Future Generation of Communication and Internet of Things (FGCIOT)

Journal homepage: http://fgciot.semnaniau.ac.ir/

Research paper

Evaluation of Knowledge Management Performance using a Fuzzy-Combined Decision Method

Mohammad Abdolshah

Department of Industrial Engineering, Semnan Branch, Islamic Azad University, Semnan, Iran

Article Info

Article History:
Received July 25, 2023
Revised September 2, 2023
Accepted October 10, 2023

Keywords:
Knowledge Management, Fuzzy Multi-Criteria Decision-Making Method, Fuzzy Screening Model, aggregation method

*Corresponding Author's Email Address: abdolshah@gmail.com

Abstract

In the economy of the developed countries, the balance between the knowledge and other resources has changed towards the knowledge. Although knowledge is a necessary resource for the organizations survival, yet many organizations have not seriously pay attention to the knowledge management. The capability of knowledge management in organizational level should be suitably measured to make decisions based on the obtained analysis results. So, the evaluation and implementation of knowledge management, before investing in this field, is crucial for organizations. To do so, the purpose of the present study is to evaluate and measure the knowledge management capability using the Gold and Chang seven-criterion model and provide solutions in organizations. To evaluate and provide solutions using the fuzzy combination decision method, the analysis of the knowledge management capability has been carried on. To illustrate the purpose of the study, the performance of knowledge management has been studied.

1-Introduction

In recent decades, the central core of the organizations has changed from the focus on financial and human resources to the technology and knowledge (Muthuveloo et al, 2017). Knowledge is considered as the strategic property and an intangible resource to create a competitive advantage, comprehensiveness, problem solving and innovation in organizations and its management leads to the creation of the sustainable competitive advantage (Nonaka & Takeuchi, 1995). Regarding the main recent investments of the world, it can be said that the developed countries invest in the top levels of knowledge of why and why not and the developing countries invest in the middle and low levels of knowledge of how (Investment Map, 2017) and it shows that the market has recognized the knowledge value and other unobservable factors in the value-creating process and mentioned it as a latent value (Bontis, 1999, Nonaka & Takeuchi, 2006). The organizations are always looking for new methods to survive aiming to meet the human needs in the business area (Abdolshah et al, 2018). So, knowledge management is very crucial in the organizations. Knowledge management as the most important resource to obtain the competitive advantage has changed to a very important issue and in many businesses especially in knowledge-based, learner and intellectual capital management organizations has gained a high position. More clearly, regarding the human changing needs in the present age, the challenge of the managers is to prepare a suitable environment for the growth and training of the human mind in the organizations (Bontis, 1995, Nonaka & Takeuchi, 2004, Reich et al, 2014).

To do so, the capability of knowledge management in organizational level should be suitably measured to make decisions based on the obtained analysis results. Several studies have been carried to investigate the capability of knowledge management and its effective indices, most of which has indicated the considerable and profound impact of knowledge management on the competitive status of organizations (Nonaka & Takeuchi, 2008, Costa et al, 2016). Therefore, the purpose of the present study is to present a method to evaluate the capability of knowledge management based on the Gold method using the Chang and Wang (2009) fuzzy multi-criteria decision making approach and the method of understanding the

Doi:

output in the format of Lotfizadeh s language variables based on the applied study (Lotfizadeh, 1965, Powell, 1998, Gold et al, 2001). Other purposes of the present study include expressing the title and effective prerequisites for the people s implicit knowledge management in organizations to make the knowledge management theory closer to practice and increase the responsiveness capability to meet the customers' needs to make the organization more dynamic. First, the basic hypothesis of the paradigms of knowledge management is presented which illustrates the practical and intellectual orientations of researchers in clarifying the concept of knowledge and its management. Then, the capability of knowledge management in the organizational level has been suitably measured and the decisions were made base on the results obtained from the analysis results.

2- Theoretical Principles and the Research Background

2-1-Fuzzy Theory

The concept of the fuzzy set originates from the observation made by Zadeh (Zadeh 1996) to order classes of objects encountered in the real world that do not have precisely defined criteria of belonging. These classes of objects are present both in the mental representations of reality and in the terminology used in natural language and therefore absent in the usual mathematical representations that make use of the binary logic of exact formulas of differential equations and so on. In this regard, the mathematician A. Sangalli (Mohammadi, Shamshirband et al. 2016) states that: “In the ideal world of mathematics things are certain and precise; but in the real world precision and absolute certainty are very rare goods".

