Ranking of key factors to success in knowledge management implementation by using Fuzzy Analytical Hierarchy Process: Empirical Observation in Iran

Reza Abedi
Department of Management and Accounting, Aliabad Katoul branch,
Islamic Azad University, Aliabad Katoul, Iran
Email: abedgolestan.co@gmail.com
Somayeh Nadaf
Department of Management and Accounting, Aliabad Katoul branch,
Islamic Azad University, Aliabad Katoul, Iran
Email: abedgolestan.co@gmail.com

Abstract: The aim of this paper is key factors to success in knowledge management implementation by using Fuzzy Analytical Hierarchy Process (FAHP) method has been ranked in terms of importance as one of the multi criteria decision making approaches. In this way at the first different experts and elites of main criteria are classified and ranked by interview in three general groups of open culture of organization, employee involvement, and systems thinking. In the next phase, on the basis of literature review of various sub-criteria which had placed in the subset of each main criterion, they were studied and ranked. The results of research show that between the main criteria, systems thinking and between the sub-criteria, staff easy access to expert and benefiting from their knowledge have the most importance.

Key words: Knowledge Management, Success, Fuzzy Analytical Hierarchy Process, Ranking.

1. Introduction.

In recent years, Knowledge Management (KM) has become a significant issue both in the relevant literature and in practice (Nonaka and Takeuchi, 1995). Companies have strived to manage knowledge more efficiently, the primary aim of this being the improvement of performance by gaining a competitive advantage (Davenport and Prusak, 1998). Knowledge is referred to as the sum of information facts, procedures, concepts, interpretations, ideas, observations and/or judgments that human beings can process and store in their minds (Skyrme, 2000). However, this definition encompasses not only the knowledge contained in individuals′ minds, but also the information existing inside single and networked organizations (Cricelli and Grimaldi, 2008). Thus, one of the most relevant issues that organizations have to cope with is that of setting up a structure for systematizing information and communication and making knowledge storable and shareable effectively (Tiwana, 2000). Today the competition between companies of a global scale requires that knowledge be managed efficiently so as to get the competitive advantage necessary to succeed (Pogarcic et al, 2012).

Most enterprises have acknowledged that codifying, sharing and applying this knowledge to their environment will benefit the organization (Wiig, 1997). Since the development of firms‘intangible assets is strongly linked to their competitive strategy, and what’s more, the adopted strategy is a direct consequence of managerial decisions related to external contexts, managers‘perceptions should shape knowledge resources by exploiting intangible assets in the organization (Chen and Huang, 2012). The task of selecting the most appropriate KMS seems to be not a very easy one. Most companies have failed in their KM implementation plans when trying to find a business process to adopt for it (Cricelli and Grimaldi, 2010). Thus, it is of the utmost importance to delineate all the necessary business processes as the first step by selecting those KMS criteria which could lead to the successful implementation of the system. For this purpose, strategic considerations by managers have proven to be of the utmost importance in choosing a KMS. In fact, if the top management is aware of the context in which the KMS will be implemented they must be in thorough agreement with the achievement of the mission and goals established by the business strategies (Hendriks, 1999). Most of the literature to date has addressed these questions by evaluating only a few KMSs (Li et al, 2011). The research work presented here aims to fill this gap by providing a comprehensive study of the most widespread KMSs in Iran's companies.

2. Method.

The approach used in this paper for prioritization of factors affecting the successful implementation of knowledge management is based on a combination of multi-criteria decision making and fuzzy theory. Since there is no value for qualitative criteria their assessment is based on the linguistic values of decision makers.

Weighted values used in this paper for weights of criteria and sub criteria (equivalent with fuzzy ones) are as table 1 below.

Decision making is very difficult for vague and uncertain environment. This vagueness and uncertainty can be handled by using fuzzy set theory, which was proposed by Zadeh (1965). A fuzzy set is defined by a membership function that maps elements to degrees of membership within a certain interval, which is usually [0, 1]. If the value assigned is zero, the element does not belong to the set (it has no membership). If the value assigned is one, the element belongs completely to the set (it has total membership). Finally, if the value lies within the interval, the element has a certain degree of membership. In particular, to tackle the ambiguities involved in the process of linguistic estimation, it is a beneficial way to convert these linguistic terms into fuzzy numbers. In practice, linguistic values can be represented by fuzzy numbers, and the TFN is commonly used.

