2528-9705

Örgütsel Davranış Araştırmaları Dergisi
Journal Of Organizational Behavior Research
Cilt / Vol.: 5, Sayı / Is.: S2, Yıl/Year: 2020, Kod/ID: 71S2716

SELECTING THE BEST KNOWLEDGE MANAGEMENT (KM) STRATEGIES BASED ON SECI FOR SMALL AND MEDIUM-SIZED ENTERPRISES IN DEVELOPING COUNTRIES

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ABSTRACT

Knowledge management (KM) is known as the most important element to achieve competitive advantage in organizations. KM helps organizations to identify and organize the important information and skills that they consider to be organizational memory. This will enable the organization to solve problems, strategic planning and dynamic decision making. Since the purpose of small and medium-sized enterprises in developing countries is to reach the global market and get more productive, then implementing knowledge management can play an effective role in acquiring knowledge and attaining these goals. Presently, few studies have been accomplished on the implementation of knowledge management in small and medium-sized enterprises in developing countries. Due to the occurrence of unanticipated event for implementation of KM in small and medium-sized enterprises, an uncertainty model in this regard is essential. Therefore, the purpose of this study is to provide an uncertainty model based on SECI for choosing the best knowledge management strategy in small and medium-sized enterprises with hesitant fuzzy decision making methods. According to result of this research, the target of promoting innovation is of the most importance, followed by improvement of performance and activation of priority information, respectively.

Keywords: *Knowledge management, SECI, SMEs, hesitant fuzzy, IVHFE-DANP, developing countries*

INTRODUCTION

In advanced countries, more attention has been paid to knowledge, so that knowledge has become even more important factor in life than wealth, work and capital. Organizational learning is one of the critical components of organizational intelligence, which means the ability to solve problems of that organization (Franciosi et al., 2019). In a knowledge-based economy, products and organizations live and die based on knowledge, and the most successful organizations are those who use this intangible asset in a better and faster way (Analoui et al., 2013).

In a strategic perspective, today, knowledge management is used to create and increase organizational value and Efficiency, and the success of each organization's depends on the management of these scarce resources (Abualoush et al., 2018).

One of the characteristics of new organizations is the excessive accumulation of knowledge. Over the past two decades, increasing the amount of information in organizations and the

Geliş tarihi/Recieved: 28.07.2020 – Kabul tarihi/Accepted: 11.12.2020 – Yayın tarihi/Published: 21.12.2020

Necessity of use it in organizational decisions has created a phenomenon called knowledge management. This implies the need for planning, organization, leadership, as well as the importance of the existence of organizational knowledge and access to proper knowledge in a way that makes it effective (Choi and Jong, 2010).

Knowledge management is the intelligent design of processes, tools, structures and etc., with the intention of increasing, renovating, sharing or improving the use of knowledge, which appears in each of the three elements of intellectual capital: structural - human and social (Chua, 2009). Knowledge as an important source of competitive advantage and value creation is an essential element for developing key competencies. Also it is a determinant factor for companies to Globalization and getting the International Finance Market (Dingsøyr, 2019).

Knowledge management helps organizations to identify and organize critical information that are considered as organizational memory and typically not organized (Faizi et al., 2018).

In fact, the need for knowledge management in developed countries is due to the transformation of theory and knowledge into action (Mahdi et al., 2019).

In most developing countries, however, knowledge management exists as a case based on theory that separate from the industry and there is no strategy for linking knowledge management to practice (Mirzaei, 2017).

Risk and inherent uncertainty in a dynamic environment have increased the importance of organizational knowledge management. There are various theoretical and empirical evidence has proven knowledge management as a key source for gaining competitive advantage and following it toward organizational success (Lambe and Patrick, 2011).

In small organizations, there may be a sudden occurrence that affects the performance of KM because these organizations have a younger age than older organizations. Small and medium-sized enterprises in developing countries are also more likely to be subject to sudden changes, because many reasons, such as state laws and accidents, may occur in these countries, and developing countries cannot quickly resolve these problems (Kaiser et al., 2015).

For this reason, choosing the best strategy for knowledge management in these companies with conventional methods may not give us the correct result. For this reason, the existence of a model based on uncertainty for choosing the best knowledge management strategy in small and medium-sized enterprises in developing countries is essential (Feyzi et al., 2017).

One of the new methods for solving uncertainty problems is a hesitant fuzzy decision-making approach which is introduced in 2009 by Torra, in which the degree of membership for each member is defined as a set of possible values (ShafieiNikabadi and Razavian, 2020). At the present, many generalizations of fuzzy sets have been introduced (Alcantud and Torra, 2018). The hesitant fuzzy decision-making offers the degree of membership of an element to a set by presenting several possible values, so it is a suitable way for problems with uncertainty (Dinçer et al., 2019). However, in some problem in real affairs the determination of exact values of membership is a difficult and impossible task and always accompanied by hesitation (Centobelli et al., 2018).

Hesitant fuzzy sets are completely suitable for dealing with situations where a set of possible values is available. Especially, those situations in which there is a marginal error or possible distribution on possible values (Alcantud and Torra, 2018). In fact, in most real situations the allocation of exact values as degree of membership cannot be properly defined the ambiguity and uncertainty in decision-making information (Krishnan et al., 2019).

Therefore, the purpose of this study is to provide a comprehensive model for selecting appropriate knowledge management strategy in small and medium-sized enterprises in developing countries under uncertainty.