Todays, a modern approach to solve the problem and respond to the ambiguities of the management systems has been presented by using the fuzzy system theories. Using the fuzzy logic theory and fuzzy sets, the fuzzy system theory can enter the parameters such as knowledge, judgment and decision-making to present a gray image of the gray world. It is clear that the results of such models will be more practical and accurate due to imposing the real condition in the model. Fuzzy system theories act based on the general process of information processing in the brain. The general process of information processing in the brain includes the following stages:

Information retrieval→ recognition→ meditation→ judgment→ evaluation→ decision

2-2-Knowledge and knowledge management

In 1980, the importance of knowledge as a competitive property has been clear among organizations, although the classic economy science had been already in shortage related to the management methods and approaches and yet, this ignorance exists in some of organizations.

In industrial economy, wealth is produced by combining a series of tangible and physical properties such as land, labor, money and …. Using knowledge as a crucial factor has been less considered. In knowledge economy, however, knowledge or intellectual capital as a factor to produce wealth is preferred in comparison with other tangible and physical properties. Therefore, the way of managing the intellectual capital in organizations and its impact on obtaining the competitive advantage can play an important role in organizational purposes progress (Acara et al, 2017). Since the late 1990s, knowledge management as a modern management method has been the hot discussion of management and other areas related to management. In fact, this method is the evolution of other managerial methods and many researchers have found a positive relationship between the performance evaluation and the successful administration of organizational knowledge management and introduced it as one of the key factors of the organization success (Barsky and Marchant, 1999, Beijerse, 2000, Bukowitz, & Williams, 2000, Bukowitz & Petrash, 1997, Carneiro, 2001, Edvinsson, 1997, Gooijer, 2000, Martinze, 1998, Moffett et al, 2003, Pearson, 1999, Hung et al, 2005, Barsky and Marchant, 2000, Plessis and Marina, 2007).

Knowledge is a concept beyond the data. Knowledge is referred to as a collection of data, a practical solution related to it, the results of using it in different decisions, the training related to it, people s attitudes in different jobs and responsibilities related to it (Nonaka & Takeuchi, 2007). The term "knowledge management" has different definitions some of which include:

A hierarchy collection composed of data, information, knowledge and recognition. It is a circumstance which gives value to the information inside the organization (Sveiby, 1997).It is a path in which knowledge is created and used to achieve the goals. It is the informed trend of creating, validity, presenting and distribution and usage of knowledge. The process of systematizing, selecting, organizing and presenting information and knowledge is in such a way that improves the individual s perception regarding a specific field (Correia et al, 2003). Knowledge management is a process which helps organizations in recognizing, selecting, organizing, disseminating of information and important skills which are a part of organizational memory and exists non-structurally in the organization.

Knowledge management is the supervisor of a set of processes during which the knowledge flow in a society is increasingly and continuously directed. Knowledge

management is defined as a collection of knowledge, intellectual capabilities and experiences of individuals of an organization and making marketing skill as a human capital (Perez, 1999). In simple words, for organizations, knowledge is more important than financial resources, market situation, technology or any other properties (Shi, 2016). Today, knowledge is considered as a main resource of job performance. Researchers have considered numerous components for knowledge management, which will be briefly discussed in the following section:

Davenport considers the following components as the basic components of knowledge management:

A) Culture: including the values and beliefs of the organization members in relationship with knowledge and information concepts.

B) Action process: in fact, the way people use the knowledge and information in their institutions.

C) Policies: including the obstacles, which appear in the information and knowledge sharing process in the organization.

D) Technology: different kinds of information systems available in the institution.

Individuals, processes and technology are the main factors in knowledge management success.

1. Technology: technological solutions in knowledge management provide a foundation to protect and share knowledge and aggregation in the work flow.

2. Processes: including the standard processes to give knowledge, managing the content (acceptance, content, keeping the quality and current content, records or omitting the old content).

3. Individuals: the most important challenge in knowledge management is assuring the members participation in knowledge sharing, aggregation and knowledge reuse for the results. Resetting the reward systems, evaluating the performance and other systems of performance measuring should be considered.