Table1. fuzzy values of linguistic variables to prioritize factors in relation to each other

Linguistic variables	Positive three-dimensional fuzzy numbers	Positive bilateral three-dimensional fuzzy numbers
Complete and utter Priority or importance	$(\frac{5}{2},3,\frac{7}{2})$	$(\frac{2}{7},\frac{1}{3},\frac{2}{5})$
Much stronger preference or importance	$(2,\frac{5}{2},3)$	$(\frac{1}{3},\frac{2}{5},\frac{1}{2})$
Stronger Priority or importance	$(\frac{3}{2},2,\frac{5}{2})$	$(\frac{2}{5},\frac{1}{2},\frac{2}{3})$
Low priority or importance	$(1,\frac{3}{2},2)$	$(\frac{1}{2},\frac{2}{3},1)$
Almost Equal Priority or importance	$(\frac{1}{2},1,\frac{3}{2})$	$(\frac{2}{3},1,2)$
Exactly equal Priority or importance	(1,1,1)	(1,1,1)

2.1. Fuzzy Analytic Hierarchy Process.

Analytic Hierarchy Process (AHP) is a multi-criteria decision making tool first proposed by Saaty (14). Since it was introduced, AHP have been one of the most useful multi-criteria decisions making tool available to decision makers and researchers. Although AHP is sophisticated in recording knowledge, the conventional AHP is unable to veritably reflect the way human thinks (15).although it uses a precise yardstick to compare the opinions of decision makers, the conventional AHP becomes confusing. AHP is criticized for using lopsided judgment scales and its inability to properly consider the inherent uncertainty and carelessness of pair comparison (16).

To overcome these deficiencies, FAHP is developed to resolve the expanded hierarchical issues. Decision makers found out that distances judgment is more persuasive than rigid judgment. That's because the individual often cannot explicitly express his preferences regarding the fuzzy nature of comparison process (15).

Since the relative importance specified by AHP decision makers is oral, it is vague and imprecise. Decision makers often prefer to employ oral presentation rather than numerical value. Because due to the nature of pairwise comparisons, they cannot explicitly express their opinions about priorities. In such condition the best solution is to make decisions on the basis of multiple conditions and goals to achieve a relatively desirable level of achievement. These issues have caused the nature of decision making to be full of complexities and ambiguities in the most minor or most major cases. Consequently, most decision is made a fuzzy environment. Therefore, considering that the fuzzy logic method is proposed for decision making in uncertain and ambiguous situation, using this method can reduce an ambiguities and increase the effectiveness of decisions made.

3. Experimental result.

In this stage, after completing the questionnaires which had the common FAHP questionnaire format and was designed based on hierarchy, by consensus decision makers express their preferences in fuzzy way by paired comparison of each levels elements to higher level elements, which the consensus opinion is given in pairwise comparison matrices.

Table2. Matrix of main criteria Pairwise comparisons				
Criteria Priority (I)	**I1**	**I2**	**I3**	**W_i**
I1	(1,1,1)	$(\frac{1}{2},\frac{2}{3},1)$	$(\frac{2}{5},\frac{1}{2},\frac{2}{3})$	0.1427
I2	$(1,\frac{3}{2},2)$	(1,1,1)	$(\frac{1}{2},\frac{2}{3},1)$	0.2984
I3	$(\frac{3}{2},2,\frac{5}{2})$	$(1,\frac{3}{2},2)$	(1,1,1)	0.3866

$$\sum_{j=1}^{3} M_{g_1}^{j} = (1,1,1) \oplus (\frac{1}{2},1,\frac{3}{2}) \oplus (\frac{1}{2},\frac{2}{3},1) \oplus (1,\frac{3}{2},2) \oplus (\frac{2}{5},\frac{1}{2},\frac{2}{3}) =$$
$$= (3.4000,4.6667,6.1667)$$

$$\sum_{j=1}^{3} M_{g_3}^{j} = (1,\frac{3}{2},2) \oplus (2,\frac{5}{2},3) \oplus (1,1,1) \oplus (1,\frac{3}{2},2) \oplus (\frac{1}{2},\frac{2}{3},1) =$$
$$= (5.5000,7.1667,9.0000)$$

$$\sum_{j=1}^{3} M_{g_5}^{j} = (\frac{3}{2},2,\frac{5}{2}) \oplus (\frac{3}{2},2,\frac{5}{2}) \oplus (1,\frac{3}{2},2) \oplus (2,\frac{5}{2},3) \oplus (1,1,1) =$$
$$= (7.0000,9.0000,11.0000)$$

$$\sum_{j=1}^{3}\sum_{j=1}^{3} M_{g_i}^{j} = (3.400,4.667,6.167) \oplus (5.500,7.167,9.000) \oplus (7.000,9.000,11.000) =$$
$$= (22.1333,28.6333,36.8333)$$

