PRESENTATION OF A FUZZY SYSTEM MODEL IN ORDER TO ASSESS THE BENEFITS OF KNOWLEDGE MANAGEMENT IN ISFAHAN UNIVERSITY OF MEDICAL SCIENCES

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Abstract

The main objective of this study is to present a fuzzy system model to evaluate the benefits of knowledge management in the Isfahan University of Medical Sciences. This study is an applied research and a survey research in terms of method. Statistical population consists of members of knowledge management and academic engineering committee of Isfahan University of Medical Sciences (n=45) and these individuals were selected using stratified random sampling method. Data collection method in this study is library and non-library method and some instruments such as questionnaire and documents are used for purpose of data collection. In this study, some benefits caused by knowledge management deployment within organizations are identified and these benefits are prioritized and weighted especially in Isfahan University of Medical Sciences. Then, using the methods provided in fuzzy logic, fuzzy inference rules were provided for evaluation of the amount of benefits caused by knowledge management deployment within the organization. To design the first questionnaire, 5-point Likert scale was used and the second questionnaire was designed using fuzzy logic and both instruments showed high reliability. To test reliability of the questionnaire, Cronbach's Alpha was used. In this study, fuzzy model is provided for evaluation of the benefits caused by knowledge management deployment.
Key words: knowledge management, benefits caused by knowledge management, fuzzy model presentation, knowledge management benefits, fuzzy inference system, benefits.

I.   INTRODUCTION

The main features of the current time economics could be increased competition in business and leaner organizations, convergence of products and services and wide range development of technology (Davenport and Prosac, 1998). Knowledge management is considered as a source of competitive advantage, which could finally cause organizational success. Many organizations have done big investments on knowledge management to gain knowledge and intellectual capitals. However, the results obtained from evaluations show that a few number of organizations have been successful in this field. Many scholars have claimed that lack of

understanding goals of knowledge management and inability to measure the value and function of knowledge assets and lack of some criteria for measurement of relevant successes of knowledge management deployment could be the most important barriers to knowledge management (Choy et al, 2006).

Without measurable success, it is rarely possible that managers could be informed that where they have acted well and where they have shown no adequate function. Hence, they would not be able to have conscious judgment about what they should not do and what they should change (Bose, 2004).

The main problem of this study at the first step is to identify the benefits caused by knowledge management deployment within the organizations and in the next step, prioritization of benefits identified for selected organization and ultimately, providing a fuzzy model to evaluate the benefits gained within the organization.

II.   METHODOLOGY

The method applied in this study is applied method in terms of purpose and is a survey method in terms of type of the data.

The desired population in this study consists of active experts and managers in field of knowledge management in the Isfahan University of Medical Sciences placed in one of the following departments:

- Management Committee members of Isfahan University of Medical Sciences with supervision on the way of knowledge management deployment within the organization
- The academic engineers of Isfahan University of Medical Sciences with the responsibility of promoting the knowledge management and the relevant mechanisms in relevant departments

In this study, as statistical population consists of members of knowledge committee of Isfahan University of medical Sciences with the responsibility of planning and knowledge management strategy within the organization and the academic engineers of the university responsible for implementing knowledge management within organizational departments, all individuals of statistical population are considered using census method to select the sample and to distribute the first and second questionnaires. It should be mentioned that the statistical sample is considered same for the first and second questionnaire and consists of all members of knowledge management committee and the academic engineers of the organization to 45 people.

Two questionnaires are designed for this study:

First questionnaire: the questionnaire was designed with the aim of identification of the significance of each benefit of knowledge management based on attitude of academic experts of Isfahan University of medical Sciences. The questionnaire contains 45 items based on 5-point Likert scale and each item evaluates the knowledge management benefits in view of experts in this field. The outputs of this questionnaire are used to design the fuzzy inference rules.

Second questionnaire: the main objective of second questionnaire is evaluation of the current status of each benefit of knowledge management and analysis of the realization of knowledge

management benefits in the Isfahan University of medical Sciences. The overall structure of the questionnaire is similar to the first questionnaire with the difference that this one is fuzzy questionnaire and is designed based on 1-10 point scale.

The points given by the experts to each benefit in the questionnaire show the level of access of organization to the desired benefit and are considered as the input of fuzzy inference system designed in previous step.