RESEARCH THEORETICAL FUNDAMENTALS

Knowledge management

The importance of knowledge is more than any other source, such as financial resources, market position or technology for organizations because it is known as the main source of Globalization. Traditions, culture, technology, actions, teams and procedures of the organization are based on knowledge and expertise. Knowledge is needed to increase the capabilities of employees to develop and Performance improvements and provide quality services to customers (Tiamaz and Souissi, 2019).

As long as the company does not identify its definition of knowledge and does not identify the type of knowledge that is organizationally important, it will not be able to manage its operational knowledge. It is clear that all knowledge is not the same value (Salimi et al., 2017).

In fact, organizational knowledge management is a new approach about sources and factors of organizational power and value of human personality and their ability to creativity and innovation. That is why the creation and acquisition of organizational knowledge, its preservation, distribution and sharing, its application and, finally, its development have become the main concern and duty of the managers of the organizations (Wang et al., 2016).

However, in addition to developing a system based on organizational knowledge and organizational memory, it is important to recognize different type's knowledge and its values. Companies that are equipped with such cognition will be able to effectively resolve the needs of their organization (Pfister et al., 2012).

Although knowledge is not easily measurable, organizations need to acquire knowledge in order to gain the benefits of effectively managing the skills, experiences, and tacit knowledge of employees (Nisar et al., 2019).

Because most of the definitions provided by researchers are based more on their own backgrounds and interests, one of the most important challenges identified is the ability to understand knowledge management and its goals (Nowacki and Bachnik, 2016).

Nonaka has identified four interactive patterns of Implicit (tacit) and explicit knowledge in the creation or development of organizational knowledge (Wu, 2008; Omotayo, 2015; Santoro et al., 2018; Lambe and Patrick, 2011; Nisar et al., 2019):

Implicit-implicit: this form of knowledge grows when a person transfers knowledge to another person in a teacher-student relationship.

Explicit-explicit: the combination and integration of explicit knowledge is achieved, as when the company controls the collection and composition of the information.

Explicit-implicit: When an individual acquires existing knowledge and adds to his tacit knowledge, he creates a new knowledge that can be shared throughout the organization.

Explicit-implicit: this form of creating knowledge occurs when the explicit new knowledge is created by the members of the organization to create new implicit knowledge, just as the new inspector budgeting process of the firm, in standardized manner Business affairs.

So far, the researchers have explained the research about the history of knowledge management, its applications, evaluation capabilities, and the results of its implementation. Many models have been introduced for KM strategies. In this study, the SECI model has been used.

SECI[1] model:

Knowledge production is an interlacing process of implicit and explicit knowledge. The interactions of these two types of knowledge lead to the production of new knowledge. The combination of these two groups makes it possible to understand the four patterns of knowledge conversion (Pina et al., 2013). In the table1, we describe the characteristics of the four stages of these transformation processes. All four strategies can be recognized as transcendental processes. The SECI model presents only one plan for producing knowledge, and expresses the idea of self-exaltation in a completely abstract and abstract manner (Nowacki and Bachnik, 2016).

SECI model of knowledge management is a model that describes how tacit and explicit knowledge are changed into organizational knowledge. The SECI model divided to four knowledge dimensions: **S**ocialization, **E**xternalization, **C**ombination, and **I**nternalization. Nonaka in 1990 introduced SECI model and after that Takeuchi extended it (Nowacki and Bachnik, 2016). The interaction of explicit and implicit knowledge of SECI model is shown in table 1.

Table 1- SECI model (Wu, 2008)

From: tacit knowledge	From: explicit knowledge	
Internalization	combination	From: explicit knowledge
Socialization	Externalization	From: tacit knowledge

Socialization: Socializing involves the sharing of tacit knowledge among individuals. The term socialization affirms that tacit knowledge is transmitted through common activities, such as being together and in a living environment, not by written or oral instructions. Long periods of internship allow the learner to understand other ways of thinking and feeling. Therefore, in a particular situation, tacit knowledge can be shared. Of course, only if a person creates such readiness in his / her knowledge of tacit knowledge. In short, it is self-explanatory, a framework for sharing tacit knowledge of individuals (Lambe and Patrick, 2011). In practice, socialization is the acquisition of knowledge through physical proximity. Knowledge learning process is highly developed through direct interaction with customers and suppliers. Another way to learn is to implicitly go inside the organization. Information is available at the workplace within the organization and the latest available information is concentrated there. The dissemination of tacit knowledge is another feature of socialization. The process of transferring opinions to colleagues and subordinates directly leads to the sharing of knowledge of individuals and the creation of a common space or place (Omotayo, 2015).

Extermination: the expression of tacit knowledge and its transfer to understandable forms for others. The so-called people expand their internal and external boundaries (Santoro et al., 2018). During the process of extermination, the person is involved in the group, so he becomes a member of the group. The set of opinions and ideas of people joins together with the opinions

[1] Socialization, Externalization, combination, Internalization

and beliefs of the group; this form of self-esteem is the key to integrating the group's views and transforming it into implicit knowledge. In practice, extrusion is done in two ways (Nowacki and Bachnik, 2016).

The second factor is dealing with the transfer of tacit knowledge to customers or professionals in ways that are easy to understand. The necessity of this factor is the effective arguments of deductive and inductive reasoning (Al-Doori, 2019).

Combination: involves the transformation of explicit knowledge into more complex forms of this kind of knowledge. The main topics are the combination of communication, saturation and systematization of knowledge. In practice, the combined process is based on three processes (Analoui et al., 2013).