Nonaka and Takeuchi model: this model considers knowledge as a distinct component. Nonaka and Takeuchi model, for example, shows a high level concept of knowledge management and considers knowledge management as a process of knowledge creation.

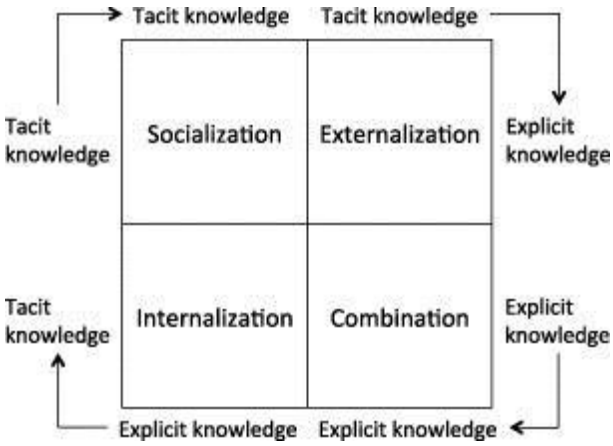

Figure 1. Nonaka and Takeuchi model

2.3. Research Background

The study carried out by Gilbert et al (2002) showed that integrating the systems of customer relation management and knowledge management can increase the advantages of using them and reduce the risk. Customer relation management requires the knowledge of/for and about the customer. The obtained results showed that knowledge management is the success factor of CRM. Knowledge management approaches aiming the support of CRM processes should be process-oriented. The studies showed that KM and CRM have a high potential and should be integrated. In a study carried out by Pakoute in 2006, knowledge sharing issue was investigated. He expressed that facilitating the knowledge sharing among individuals and internal groups of the organization is necessary. However, since this knowledge is not in the ownership of the organization individuals and enters the organization from outside, it is more difficult. So, the creation of social structures, business processes and technology considered as a solution to facilitate the customer knowledge flow can have a considerable impact on the improvement of organizational performance and use a new source of knowledge.

In a study, Washit, Kumaru Chandra (2010) investigated how academic researchers and research centers of India face the obstacles of knowledge management. To do so, knowledge collection, knowledge creation and knowledge distribution have been studied from individual, social and technical aspects. The results show that researchers are more engaged with individual, social and organizational aspects of knowledge management rather than its technical aspect. Muthuveloo et al (2017) have investigated the impact of implicit knowledge management on organizational performance in Malaysia. In this study, they have investigated as if the organizations have strategies for implicit knowledge management. The result is that implicit knowledge management is derived from basic scientific dimensions, socialization, extraction,

combination and internalization (SECI Model). Torabi et al (2016) have studied the impact of knowledge management on human resource performance with the case study of Tehran Central Bank. The result shows that KM has a significant impact on HR performance and all aspects of performance, except the environment, had an impact. Chuan and Moolson (2015) have studied the capability of knowledge management in improving the companies' performance in South Africa. The results show that in future, the main part of the companies' performance is based on KM performance impacts. Presenting a seven-criterion model for knowledge management, Gold et al (2001), showed that the improvement of performance and creation of competitive advantage in organization exist in knowledge management category.

Investigating the results of carried out studies, it can be said that knowledge management can suitably provide the context of promoting the activities and achieving the considered purposes by integrating the organizations knowledge capitals in different parts and direct impact on concepts such as customer-management, organizational learning, organizational culture promotion, leadership and intelligent decision-making, the process redesign, new knowledge production and the conversion of implicit knowledge to explicit and paying attention to experts knowledge. Although frequent knowledge management systems have been already presented, they could slightly meet the individuals and organizations needs regarding the organizational knowledge. Most of these systems are composed of traditional approaches of knowledge management and could only provide an effective support for one of the components of knowledge cycle (knowledge classification, knowledge storage and knowledge correction). Reviewing the literature of knowledge management effectiveness, it can be concluded that little has been done regarding the use of the fuzzy approach. To evaluate the effectiveness of knowledge management, however, it is necessary to use the experts' ideas besides the qualitative data. Therefore, using the proposed approaches using the fuzzy logic can drastically help to model this area.