At the first, the conceptual framework of the study inferred from the meta-synthesis method was sent to 3 experts of knowledge management to confirm its content validity. After confirmation of content validity of the conceptual framework, as the first and second questionnaires are designed based on conceptual framework of research; the questionnaires had high content validity and it is necessary to confirm their face validity too. To this end, the face validity of the questionnaires was confirmed by 3 experts of knowledge management.
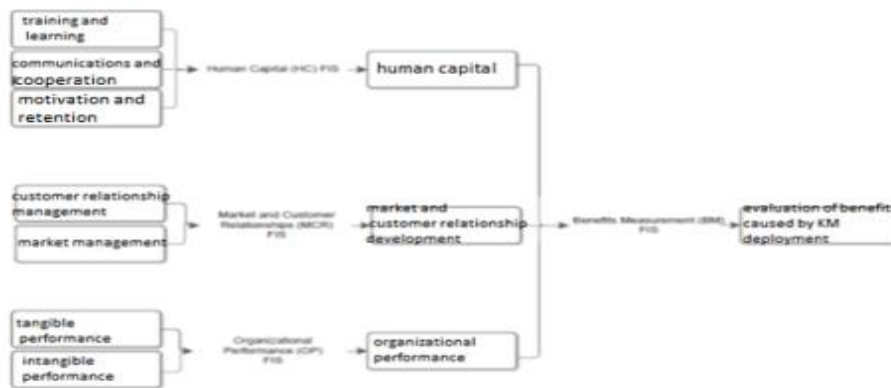
III.   RESULTS

Figure 1: the structure of fuzzy inference system layers

In the architecture provided in figure 1, multilayer structure is considered for the fuzzy inference system. In other words, the outputs of fuzzy layer first layer are used as inputs for the layer 2.

The layer 1 is formed of 3 subsystems of fuzzy inference including HC, MCR and OP, which get the values of 7 benefits as input and the outputs of the 3 said subsystems are used as inputs by the last layer or same final fuzzy inference system related to knowledge management benefit evaluation (BM).

- Fuzzy inference system of human capitals (Sub-FIS) HC:

The FIS includes 3 inputs as follows:
- Training and learning (TL)
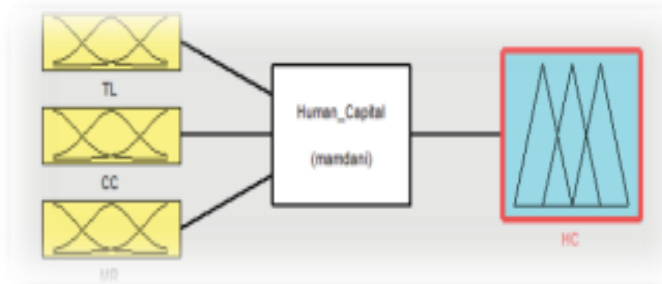- Communication and cooperation (CC)
- Motivation and retention (MR)

Figure 2: fuzzy inference system for human capitals

In figure 2,the yellow graphs are the membership functions of fuzzy sets used as input of fuzzy inference system. The white part shows the inference rules used for inference of system and conversion of input to output. The blue graph shows the output of fuzzy inference system, in which the amount of realization of knowledge management benefits in field of human capitals is illustrated. It should be mentioned that this study has applied MATLAB software 7/14/0/739 to design all fuzzy inference systems and analysis of the outputs of first and second questionnaires.

- Fuzzy inference system for market and customer relationship management MCR (Sub-FIS):

The FIS includes two inputs as follows:
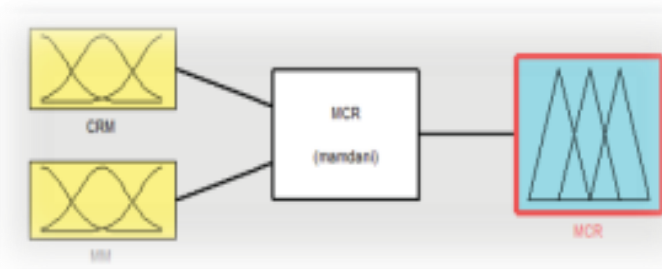- Customer relationship management (CRM)
- Market management (MM)

Figure 3: fuzzy inference system for market and customer relationship management

- Fuzzy inference system for organizational performance OP (Sub-FIS):

The FIS includes 2 inputs as follows:
- Tangible performance (TP)
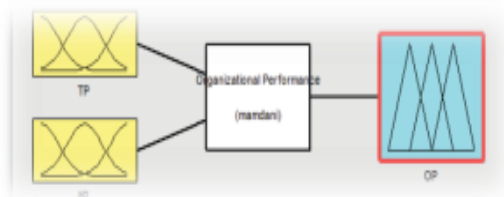- Intangible performance (ItP)

Figure 4: fuzzy inference system for organizational performance

- Fuzzy inference system for the knowledge management benefits BM (FIS):