It is necessary to capture and integrate the new explanatory knowledge. This includes collecting external knowledge, such as public data, from within or outside the organization, and then combining these data (Al-Doori, 2019). The publication of explicit knowledge is based on the process of transferring this form of knowledge directly through presentations and meetings. Here, new knowledge is disseminated among members of the organization. Editing or refining the explicit knowledge increases its applicability, such as documents such as designs, reports and market information (Analoui et al., 2013).

Internalization: Internalization is in fact the transformation of explicit knowledge into the tacit knowledge of the organization. In internalizing, it is necessary for a person to identify his knowledge within the knowledge of the organization and also finds himself in a broader range. Learning through doing, teaching, and practicing makes individuals reach the domain of group knowledge and the whole organization. In practice, internalization relies on two dimensions, which are: explicit knowledge in action and practice (Al-Doori, 2019).

Research Background

Wu (2008) presented a model for choosing knowledge management strategy using robust MCDM and ANP and DEMATEL approach. In his article, he proposed an effective solution based on the robust MCDM combined approach to help companies that need to evaluate and select KM strategies. In addition, an empirical study is presented to illustrate the application of the proposed method.

Wang et al (2016) presented a new model for knowledge management strategy choosing. The purpose of their paper was to focus on the fit between intellectual capital (IC) and knowledge management (KM) strategy and its impacts on firm performance. The finding shows more fit a firm's IC is to its KM strategic type, the better operational and financial performance it can achieve.

Mirzaei et al (2017) in their research identify all organizational factors related to KM strategy selection in three industrial strategic organizations. Methodology for this research is applied in purpose and descriptive in data gathering. To analyze data and test hypotheses the authors have used Chi-square method through windows SPSS.20 software. Results clearly showed that there are meaningful relationships between all main variables of research (organizational strategy, organizational culture, leadership style, human resources strategy, and IT maturity level) by adequate selection of strategy; while there are not meaningful relationships among three sub-variables of cultural super-imposable, isolationist leadership style and secondary human

resource strategy. Therefore, by omitting them from conceptual model of research, the model of factors affecting the selection of adequate knowledge management strategy is proposed.

Salami et al (2017) presented a model for choosing knowledge management strategy using a hybrid approach to network analysis process (ANP) and DEMATEL phase in Ansar bank branches in Kermanshah. The research method in terms of purpose was practical and data collection is descriptive-analytic. The statistical population consists of experts in the field of knowledge management, senior managers and staff of Ansar bank branches in Kermanshah. Data were collected by census and questionnaire. Also the data were analyzed using SPSS software and Super Decision. According to the findings, the weight of each sub criteria (Wi) and standard points (Si) was obtained in the organization; Using them the 6.709 value was obtained for the criteria KMSI in which the hybrid strategy toward the coding strategy was chosen as the dominant strategy in the organization.

Centobelli et al (2018) propose a three-dimensional fuzzy logic approach to evaluate the level of alignment between the knowledge an enterprise possesses and the knowledge management systems (KMSs) it adopts. The study also aims to propose the KMSs best suited to reducing misalignment and improving operational performance in terms of efficiency and effectiveness, analyzing the level of alignment between an enterprise's knowledge and its KMSs from both the ontological and epistemological points of view.

According to Wu (2008), the goals and criteria of the research were selected and the SECI model would be used for the KM strategy. The hierarchical model of research is as figure1. As you can see, three main goals, six criteria and four strategies are examined in this study.

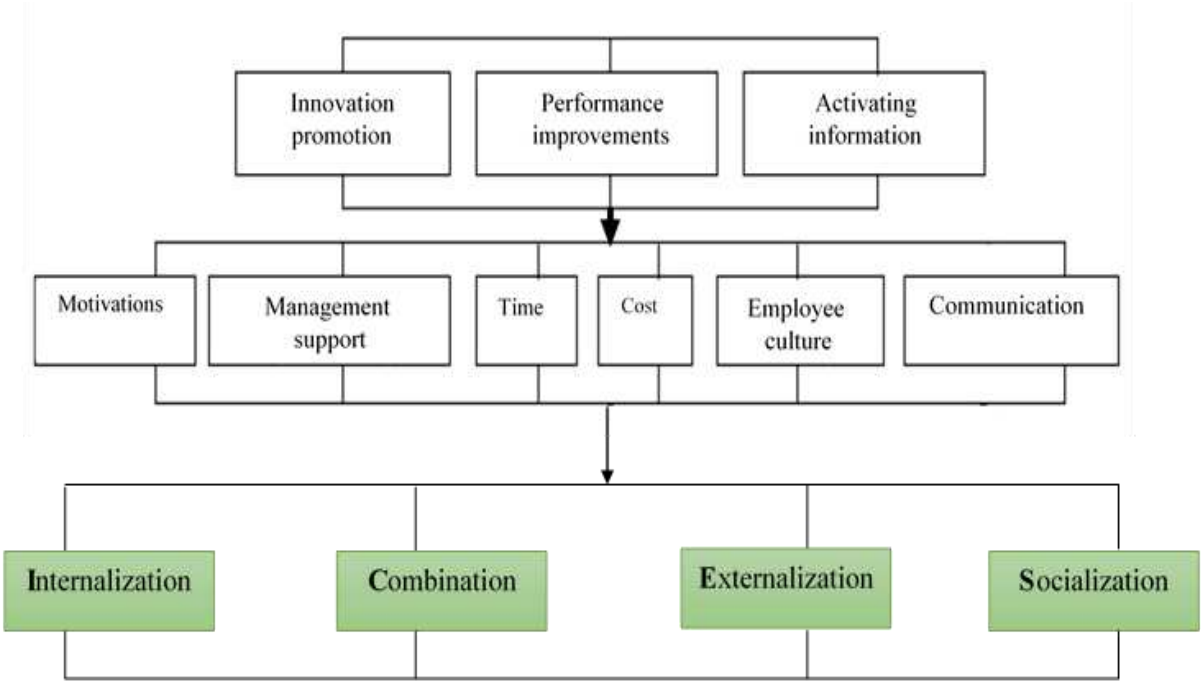

Figure 1- Decision structure for the KM strategy selection (Hierarchical Model of Research)