3. Evaluation of Knowledge Management Performance using a Fuzzy-Combined Decision Method

Two theoretical frameworks have been considered in this study. The first theoretical framework: it is the capability level of knowledge management Gold et al (2001) s model has been considered as the primary theoretical framework in this area. This model studies knowledge management based on two dimensions: infrastructure and process dimensions. Seven criteria of technology, structure and culture are in infrastructure dimension and learning, conversion, usage and protection are in the process dimension.

The second theoretical framework: using the proposed approaches to improve the current state, the necessary solutions are provided.

This is done by measuring the heptad criteria performance which enables senior managers to identify and classify the aspects requiring the improvement and plan to perform the required activities.

In the first theoretical framework, Gold et al (2001)' s model has been used and the capability of knowledge management in two dimensions (infrastructure and process) and 7 criteria (technology, structure, culture, learning, conversion, usage and knowledge protection).

In the present study, data has been qualitatively and quantitatively analyzed. The qualitative data was obtained through interviewing with reference groups, experts and individuals engaging knowledge management and quantitative data was obtained through questionnaires. Then, using the fuzzy filtering model and concepts such as triangular fuzzy numbers and fuzzy language approach, a method has been presented to measure and analyze the capability of knowledge management. In the qualitative section of this study (case study), the main mechanism to gather data is interviews. In the case studies, the interviews are mostly used to study the specific conditions and relationships between the organizational behavior and its specific context. In the aggregation approach, the experts are firstly asked to express their ideas without any interactions with each other. Then, a statistical analysis of data is presented. After that, the statistical data is transferred to the candidate experts to review the results and present a new estimation. This new estimation is analyzed and new data is sent to the candidate experts. This process continues to achieve an acceptable stable answer.

The above explanation shows that the aggregation method is an approach in which the subjective data of the experts is converted to the nearly objective data and this leads to the aggregation in decision-making (reaching a stable point). The aggregation method can be used in numerous issues related to the prediction and decision-making.

In aggregation method, the experts proposed predictions are expressed in the form of definite numbers, however, using the definite numbers for long-term predictions seems unrealistic. So, it is better to use fuzzy collections in long-term predictions and decision-making in the real world. Different kinds of fuzzy numbers can be used to get the experts ideas. Triangular fuzzy numbers (T.F.N) are used to facilitate the computation. This process can be generalized to other fuzzy numbers.

3.1. Evaluation of knowledge management capability

Aggregation method is based on 5 steps which will be discussed in next sections.

Step 1: experts are asked to present their prediction (based on triangular fuzzy numbers) in the form of the minimum value, the most possible value and the maximum value.

Step 2: the answers of n experts compose a cluster; the concept of fuzzy number cluster is very useful in making the objectivity of subjective ideas and opinions. The average of this cluster is calculated and for each expert, the difference value from the average is computed. This difference can be positive, negative or null. This data will be resent to get the experts new ideas.

Step 3: in this step, each expert presents a new prediction based on the data obtained from the previous step and modifies his previous idea, if necessary. After the end of this step, return to step 2 and repeat the process.

Step 4: when the average of fuzzy number cluster is stable enough, this process ends. Later, if necessary or when an important event occurs, the prediction can be reevaluated by repeating the above processes.

Step 5: screening process: this process is used when a small subset should be selected among frequent alternatives. This screening method is based on the preliminary data and the discussed technique just needs a non-numerical scale to evaluate and select the options. This technique has been presented by Yuger in which the linguistic variable and operator (OWA) has been used. This method is a multi-criteria fuzzy approach of decision-making which uses several experts' ideas about different criteria (Yuger, 1993).

Yuger fuzzy screening process is a two-step process. In the first step, each expert is asked to present the evaluation of each option after weighing different criteria. In the second step, the evaluation of experts are combined using a specific methodology to obtain a unit value for each option. In this method, the experts' ideas are received in the form of language variables of scale S (table 1). Linguistic variables are practical tools to face the conditions not met by traditional minimization models.

S7	Ou (Outstanding)	Outstanding
S6	VH (Very high)	Very high
S5	H (high)	High
S4	M (Medium)	Medium
S3	L (Low)	Low
S2	VL (Very low)	Very low
S1	N (None)	None

Table1. Language terms of scale S.