The FIS includes 3 inputs as follows:
  - Human capital (HC)
  - Market and customer relationship development (MCR)
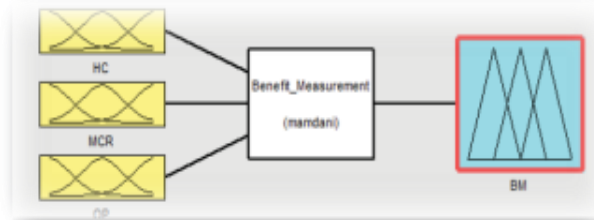 - Organizational performance (OP)

Figure 5: fuzzy inference system for measurement of knowledge management benefits (overall view of final fuzzy system)

IV.   MAKING INFERENCE RULES IN MATLAB SOFTWARE

Per each fuzzy inference subsystem, the above defined rules are entered to the software and then, the rules of final fuzzy inference system using the outputs of 3 subsystems are also created in the software.
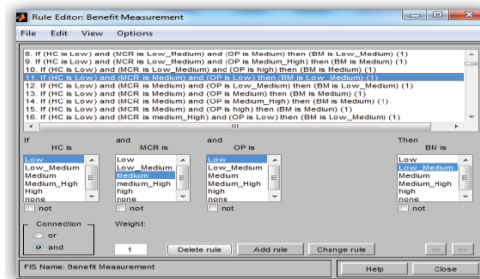

Figure 6: the user interface of making rules

It should be mentioned that for all Sub-FISs designed here, the inference rules are created in the software. One of the useful user interfaces providing by the MATLAB software for the users is the interface of rule screen. The screen could show the overall plan of fuzzy inference process.

Figure 7: a section of fuzzy inference system rules for KM benefit measurement

As it is obvious in figure 7,the final system includes 3 input variables and 1 output variable. 4 diagrams in first row show the hypothesis and the results of rule 1. Each row of the diagrams of

the figure is related to a rule and each column is related to one variable. 3 first columns of said diagrams (yellow diagrams) show the membership functions related to the hypothesis (if) of rules and the column 4 (blue one) shows the membership functions related to the results (then) of rule. Finally, the last diagram in column 4 shows the diagram related to accumulation of weighted decisions. For example, in this figure, the points of inputs (human capital, market and customer relationship development and organizational performance) are respectively selected with 1.39 (low), 3.92 (lower than medium) and 8.49 (high). The system has determined the output based on fuzzy rules defined for the final fuzzy inference system and the number 5.55 (medium) is presented as output or the benefits caused by knowledge management (the figure is synonym for the rule 10 defined for final fuzzy inference system).

3-D analysis diagrams

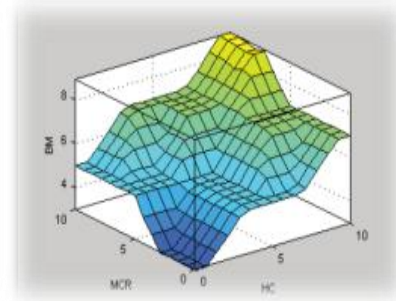- **The 3-D analysis diagram for knowledge management benefits**

Figure 8: diagram of the impact of realization of benefits of HC and MCR on final benefits of KM
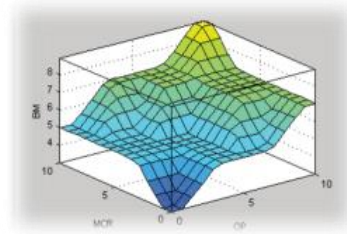

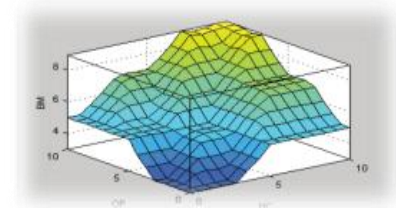Figure 9: diagram of the impact of realization of benefits of OP and MCR on final benefits of KM

Figure 10: diagram of the impact of realization of benefits of HC and OP on final benefits of KM

In diagrams 1 and 3, it could be observed that realization of KM benefits in field of human capital (HC) and realization of KM benefits in field of organizational performance (OP) could

have more effects on realization of final benefits of KM (BM) in Isfahan University of medical Sciences compared to realization of KM resources in field of MCR. Moreover, according to the diagrams, the effect of realization of benefits in fields of HC and OP on deployment of final benefits is relatively same.

Measurement of benefits caused by KM deployment in Isfahan University of Medical Sciences

For this purpose,second questionnaire was designed. The structure of this questionnaire is similar to the first questionnaire with the difference that the 1-10 scale is considered for each item in this questionnaire and the number 10 shows the highest level of realization of the relevant item and number 1 shows highest level.