This model has 3 sections. The top of model is Purpose that divided to 3 sections and in the middle of shape 6 criteria does exist (wu, 2008). In the bottom of shape 4 strategies of SECI model is

there (**S**ocialization, **E**xternalization, **C**ombination, and **I**nternalization). 2 section are based on wu (2008) and 4 strategies is based on this research.

RESEARCH METHODOLOGY

hesitant fuzzy set

This is an extension of fuzzy set, which prepare the degree membership of an element by representing several possible values between 0 and 1. The hesitant sets have more advantages in comparison with traditional fuzzy, particularly in group decision-making under uncertainty (Divsalar et al., 2017). These advantages prepare the opportunity to search on decision-making in hesitant conditions (ShafieiNikabadi and Razavian, 2020). The hesitant fuzzy sets were introduced by Torra in 2009 that is widely applied in decision-making science. A hesitant fuzzy decision-making, which provides several possible values for degree membership of an element, is considered as a useful method to describe and deal with uncertain data (Alimohammadlou and Bonyani, 2019) .It has indicated that assigning an interval for an answer set may have less precision than a membership degree, which indicates that the hesitant fuzzy decision-making methods are more accurate than other methods (Castro et al., 2018).

Definition 1 (Jafari-Moghadam et al., 2017): A fuzzy set is in a reference set, such as X, with membership function m_F whose values are in range of [0,1] so that:

$$\mu_F : X \to [0,1] \tag{1}$$

After introducing the function of fuzzy sets, the concept of Intuitionistic Fuzzy set (IFS) was defined by Atanassov to express the decision makers' preferences more precisely in the decision-making process.

Definition 2 (Divsalar et al., 2017): If the set $X=\{x_1,x_2,\ldots,x_n\}$ is a reference set, the intuitionistic fuzzy set A on the reference set X is defined as following:

$$A=\{\langle x_i,\mu(x_i),\nu(x_i)\rangle | x_i \in X\} \tag{2}$$

$\mu(x_i)$ and $\nu(x_i)$ are the membership function and the non-membership function in the interval [0,1] and are true in the following condition for all values:

$$0 \le \mu(x_i)+\nu(x_i) \le 1 \tag{3}$$

Now we have $\pi_A(x_i)=1-\mu(x_i)-\nu(x_i)$ that $\pi_A(x_i)$ is the uncertainty value of x_i in the reference set A.

Definition 3 (Divsalar et al., 2017): A hesitant fuzzy element, such as H in A, is a function in HFS that is defined as a subset of h when the reference set is applied to the interval [0,1]. In fact, the hesitant fuzzy set is the generalization of intuitionistic fuzzy sets. This set is defined by Xu and Xia for convenience as follows:

$$H=\{\langle x_i,h(x_i)\rangle | x_i \in X\} \tag{4}$$

$h(x_i)$ is a set of different values in the interval [0,1]. $h(x_i)$ is called the hesitant fuzzy element (HFE) in the set H .

Definition 4 (Divsalar et al., 2017): For a reference set X, if $h(x) = \{\gamma_1, \gamma_2, \ldots, \gamma_l\}$ is a hesitant fuzzy element with a set of possible values of with γ_k (k=1,2,….,l) and 1 is a value of h(x) then the mean of h (x) in the HFE is defined by the following formula:

$$\bar{h}(x) = \frac{1}{l}\sum_{k=1}^{l}\gamma_k. \tag{5}$$

To compare the rules of hesitant fuzzy elements, a definition of the value operator and also variance operator is needed:
Definition 5 (Divsalar et al., 2017): For per HFE the value operator is as follows:

$$s(h) = \frac{1}{l_h}\sum_{\gamma\in h}\gamma \tag{6}$$

It is clear that for two HF elements such as h_1 and h_2, if $s(h_1) > s(h_2)$ then $h_1 > h_2$ and if these two values are equal $s(h_1) = s(h_2)$ then $h_1 = h_2$.

Note: obviously, due to the fact that the value operator of the two values is the same, there is no superiority between these two hesitant fuzzy elements. Moreover, another concept called the variance operator is defined:

Definition 6 (Divsalar et al., 2017): For each HFE, the variance operator formula is as follows:

$$v_1(h) = \frac{1}{l_h}\sqrt{\sum_{\gamma_i,\gamma_j\in h}(\gamma_i - \gamma_j)^2} \tag{7}$$

For both HFE elements such as h1 and h2, if $\upsilon_1(h_1) > \upsilon_1(h_2)$ then $h_1 < h_2$
New developments for hesitant fuzzy sets have been introduced. One of these constraints is that the interval-*valued hesitant fuzzy* (IVHF). This development shows the degree of membership of the components as possible intervals at [0, 1].
The coefficient of variation in 1 is as follows (Divsalar et al., 2017):

$$CV = \frac{s}{\sigma + \varepsilon} \tag{8}$$

IVHF-DANP

The DANP method is one of the multi-criteria decision-making methods that computes an ANP super matrix using the DEMATAL communication link matrix and calculates the weight of criteria and sub-criteria. In fact, the DANP method is a combination of the DEMATAL based ANP (DANP) method (Divsalar et al., 2017).