As equation (1), using such a scale provides a natural order of Si so that:

(1) Si > Sj IF i > j

Maximum operator: Max (Si , Sj)= Si IF Si ≥ Sj

Minimum operator: Min (Si , Sj)= Sj IF Si ≥ Sj

First step: according to the above scale, each expert presents a set of n values {nn ,..... 1, n2,n{ for each option in which jn indicates the satisfaction rate of the jth criterion by organization. Each jn is a component of the acceptable set of S. Then, the organization unit score (U) is calculated as equation (2) in which Uk is the expert k s unit score to the organization and Iki is the significance of the jth criterion based on the kth expert s idea. The operator Neg is defined as equation (3):

(2) Uk=Min{ Neg (Ikj) v πkj{

, k = 1,2,… , r

, j=1,2, … , 7

(3) Neg (Si) = S7-i+1

Neg(OU) = N , Neg(V H) = V

, L Neg(H) = L , Neg(M) = M

, Neg(L) = H , Neg(V L) = VH

, Neg(N) = OU

According to equation (4), the result of the first step of screening is to obtain the individual' s unit score by organization knowledge management capability.

(4) {U1, U2, … , Ur } , k=1, 2, …, r =U(k)

The second step. In this step of the screening process, the experts' evaluations are mixed together to achieve a general evaluation of knowledge management capability in the organization. The first step of this stage is to determine the aggregation function for decision-making process which is (equation 5):

(5) $$\begin{cases} Q_A(k) = S_{b(k)} \\ b(k) = Int[1 + \left(k \times \frac{q-1}{r}\right)] \end{cases} \qquad k = 1,2,\dots,r$$

In which the aggregation function, Int indicates an integer, q indicates the number of points in the selected scale (in scale S1, S2,….S7, the number of points is7) and r shows the number of experts engaging the decision-making process. After selecting the suitable aggregation function, the operator OWA can be used for the experts' aggregation regarding the knowledge management capability. As equation (6), we put the experts unit evaluations in a descending order and the general evaluation of the organization is computed as follows:

In which Bj, is the jth big component among Uis.

(6) $$U = max_j\{Q(j) \wedge B_j\}$$

After these steps, knowledge management capability of the organization is determined in the form of the Si seven-criterion scale which indicates the possible success rate of the knowledge management in the organization. According to the organizational senior managers and experts, when the current state is desirable, the next decision may be the initiation of knowledge management implementation, however, when the current state is undesirable, the decision of improving and promoting the knowledge management capability will be made which requires the use of a suitable methodology to study and analyze the strengths and weaknesses discussed in the next section.

After determining the capability of knowledge management in the organization in the format of a linguistic variable, the obtained criteria will be evaluated by equations which will be expressed in the following. So, the weaknesses can be identified and suitable solutions can be provided to promote the present situation. Before defining the mentioned equations, it is necessary to explain some of the concepts and operational-theoretical rules of the fuzzy sets. Equations (7) and (8) show the membership function of triangular fuzzy numbers and algebraic operations of triangular fuzzy numbers, respectively.

$$\mu\tilde{A}(X) = \begin{cases} (X-L)/(M-L) & L \le X \le M \\ (U-X)/(U-M) & M \le X \le U \\ \cdot & Otherwies \end{cases}$$

(7)

(L1, M1, U1) + (L2, M2, U2) = (L1+L2, M1+M2, U1+U2)
(L1, M1, U1) × (L2, M2, U2) ≈ (L1L2, M1M2, U1U2)
α ×(L, M, U) = (α L, α M, α U)
(8)

Table 2 shows the triangular fuzzy numbers corresponding to the Chang and Wang' s seven language variables.

Table 2. Triangular fuzzy numbers corresponding to the scale elements corresponding triangular fuzzy numbers Definition

Definition	corresponding triangular fuzzy numbers
OU(Outstanding)	(1.0 ,1.0 ,0.9)
VH(Very High)	(1.0 ,0.9 ,0.7)
H(High)	(0.9 ,0.7 ,0.5)
M (Mediom)	(0.7 ,0.5 ,0.3)
L (Low)	(0.5 ,0.3 ,0.1)
VL (Very Low)	(0.3 ,0.1 ,0.0)
N (None)	(0.0 ,.00 ,0.1)

According to Table 2, the experts' ideas about the significance degree of criteria can be converted to triangular fuzzy numbers using equation (9).