$$\left(\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right)^{-1} = (\frac{1}{36.8333},\frac{1}{28.6333},\frac{1}{22.1333}) = (0.0271,0.0349,0.0452)$$

$$S_1 = (3.4000,4.6667,6.1667) \otimes (0.0271,0.0349,0.0452) =$$
$$= (0.0923,0.1630,0.2786)$$

$$S_2 = (5.5000,7.1667,9.0600) \otimes (0.0271,0.0349,0.0452) =$$
$$= (0.1493,0.2503,0.4066)$$

$$S_3 = (7.0000,9.0000,11.0000) \otimes (0.0271,0.0349,0.0452) =$$
$$= (0.1900,0.3143,0.4970)$$

$$V(S_1 \geq S_2) = 1.000 \quad , V(S_1 \geq S_3) = 0.597 \quad , V(S_1 \geq S_4) = 1.000$$
$$V(S_1 \geq S_5) = 0.369$$

$$V(S_3 \geq S_1) = 1.000 \quad , V(S_3 \geq S_2) = 1.000 \quad , V(S_3 \geq S_4) = 1.000$$
$$V(S_3 \geq S_5) = 0.772$$

$$V(S_5 \geq S_1) = 1.000 \quad , V(S_5 \geq S_2) = 1.000 \quad , V(S_5 \geq S_3) = 1.000$$
$$V(S_5 \geq S_4) = 1.000$$

$$V(S_1 \geq S_2, S_3, S_4, S_5) = \min(V(S_1 \geq S_2), V(S_1 \geq S_3)$$
$$V(S_1 \geq S_4), V(S_1 \geq S_5)) = 0.369$$

$V(S_3 \geq S_1, S_2, S_4, S_5) = \min(V(S_3 \geq S_1), V(S_3 \geq S_2)$
$V(S_3 \geq S_4), V(S_3 \geq S_5)) = 0.772$

$V(S_5 \geq S_1, S_2, S_3, S_4) = \min(V(S_5 \geq S_1), V(S_5 \geq S_2), V(S_5 \geq S_3), V(S_5 \geq S_4)) = 1.000$

$W = (w_1, w_2, w_3)^T = (0.369, 0.772, 1.000)^T$

$W = (w_1, w_2, w_3) = (0.143, 0.298, 0.387)$

Table3. Matrix of open culture of organization sub-criteria Pairwise comparisons

I1. Open culture of organization	**I1-1**	**I1-2**	**I1-3**	**I1-4**	**w_j**
I1-1	(1,1,1)	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{3}{2}, 2, \frac{5}{2})$	$(1, \frac{3}{2}, 2)$	0.3427
I1-2	$(1, \frac{3}{2}, 2)$	(1,1,1)	$(\frac{3}{2}, 2, \frac{5}{2})$	$(\frac{3}{2}, 2, \frac{5}{2})$	0.4505
I1-3	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	(1,1,1)	$(\frac{1}{2}, \frac{2}{3}, 1)$	0.0250
I1-4	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	$(1, \frac{3}{2}, 2)$	(1,1,1)	0.1817

Table4. Matrix of employee involvement sub-criteria Pairwise comparisons

I2. Employee involvement	**I2-1**	**I2-2**	**I2-3**	**I2-4**	**w_j**
I2-1	(1,1,1)	$(\frac{1}{3}, \frac{2}{5}, \frac{1}{2})$	$(1, \frac{3}{2}, 2)$	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	0.1237
I2-2	$(2, \frac{5}{2}, 3)$	(1,1,1)	$(1, \frac{3}{2}, 2)$	$(1, \frac{3}{2}, 2)$	0.4407
I2-3	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{1}{2}, \frac{2}{3}, 1)$	(1,1,1)	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	0.0603
I2-4	$(\frac{3}{2}, 2, \frac{5}{2})$	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{3}{2}, 2, \frac{5}{2})$	(1,1,1)	0.3752

Table5. Matrix of System thinking sub-criteria Pairwise comparisons

I3. Systems thinking	**I3-1**	**I3-2**	**I3-3**	**I3-4**	**I3-5**	**w_j**
I3-1	(1,1,1)	$(\frac{1}{2}, 1, \frac{3}{2})$	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{3}{2}, 2, \frac{5}{2})$	$(\frac{3}{2}, 2, \frac{5}{2})$	0.2465
I3-2	$(\frac{2}{3}, 1, 2)$	(1,1,1)	$(\frac{1}{2}, \frac{2}{3}, 1)$	$(\frac{3}{2}, 2, \frac{5}{2})$	$(\frac{3}{2}, 2, \frac{5}{2})$	0.2489
I3-3	$(1, \frac{3}{2}, 2)$	$(1, \frac{3}{2}, 2)$	(1,1,1)	$(2, \frac{5}{2}, 3)$	$(\frac{1}{2}, 1, \frac{3}{2})$	0.2768
I3-4	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	$(\frac{2}{5}, \frac{1}{2}, \frac{2}{3})$	$(\frac{1}{3}, \frac{2}{5}, \frac{1}{2})$	(1,1,1)	$(\frac{3}{2}, 2, \frac{5}{2})$	0.1283