In traditional and classical methods for solving the DEMATAL and ANP combination models, this was done using the DEMATAL method of the total communication matrix, then the threshold value was taken and based on the threshold value and the total communication matrix, the relationship between the criteria and The sub-criteria were extracted and subjected to the ANP method, and then the pairwise comparisons were performed and the weight of the criteria and sub-criteria were calculated. (One of the disadvantages of this approach is that, taking into account the threshold value, a large number of internal relationships are eliminated) (Jafari-Moghadam et al., 2017).

But in the other DANP method, the total communication matrix does not take the threshold value (this makes it possible to maintain all internal relations), and with the same total effect numbers, the super matrix is formed, then it is balanced and reaches infinite power to the weight The final criteria and sub-criteria are calculated (Divsalar et al., 2017).

The steps in this algorithm are as follows (Divsalar et al., 2017):

First, the direct impact matrix is calculated based on the experts' opinion based on IVHFE.

$$\tilde{G}=\begin{bmatrix} \tilde{g}^{11} & \cdots & \tilde{g}^{1j} & \cdots & \tilde{g}^{1n} \\ \vdots & & \vdots & & \vdots \\ \tilde{g}^{i1} & \cdots & \tilde{g}^{ij} & \cdots & \tilde{g}^{in} \\ \vdots & & \vdots & & \vdots \\ \tilde{g}^{n1} & \cdots & \tilde{g}^{nj} & \cdots & \tilde{g}^{nn} \end{bmatrix} \tag{9}$$

Which $\tilde{g}^{ij}=(\tilde{\gamma}_1^{ij},...,\tilde{\gamma}_t^{ij},...,\tilde{\gamma}_s^{ij})$ Such a way that $\tilde{\gamma}_t^{ij}=[\tilde{\gamma}_t^{ijL},\tilde{\gamma}_t^{ijR}]$

In the next step, we normalize the direct impact matrix and then obtain the overall impact matrix using the following relation:

$$\tilde{T}=\tilde{D}+\tilde{D}^2+\tilde{D}^3+...+\tilde{D}^m=\tilde{D}(\tilde{I}-\tilde{D})^{-1} \tag{10}$$

Where $\tilde{T}$ *and* $\tilde{D}$ represent the total impact matrix, and the direct impact matrix, respectively

$$(I-\tilde{D})=\begin{bmatrix} 1 & \cdots & 0 & \cdots & 0 \\ \vdots & 1 & \vdots & & \vdots \\ 0 & \cdots & 1 & \cdots & 0 \\ \vdots & & \vdots & 1 & \vdots \\ 0 & \cdots & 0 & \cdots & 1 \end{bmatrix}-\begin{bmatrix} 0 & \cdots & \tilde{d}_{1j} & \cdots & \tilde{d}_{1n} \\ \vdots & & \vdots & & \vdots \\ \tilde{d}_{i1} & \cdots & \tilde{d}_{ij} & \cdots & \tilde{d}_{in} \\ \vdots & & \vdots & & \vdots \\ \tilde{d}_{n1} & \cdots & \tilde{d}_{nj} & \cdots & \tilde{d}_{nn} \end{bmatrix}=\begin{bmatrix} 1 & \cdots & 0 & \cdots & 0 \\ \vdots & 1 & \vdots & & \vdots \\ 0 & \cdots & 1 & \cdots & 0 \\ \vdots & & \vdots & 1 & \vdots \\ 0 & \cdots & 0 & \cdots & 1 \end{bmatrix} \tag{11}$$

And also:

$$\tilde{D}(I-\tilde{D})^{-1}=\tilde{D}.I$$
$$=\begin{bmatrix} 0 & \cdots & \tilde{d}_{1j} & \cdots & \tilde{d}_{1n} \\ \vdots & & \vdots & & \vdots \\ \tilde{d}_{i1} & \cdots & \tilde{d}_{ij} & \cdots & \tilde{d}_{in} \\ \vdots & & \vdots & & \vdots \\ \tilde{d}_{n1} & \cdots & \tilde{d}_{nj} & \cdots & \tilde{d}_{nn} \end{bmatrix}.\begin{bmatrix} 1 & \cdots & 0 & \cdots & 0 \\ \vdots & 1 & \vdots & & \vdots \\ 0 & \cdots & 1 & \cdots & 0 \\ \vdots & & \vdots & 1 & \vdots \\ 0 & \cdots & 0 & \cdots & 1 \end{bmatrix}=[\cdot]_{n\times n} \tag{12}$$

To calculate the matrix we use the following coefficient of variation operator. For this purpose, we first obtain the direct impact matrix using the coefficient of variation operator.

$$\Phi = \begin{bmatrix} \varphi_{11} & \cdots & \varphi_{1j} & \cdots & \varphi_{1n} \\ \vdots & & \vdots & & \vdots \\ \varphi_{i1} & \cdots & \varphi_{ij} & \cdots & \varphi_{in} \\ \vdots & & \vdots & & \vdots \\ \varphi_{n1} & \cdots & \varphi_{nj} & \cdots & \varphi_{nn} \end{bmatrix} \tag{13}$$

$$\varphi_{ij} = \mathrm{IVHFCV}(\tilde{g}^{ij})$$

Then we normalize the direct impact matrix using the following relation:

$$H = \frac{\Phi}{s} \tag{14}$$

$$s = \max\left(\max_{1 \le i \le n} \sum_{j=1}^{n} \varphi_{ij}, \max_{1 \le j \le n} \sum_{i=1}^{n} \varphi_{ij} \right) \tag{15}$$