(9) $I_{jK} = (L\ I_{jK}, M\ I_{jK}, U\ I_{jK})$

In this equation, Ijk is the triangular fuzzy number corresponding to the significance coefficient of the jth criteria based on the kth expert s idea. Since the experts' ideas are different in terms of experience, understanding or knowledge, in equation (10), the average method is used to integrate the experts' ideas.

(10) $\tilde{\omega}j = \frac{1}{r}\left[\sum_{k=1}^{r} I_{jk}\right]$

Show the significance coefficient of the jth criterion. (ω̃j =(L ω̃j ,M ω̃j ,U in which ω̃j. Then, equation (11) is used to de-fuzz the triangular fuzzy number wi in which wi is the definite significance coefficient of the jth criterion

(11) $\text{BNP wj} = \frac{[(u\tilde{\omega}j - L\tilde{\omega}j) + (M\tilde{\omega}j - L\tilde{\omega}j)]}{3} + L\tilde{\omega}j$

Now, using the equation (12), the experts' ideas about the satisfaction rate of the criteria in the organization are converted to the triangular fuzzy numbers in which the triangular fuzzy number is corresponding with the satisfaction rate of the jth criterion of the kth expert.

(12) $\pi jk = (L\pi jk\ ,\ M\pi jk,\ U\pi jk)$

Then, the experts ideas are integrated using the equation (13) in which the fuzzy performance rate of the jth criterion is shown.

(13) $$\tilde{\rho_j} = \frac{1}{r}\left[\sum_{k=1}^{r} \pi jk\right]$$

$$\tilde{\rho_j} = (L_{\rho j}, M_{\rho j}, U_{\rho j})$$

The value of (BNP) for the fuzzy number is calculated through equation (14) in which Pi is the definite satisfaction rate of the jth criterion in the organization. In fact, equation (14) de-fuzzes.

(14)
$$BNP_{pj} = \frac{[(U\rho_j - Lt_j) + (M\rho_j - L\rho_j)]}{3} + Lt_j$$

Multiplying the significance coefficient of the jth criterion in the satisfaction rate of the jth criterion (Pj*Wj), the expected numerical value of the jth criterion

in an organization is calculated and the obtained results are normalized. Finally, comparing the values of these seven criteria, the strengths and weaknesses of the organization will be identified.

The weight significance (Wj) is the result of the knowledge management of vector { n*1} which shows the true significance of each of the knowledge management results. The weight significance is calculated using the equation (15).

(15) $W_j^* = dj \times Wj$

dj is the distance between the current state and the desirable state of each of the knowledge management results in different sections which is determined by verbal judgments. Since the current and desirable state are fuzzy numbers, the fuzzy distance between these two numbers should be calculated. To do so, Euclidean method is used. Having two fuzzy sets of A= (a1, a2, a3) and U= (u1, u2, u3), the Euclidean distance is calculated by equation (16).

(16)

$$d_{kj}(\tilde{A}, \tilde{U}) = \sqrt{\frac{1}{3}\left[(a1-u1)^2 + (a2-u2)^2 + (a3-u3)^2\right]}$$

Therefore, the distance between the current state and desirable state of the jth knowledge management criterion based on the n*1 expert is calculated by equation (17).

(17) $$d_j = \frac{\sum_{k=1}^{r} d_{kj}}{r}$$

Conclusions

Every organization needs knowledge to survive and every moment, the human needs are changing. So, each organization needs organizational knowledge management. Since 1990s, several studies have been carried out on knowledge management. Most studies were quantitatively carried out, in knowledge management area, however, qualitative studies are considered as one of the most suitable methods. Regarding the novelty of knowledge management as one of the managerial tools in Iranian organizations from one hand, and the existence of differences in some of the organizations in comparison with their foreign counterparts on the other hand, the qualitative method will be effective in better recognition of different dimensions of this managerial tool. Some of the scholars in the area of qualitative method believe that the review of the related literature should not be studied before the interviews, in order to prevent the subjective orientation in the study. The researchers of the present study, however, provided the primary conceptual framework of the study by reviewing the related literature. In this study, the knowledge management capability of Sanam Company was evaluated by using Gold et al (2001) and Chang and Wang (2009) models of knowledge management and the concept of Yuger and Lotfizadeh fuzzy numbers. Finally, in this paper a method for Evaluation of Knowledge Management Performance using a Fuzzy-Combined Decision Method has been developed.