I3-5	$(\frac{2}{5},\frac{1}{2},\frac{2}{3})$	$(\frac{2}{5},\frac{1}{2},\frac{2}{3})$	$(\frac{2}{3},1,2)$	$(\frac{2}{5},\frac{1}{2},\frac{2}{3})$	(1,1,1)	0.0996

Table 6. Rank on basis of FAHP

Criteria	Weight of Criteria	Sub-criteria	Weight of Sub-criteria	Final Weight	Rank
I1. Open culture of organization	7	I1-1	0.3427	0.0489	8
		I1-2	0.4505	0.0642	6
		I1-3	0.0250	0.0035	12
		I1-4	0.1817	0.0259	14
I2. Employee involvement	4	I2-1	0.1237	0.0369	10
		I2-2	0.4407	0.1315	1
		I2-3	0.0603	0.0179	11
		I2-4	0.3752	0.1119	2
I3. Systems thinking	6	I3-1	0.2465	0.0952	5
		I3-2	0.2489	0.0962	4
		I3-3	0.2768	0.1070	3
		I3-4	0.1283	0.0496	7
		I3-5	0.0996	0.0385	9

4. Conclusion.

The aim of this paper was key factors to success in knowledge management implementation by using Fuzzy Analytical Hierarchy Process (FAHP) method has been ranked in terms of importance as one of the multi criteria decision making approaches.

Effective measures includes 12 criteria which were prioritized in three main groups based on the importance of weight and they were as systems thinking (0.3866), employee involvement (0.2984), open corporate culture (0.1427) and other minor factors (according to the profile (7)) so that the necessary measures be provided by officers and managers.

It should be noted that in primary and secondary factors prioritization, that part of objective view has first priority which is not evident in the ranking. However, we note that FAHP method is development of priorities based on consensus of experts and professionals and its result is the outcome of experts' different opinions in a ranked and specified domain. Because of ambiguity and uncertainty of human judgment in multi criteria decision making definite data expression is not proper. Fuzzy situation is a kind of decision making environment in which the collected data are vague or closed. Anyway, this study can be developed in different directions.

References:

1. Chen YY, Huang HL (2012) Knowledge Management Fit and its Implications for Business Performance: A Profile Deviation Analysis. Knowledge-based Systems. 27: 262-270.

2. Cricelli L, Grimaldi M (2008) A Dynamic View of Knowledge and Information: a Stock and Flow Based Methodology. International Journal of Management and Decision Making. 9 (6): 686-698.

3. Cricelli L, Grimaldi M (2010) Knowledge Based Inter Organizational Collaborations. Journal of Knowledge Management. 14 (3): 348-358.

4. Davenport T, Prusak L (1998) Working Knowledge: How Organizations Manage What They Know. Cambridge, MA: Harvard Business School Press. 224 p.

5. Hendriks P H (1999) The Organisational Impact of Knowledge Based Systems: a Knowledge Perspective. Knowledge based Systems. 12: 159-169.

6. Li BM, Xie SQ, Xu X (2011) Recent Development of Knowledge Based Systems, Methods and Tools for One of a Kind Production. Knowledge based Systems. 24: 1108-1119.

7. Management: Classic and Contemporary Works. Boston, MA: MIT Press. pp. 61-84.

8. Nonaka I, Takeuchi H (1995) The Knowledge Creating Company. New York: Oxford University Press. 298 p.

9. Pogarcic I, Krnjak D, Ozanic D (2012) Business Benefits from the Virtualization of an ICT Infrastructure. International Journal of Engineering Business Management. 4(42): 2012.

10. Skyrme DJ (2000) Developing a Knowledge Strategy: From Management to Leadership. In: Morey D, Maubury M, Thuraisingham B editors. Knowledge

11. Tiwana A (2000) The Knowledge Management Toolkit: Practical Techniques for Building a Knowledge Management System. New Jersey: Prentice-Hall PTR. 416 p.

12. Wiig K (1997) Knowledge Management: An Introduction and Perspective. Journal of Knowledge Management. 1: 6-14.