Finally, using the following relation matrix, the overall impact is calculated:

$$Z = H + H^2 + H^3 + \ldots + H^m + = H(I - H)^{-1} \tag{16}$$

Now we calculate r and c:

$$r = \left[\sum_{j=1}^{n} t_{ij} \right]_{n \times 1}, \quad c = \left[\sum_{j=1}^{n} t_{ij} \right]'_{n \times 1} \tag{17}$$

Then we calculate super matrix and weighted super matrix with combining methods DEMATEL and ANP:

$$T_C = \begin{array}{c} \\ D_1 \\ \vdots \\ D_i \\ \vdots \\ D_m \end{array} \begin{array}{c} \begin{array}{ccccccc} D_1 & & \cdots & D_j & & \cdots & D_m \end{array} \\ \begin{array}{ccccccc} c_{11} \cdots c_{1n_1} & & \cdots & c_{j1} \cdots c_{jn_j} & & \cdots & c_{m1} \cdots c_{mn_m} \end{array} \\ \begin{bmatrix} g_c^{11} & \cdots & g_c^{1j} & \cdots & g_c^{1n} \\ \vdots & & \vdots & & \vdots \\ g_c^{i1} & \cdots & g_c^{ij} & \cdots & g_c^{in} \\ \vdots & & \vdots & & \vdots \\ g_c^{n1} & \cdots & g_c^{nj} & \cdots & g_c^{nn} \end{bmatrix} \end{array} \begin{array}{l} c_{11} \\ c_{12} \\ \vdots \\ c_{1n_1} \\ c_{i1} \\ c_{i2} \\ \vdots \\ c_{in_i} \\ c_{m1} \\ c_{m2} \\ \vdots \\ c_{mn_m} \end{array} \tag{18}$$

Then normalize the matrix T_C:

$$T_C^{nor} = \begin{bmatrix} T_C^{nor_{11}} & \cdots & T_C^{nor_{1j}} & \cdots & T_C^{nor_{1n}} \\ \vdots & & \vdots & & \vdots \\ T_C^{nor_{i1}} & \cdots & T_C^{nor_{ij}} & \cdots & T_C^{nor_{in}} \\ \vdots & & \vdots & & \vdots \\ T_C^{nor_{n1}} & \cdots & T_C^{nor_{nj}} & \cdots & T_C^{nor_{nn}} \end{bmatrix} \quad (19)$$

Then, the total influential matrix is normalized into a super-matrix according to the interdependence between the relations of the dimensions and related clusters to obtain an un-weighted super-matrix, *WC*,

$$W_C = (T_c^{nor})' = \begin{array}{c} \\ D_1 \begin{matrix} c_{11} \\ \vdots \\ c_{1n_1} \end{matrix} \\ \\ D_i \begin{matrix} c_{i1} \\ \vdots \\ c_{in_1} \end{matrix} \\ \\ D_m \begin{matrix} c_{m1} \\ \vdots \\ c_{mn_m} \end{matrix} \end{array} \begin{array}{c} \begin{matrix} D_1 & \cdots & D_j & \cdots & D_m \\ c_{11} \cdots c_{1n_1} & \cdots & c_{m1} \cdots c_{mn_m} & \cdots & c_{j1} \cdots c_{jn_j} \end{matrix} \\ \begin{bmatrix} W_c^{11} & \cdots & W_c^{i1} & \cdots & W_c^{m1} \\ \vdots & & \vdots & & \\ W_c^{1j} & \cdots & W_c^{ij} & \cdots & W_c^{mj} \\ \vdots & & \vdots & & \\ W_c^{1m} & \cdots & W_c^{im} & \cdots & W_c^{mm} \end{bmatrix} \end{array} \quad (20)$$

Calculate the weighted super-matrix *WC**

$$W_c^* = T_D^{nor} \times W_c = \begin{bmatrix} t_D^{nor11} \times W_c^{11} & \cdots & t_D^{nor1i} \times W_c^{11} & \cdots & t_D^{norm1} \times W_c^{m1} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor1j} \times W_c^{1j} & \cdots & t_D^{nori j} \times W_c^{ij} & \cdots & t_D^{normj} \times W_c^{mj} \\ \vdots & & \vdots & & \vdots \\ t_D^{nor1m} \times W_c^{1m} & \cdots & t_D^{norim} \times W_c^{im} & \cdots & t_D^{normm} \times W_c^{mm} \end{bmatrix} \quad (21)$$

Limit the weighted super-matrix by raising it to a sufficiently large power φ until it converges and become a long stable super-matrix term to obtain global priority vector, which defines the influential weights $w = (w1, \ldots, wj, \ldots, wm)$ from $\lim_{\varphi \to \infty} (W_c^*)^{\varphi}$ for the criteria.

