symbol	Input	Output	Unity	Level
C9	C2-C7-C8-C9	C1-C3-C4-C5-C6-C7-C8-C9-C10	C7-C8-C9	2
C10	C1-C2-C3-*C4*-C5-C6-C7-C8-C9-C10	C1-C10	C1-C10	5

Therefore, variable C2 is the first level variable. After identifying the variables of the first level, these variables are removed and the set of inputs and outputs is calculated without considering the variables of the first level. The common set of identification and the variables whose commonality is equal to the set of inputs is selected as the second-level variables.

- C7-C8-C9 variables are second-level variables.
- C5-C6 variables are third-level variables.
- C3-C4 variable is the fourth level variable.
- C1-C10 variables are fifth-level variables.

The final pattern of the levels of the identified variables is shown in the figure. In figure 1, only the meaningful relationships of the elements of each level on the elements of the lower level, as well as the meaningful internal relationships of the elements of each row, are considered.

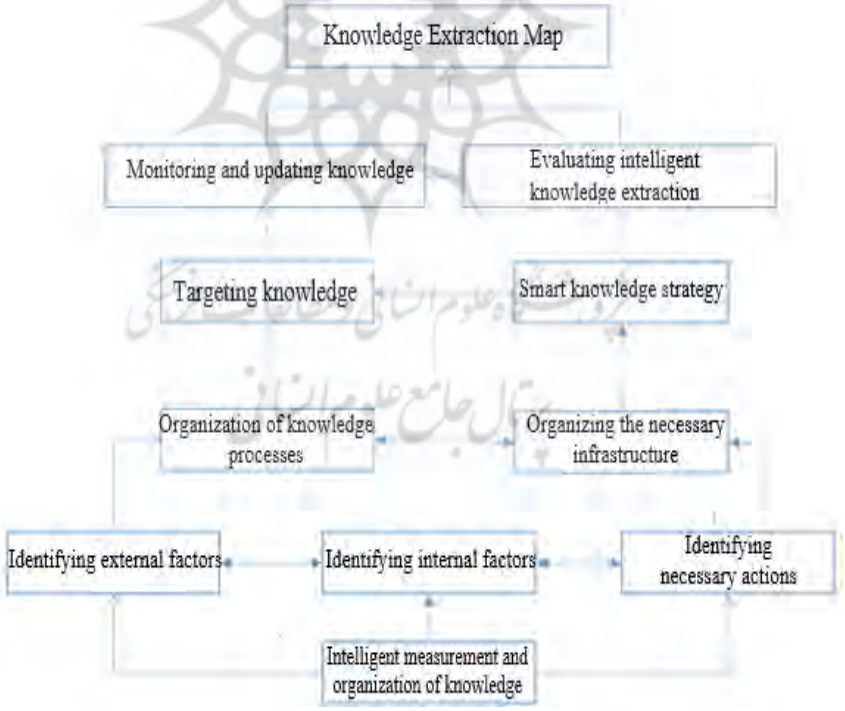

Figure 1. Map of Intelligent extraction of Knowledge

Following the steps of this model can make organizations prepared for intelligent knowledge extraction. This process can be managed and run by knowledge managers and developed by data scientists and analysists.

Conclusion

In this study, we have provided the leveled components of implementing intelligent knowledge extraction to increase the value in the organizations. Intelligent measurement and organization of knowledge are at the first step in initiating knowledge extraction. This factor has been mentioned in most studies. Evaluating performance (Zhao et al., 2012; Wang et al., 2005; Tedmori & Jackson, 2012) and applied knowledge satisfaction (Plyasunov et al., 2017) are points needed more attention. At the second level, there are Identifying necessary actions, identifying internal factors, and Identifying external factors. In an effective management, external and internal factors can play an essential role as mentioned in Kalpič & Bernus's (2006) and Girard & McIntyre's, (2010), Ansari's et al. (2019), Lansu's et al. (2020) studies as the factors in modeling knowledge extraction. At the third level, there are Organization of knowledge processes and Organizing the necessary infrastructure for intelligent knowledge extraction. To be successful in knowledge extraction, proper infrastructure is needed (Neumann & Xu, et al., 2016). At the fourth level, there are Targeting knowledge and Smart knowledge strategies. These two factors have to be clear to conduct the process of knowledge extraction. Their importance is mentioned by Neumann & Xu, et al. (2004), Mazilescu (2008), and Kadhim et al. (2014). Finally, the last level, there are Monitoring and updating knowledge and Evaluating intelligent knowledge extraction which are interactive. An appropriate knowledge extraction map can be led to evaluation which needs its own tools (Hao et al., 2022).

In developing a knowledge extraction map, components such as creating a technical committee for drawing the role of knowledge, updating organizational knowledge, expanding the R&D department, updating the knowledge map, creating illustrated interfaces for display, and applying knowledge should also be considered. A knowledge extraction map must be able to illustrate the achievement of organizational goals in the knowledge acquisition and extraction process; Experts can also utilize this map to estimate financial resources and organizational budget.

As in the process of knowledge management, the needs assessment is one of the first steps, in each of the steps of this process, special attention

should be paid to the discussion of needs assessment. Identifying sections and areas of knowledge, identifying weaknesses and threats, categorizing strengths and opportunities, structuring current knowledge in processes, establishing knowledge connections through illustrated interfaces, and surveys, and brainstorming on the role of knowledge can precede any use of energy and financial, time and human resources to create a certain path in extracting knowledge of the organization.

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