Resources

[1] A.H. Gold, A. Malhotra, A.H. Segars, (2001). Knowledge management: An organizational capabilities perspective Journal of Management Information Systems, pp. 185-214.

[2] Barsky, N. and Marchant, G. (2000). “The most valuable resource: measuring and managing intellectual capital, Strategic Finance Magazine, Vol. 81 No. 8, pp. 58-62.

[3] Bassi, L., & Van Buren, M. (1999). “Valuing investments in intellectual capital”. International Journal of Technology Management, 18(5), pp. 414 – 432.

[4] Beijerse, U.R.P. (2000). “Knowledge management in small and medium sized companies: Knowledge management for entrepreneurs”. Journal of Knowledge Management, Vol.4 No.2 pp. 162 – 179.

[5] Bontis, N. (1999) ‘ Managing an organizational learning system by aligning stocks and flows of knowledge: An empirical examination of intellectual capital, knowledge management and business performance’ , Ph.D. Dissertation, London, Canada: Ivey Business School – University of Western Ontario.

[6] Bontis, N. (1995) ‘ Organizational learning and leadership: a literature review of two fields’ , Published Proceedings of ASAC ‘95, Windsor, Canada.

[7] Paquette, S. (2006) “Customer knowledge management” available at http://www.fis.utoronto.ca/phd/paquette/Documents/paquette%20%20 customer%20knowledge%20management.pdf

[8] Gibbert, M., Leibold, M., Probst, G. (2002) “Five styles of customer knowledge management, and how smart companies use them to create value” European Management Journal. 20(5), pp. 459-469.

[9] Bukowitz, W., & Petrash, G. (1997). “Visualising, Measuring and managing knowledge”, Research Technology Management, Vol. 40, pp. 24 – 31.

[10] Bukowitz, W.R., & Williams, R.L. (2000). The knowledge management fieldbook Revised edition. London: Prentice-Hall.

[11] Carneiro, A. (2001), ‘‘The role of intelligent resources in knowledge management’’, Journal of Knowledge Management, Vol. 5 No. 4, pp. 358-67.

[12] Correia Ann.M, Saramento anabela, (2003), "knowledge management: Key competences and Skills for Innovation and competitiveness, the technology and HRM conference on the dual interaction between technology and Human resource", France.2003, 19-21 may.

[13] Edvinsson, L., & Malone, M.S. (1997). Intellectual capital. New York, NY: HarperCollins.

[14] Gooijer,F.D,.(2000).,Designing a knowledge management performance -framework, journal of Knowledge Management, Vol.4 No.4, pp.303-310.

[15] Greg L. Stewart, Kenneth G. Brown, (1386). Human Resource Management: Linking Strategy to Practice, Wiley, Business & Economics - 656 pages.

[16] Abdolshah, M., Moghimi, M., Khatibi, S.A.M., (2018). Investigating Competitive Advantage in Banking Industry Based on Porter's Generic Strategies: IRANs Newly-Established Private

Banks, International Journal of Applied Management Sciences and Engineering, Volume 5, Issue 1, Article 4.

[17] http://www.investmentmap.org/data_availability.aspx

[18] Acara, M.F., Tarim, M., Zaim, H., Zaim, S., Delene, D., (2017), Knowledge management and ERP: Complementary or contradictory?, International Journal of Information Management, Volume 37, Issue 6, Pages 703-712 https://doi.org/10.1016/j.ijinfomgt.2017.05.007

[19] Hung, Y.C., Huang, S.M., Lin, Q.P., & Tsai, M.L. (2005). "Critical factors in adopting a knowledge management system for the pharmaceutical industry". Industrial Management & Data Systems, Vol.105 No.2, pp. 164 – 183.

[20] Jason F.Cohen, J.F., Olsen, K. (2015). Knowledge management capabilities and firm performance: A test of universalistic, contingency and complementarity perspectives, Expert Systems with Applications, Volume 42, Issue 3, 15 February 2015, Pages 1178-1188. https://doi.org/10.1016/j.eswa.2014.09.002

[21] Martinze,M.N. (1998).The collective power of employee knowledge,HR Majazine,Vol.43 No.2,pp.88-94.