RESEARCH FINDINGS & RESULTS

First decision matrix and direct impact matrix **Φ** is calculated in table2:

Table 2. Direct impact matrix Φ

	C1	C2	C3	C4	C5	C6
C1	0	6/82	4/63	6/94	3/38	3/3
C2	1/5	0	1/95	5/68	1/47	3/03
C3	1/78	1/99	0	3/95	6/21	4/62
C4	3/11	4/23	2/88	0	2/83	1/08
C5	3/42	4/58	5/64	6/14	0	2/02
C6	5/21	5/91	4/89	6/71	1/4	0

Then general matrix Z based on IVHFE calculated in table3:

Table 3. General matrix Z based on IVHFE

	C1	C2	C3	C4	C5	C6
C1	0/1224	0/1392	0/2247	0/2474	0/3814	0/2547
C2	0/4142	0/1771	0/2147	0/3178	0/2574	0/2874
C3	0/0795	0/1217	0/0875	0/2254	0/0941	0/2478
C4	0/0674	0/0777	0/1148	0/0174	0/0547	0/0975
C5	0/3214	0/3444	0/2876	0/7474	0/1879	0/2784
C6	0/1314	0/1347	0/1748	0/1286	0/1784	0/0148

Now $r_i + c_i$ and $r_i - c_i$ are calculated in table 4:

Table 4. $r_i + c_i$ and $r_i - c_i$

criteria	$r_i + c_i$	$r_i - c_i$
C1	3.389	0.314
C2	2.312	2.314
C3	1.841	-0.717
C4	2.257	-0.511
C5	2.732	1.0526
C6	2.544	-0.471

Based on data from Table 4, Fig. 2 is drawn and network relationship map (NRM) of influential relationships is created. Figure 2 shows the importance and effectiveness of the measures between the criteria. The horizontal axis of the graph shows the importance of the criteria and the vertical axis of the impact or influence of the criteria.

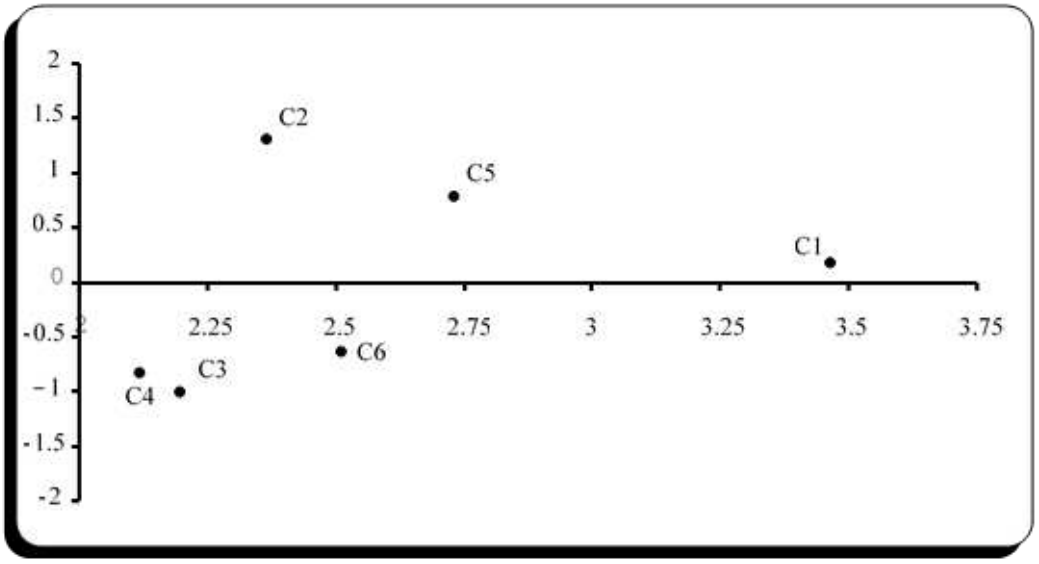

Figure 2. The causal diagram

As the results of Figure 2 show, the measures of management support, staff culture and incentives are in the positive half of the causal graph. As a result, they are highly influential. The other three criteria, namely cost, time, and communication, are on the negative side of the graph, indicating that these factors are highly impressible.

Now super matrix and its normalizations are calculated in table 5 and 6:

Table 5. Super matrix

	P1	P2	P3	C1	C2	C3	C4	C5	C6	A1	A2	A3	A4
P1	0	0	0	0	0	0	0	0	0	0.45424	0.42414	0.61026	0.47025
P2	0	0	0	0	0	0	0	0	0	0.34997	0.28437	0.24535	0.3094
P3	0	0	0	0	0	0	0	0	0	0.22179	0.19169	0.15629	0.20305
C1	0.171627	0.2478114	0.2378378	0.1684086	0.27908	0.17018	0.2038259	0.140176	0.1098097	0	0	0	0

C2	0.311468	0.3063973	0.2594594	0.1180476	0.21789	0.20853	0.2532982	0.1684086	0.318448	0	0	0	0
C3	0.092251	0.21789	0.1147544	0.0918959	0.22654	0.23917	0.0501319	0.1180476	0.0845401	0	0	0	0
C4	0.066261	0.22654	0.0445946	0.3469896	0.12997	0.16786	0.1154454	0.09189059	0.0496104	0	0	0	0
C5	0.279518	0.12997	0.2594595	0.1346023	0.0997	0.13056	0.244723	0.3469896	0.2895634	0	0	0	0
C6	0.068416	0.0997	0.0986486	0.05927	0.06041	0.11114	0.1325858	0.1346023	01414584	0	0	0	0
A1	0	0	0	0.27177	0.25472	0.28785	0.30916	0.31556	0.25416	0	0	0	0
A2	0	0	0	0.25822	0.17421	0.22076	0.19582	0.22129	0.32502	0	0	0	0
A3	0	0	0	0.11825	0.12509	0.12739	0.12982	0.12457	0.25458	0	0	0	0
A4	0	0	0	0.31976	0.44598	0.364	0.3652	0.32288	0.18589	0	0	0	0

Table 6. Normalization super matrix

	P1	P2	P3	C1	C2	C3	C4	C5	C6	A1	A2	A3	A4

C6	C5	C4	C3	C2	C1	P3	P2	P1
0.0512448	0.0875972	0.0627686	0.0815914	0.1211656	0.1124747	0.0478429	0.081549	0.119489
0.0477999	0.0903095	0.0575217	0.0762064	0.1160002	0.1111275	0.0530519	0.0755771	0.12205
0.0477999	0.0903095	0.0575217	0.0762064	0.1160002	0.1111285	0.0530519	0.075479	0.12205
0.0478548	0.0902972	0.0577686	0.0765914	0.1161656	0.1114847	0.0529829	0.0752161	0.1218929
0.0478939	0.0904141	0.0677636	0.0765678	0.1162702	0.1115262	0.0527983	0.0752161	0.1214688
0.0477999	0.0903095	0.0575217	0.0762064	0.1160002	0.1111285	0.0530519	0.0755771	0.12205
0.0478939	0.0904141	0.0577636	0.0765678	0.1162702	0.1115262	0.0527983	0.0752161	0.1214688
0.0478939	0.0904141	0.0577636	0.0765678	0.1162702	0.1115252	0.0527983	0.0752161	0.1214688
0.0478548	0.0902972	0.0577686	0.0765914	0.1161656	0.1114847	0.0529829	0.075479	0.1218929
0.0478939	0.0904141	0.0577636	0.0765678	0.1162702	0.1115262	0.0527983	0.0752161	0.1214688
0.0478548	0.0902972	0.0577686	0.0765914	0.1161656	0.1114847	0.0529829	0.075479	0.1218929
0.0477999	0.0903095	0.0575217	0.0762064	0.1160002	0.1111285	0.0530519	0.0755771	0.12205
0.0512448	0.0985972	0.0627686	0.0815914	0.1211656	0.1124747	0.0478429	0.081549	0.119489

A1	0.0633878	0.0702322	0.0702322	0.0699878	0.0701562	0.0702322	0.0701562	0.0701562	0.0699878	0.0701562	0.0699878	0.0702322	0.0633878
A2	0.0619465	0.0579493	0.0579493	0.0577465	0.0578879	0.0579493	0.0678879	0.0678879	0.0577465	0.0578879	0.0577465	0.0579493	0.0619465
A3	0.0441171	0.336317	0.0336317	0.0335171	0.0335928	0.0336317	0.0335928	0.0335928	0.0335171	0.0335928	0.0335171	0.0336317	0.0441171
A4	0.0991417	0.0885415	0.0885415	0.0882317	0.0884441	0.0885415	0.0884441	0.0884441	0.0882317	0.0884441	0.0882317	0.0885415	0.0991417

Now based on super matrix the weight and Normalized weight of target and criteria and strategies are calculated in table 7:

Table 7. Final result for ranking KM strategies

Normalized weight	weight	target
0.480205	0.119489	P1
0.327563	0.081549	P2
0.192232	0.0478429	P3
Normalized weight	weight	criteria
0.217819	0.1124746	C1
0.23334	0.1211657	C2
0.157765	0.0815914	C3
0.121446	0.0627686	C4
0.169485	0.0875972	C5
0.09915	0.0512448	C6
Normalized weight	weight	strategies
0.235999	0.0635178	A1
0.230633	0.0624465	A2
0.164253	0.0434671	A3
0.369115	0.0981417	A4

According to the table 7, the target of promoting innovation is of the most importance, followed by improvement of performance and activation of priority information, respectively.
Priority weighting criteria for knowledge management strategies include management support, incentives, staff culture, time, communication, and cost.
The prioritization of KM strategies in SMEs in developing countries is as follows:
1. Socialization
2. Internalization
3. Composition
4. Externalization

CONCLUSIONS AND SUGGESTIONS

Conclusions

Knowledge management is considered one of the newest and most important management issues today. In fact, knowledge management is a response to the ever-changing business environment of the current institutions. Changes in management practices are necessary and inevitable. All institutions need effective implementation of KM strategies in order to survive and grow and adapt to changing competitive environments. Therefore, given the scarcity of organizational resources, choosing the right strategy with the organizational structure is important in advance. This study was conducted in line with this topic and presented a consolidated model for prioritizing KM strategies in SMEs in developing countries.
Overall, the results of the integrated approach of prioritizing knowledge management strategies indicated that management support, staff culture and incentives had high impact and cost, time and communication had high impact. Also among these criteria, the criterion of management support is the most important one in prioritizing knowledge management strategies. Finally, prioritizing the results of knowledge management strategies using the integrated approach showed that the best knowledge management strategy for SMEs is socialization strategy.

Suggestions

- Governments should provide the necessary training and incentives for small and medium-sized enterprises, the area of knowledge acquisition, labor, equilibrium, ideas, knowledge and practices, skills, practices, and practices.
- Small and medium-sized enterprises in developing countries need special attention because they provide a balanced view of the world and help small businesses in developing countries flourish in the global economy.
- The areas required for identification, organizing, and transferring knowledge, including the knowledge of the organizations, in addition to the knowledge.

Suggestions for future research

- Identification the relationship and correlation of sub-criteria for KM with hesitant fuzzy entropy
- Application of Proposed model for choose the best KM strategies with grey theory
- Investigating the role of KM strategy in the supply chain

- Determination of the relationship between criteria and sub-criteria by using the ISM technique.

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