[22] Mir Hamid RezaTorabi, M.H.R., Kyani, A.K., Falakini, H. (2016). An Investigation of the Impact of Knowledge Management on Human Resource Performance in Management of Keshavarzi Bank Branches in Tehran, Procedia - Social and Behavioral Sciences, Volume 230, 12 September 2016, Pages 471-481. https://doi.org/10.1016/j.sbspro.2016.09.059

[23] Moffett, S., R. McAdam and S. Parkinson (2003). An Empirical Analysis of Knowledge Management Applications. Journal of Knowledge Management, Vol 7 No.3, pp 6-26.

[24] Muthuveloo R., Shanmugam, N. Teoh, A.P. (2017). The impact of tacit knowledge management on organizational performance: Evidence from Malaysia Asia Pacific Management Review, Volume 22, Issue 4, Pages 192-201https://doi.org/10.1016/j.apmrv.2017.07.010

[25] Nonaka & Takeuchi (2008). "The Knowledge-Creating Company" Oxford University Press

[26] Nonaka, I, (2005).The knowledge-creating company, in:HBR: 96-104

[27] Nonaka, I. (2006) 'A Dynamic Theory of Organizational Knowledge Creation', Organization science, Vol 5,No. 1, pp. 14-37

[28] Nonaka, I. and Takeuchi, H. (2008) The knowledge, New York: Oxford University Press.

[29] Nonaka, I., & Takeuchi, H. (2004).The knowledge creating company. Oxford: Oxford University Press

[30] Nonaka, I., Takeuchi, H. (1995). The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University.

[31] Nonaka, I., Takeuchi, H., & Umemoto, K. (2007) 'A theory of organizational knowledge creation', International Journal of Technology Management, Vol. 11, No. 8/7, pp. 833-922

[32] Pearson, T. (1999). Measurements and the knowledge revolution, Quality Progress, Vol.32. No 9, pp. 31 – 37.

[33] Perez Ernest, (1999), "Knowledge management in the library", database magazine. Vol.22, No.2: PP.75-78.

[34] Powell, W. W. (1998). "Learning from aggregation: Knowledge and networks in the biotechnology and pharmaceutical industries". California Management Review (40:3), pp. 228–240.

[35] Plessis, Marina du. (2007), Knowledge management: what makes complex implementations successful? , Journal of Knowledge Management, Vol 11 No.2, pp 91-101.

[36] Sveiby, K.E., (1997). The New Organizational Wealth: Managing and Measuring KnowledgeBased Assets , San Francisco, BerrettKoehler.

[37] Chang, T.H., Wang, T.C., (2009). Using the fuzzy multi-criteria decision making approach for measuring the possibility of successful knowledge management, Information Sciences, Volume 179, Issue 4, 1 February 2009, Pages 355-370 https://doi.org/10.1016/j.ins.2008.10.012

[38] Yager, R. R. (1993). Fuzzy screening systems. In R. Lowen & M. Roubens (Eds.), Fuzzy logic: State of the art Dordrecht: Kluwer Academic Publishers, 251–261.

[39] Reich, B.H., Gemino, A., Sauer, C, (2014). How knowledge management impacts performance in projects: An empirical study , International Journal of Project Management, Volume 32, Issue 4, May 2014, Pages 590-602 https://doi.org/10.1016/j.ijproman.2013.09.004

[40] Costa, A., Soares, A.L., Sousa, J.P. (2016). Information, knowledge and aggregation management in the internationalisation of SMEs: A systematic literature review, International Journal of Information Management, Volume 36, Issue 4, August 2016, Pages 557-569. https://doi.org/10.1016/j.ijinfomgt.2016.03.007

[41] Shi, Ch., (2016), Knowledge Based on Reliable Evidence, Epistemology, Knowledge and the Impact of Interaction pp 237-249

[42] Mohammadi, K., S. Shamshirband, A. S. Danesh, M. S. Abdullah and M. Zamani (2016). "Temperature-based estimation of global solar radiation using soft computing methodologies." Theoretical and applied climatology 125(1-2): 101-112.

[43] Zadeh, L. A. (1996). On fuzzy algorithms. Fuzzy Sets, Fuzzy Logic, And Fuzzy Systems: Selected Papers by Lotfi A Zadeh, World Scientific: 127-147.