Measurement of the realization of HC benefit

The major HC benefits include 3 benefits (training and learning, communications and cooperation and motivation and retention). Each benefit includes some measurements. At the first, using diagrams, the points of relevant measurements are compared to each other for each benefit. The point related to each measurement shows the realization level of that measurement in Isfahan University of medical Sciences.
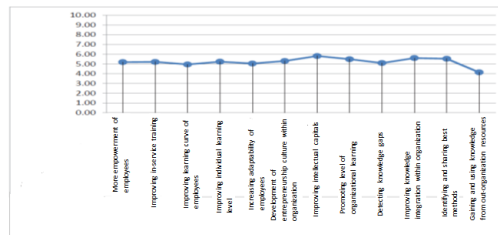

Figure 11: the diagram of comparing realization of TL measurements

According to figure 11, the realization of all measurements of TL in the Isfahan University of Medical Sciences is in medium level. in this field, the measurement of improvement of intellectual capitals has had the highest level and the lowest points are related to the measurement of gaining and using knowledge from out-organization resources. To calculate the point of TL benefit, the average of the points of each measurement is adjusted based on its weight and the point of TL is obtained to 5.24, which shows average level of realization of this benefit.
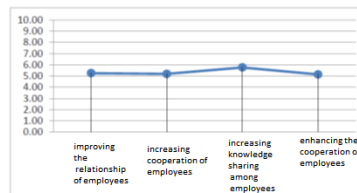

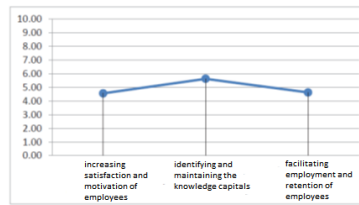Figure 12: comparing the realization level of CC measurements

Figure 13: comparing the realization level of MR measurements

HC (Sub-FIS)			
Inputs			Output
TL	CC	MR	HC
5.24	5.35	5.00	5.43

Table 1: measurement of the realization level of HC benefit

The output of fuzzy inference system for HC is obtained to 5.43. Through comparing this value with the membership function defined for fuzzy inference systems in this study, the realization level of benefits in field of HC could be considered in medium level.

MCR (Sub-FIS)		
Inputs		Output
CRM	MM	MCR
3.28	3.3	3.38

Table 2: measurement of realization of MCR benefit

The output of fuzzy inference system for MCR is obtained to 3.38. Through comparing this value with the membership function defined for fuzzy inference systems in this study, the realization level of benefits in field of HC could be considered lower than medium level.

OP (Sub-FIS)		
Inputs		Output
TP	ItP	OP
4.49	5.09	5.14

Table 3: measurement of realization of OP benefit

The output of fuzzy inference system for OP is obtained to 5.14. Through comparing this value with the membership function defined for fuzzy inference systems in this study, the realization level of benefits in field of HC could be considered in medium level.

Fuzzy inference system for knowledge management benefits (BM-FIS)							
Input 1			Input 2		Input 3		Output
HC			MCR		OP		BM
L	CC	R	CRM	MM	P	tP	M
5.24	5.35	5.00	3.28	3.3	4.49	5.09	5.51
5.43			3.38		5.14		

Table 4: measurement of benefits of KM deployment in Isfahan University of medical Sciences

The numerical value (absolute) of FIS of BM in Isfahan University of medical Sciences is obtained to 5.51. Through comparing the value with membership functions defined in this

study, the status of realization of BM in the Isfahan University of Medical Sciences could be considered in medium level.

V.   DISCUSSION AND CONCLUSION

In this study, through interpreting and combining the findings of previous studies, a framework is provided including 3 layers (measurements, benefits and major benefits) and 45 benefits of knowledge management are placed for the framework. One of the differentiation points of this study from other studies is the comprehensive framework compared to previous studies.

Another difference of this study with previous literature is providing a 3-layer framework of knowledge management benefits.

VI.   SUGGESTIONS

According to the results obtained from this study, for the major benefits of human capital (HC), the level of realization of TL, CC, MR in in medium level and the results obtained from this study showed that the TL benefit, due to its degree of significance, has had lower realization than other human capitals. Hence, achievement of this benefit needs more considerations.

- Among the measurements of TL benefit, the measurements of empowerment of employees, identifying the knowledge gaps within the organization, identifying and sharing the best methods and improving gaining and using knowledge from out-organization resources have been less realized compared to their degree of significance. Hence, the measurements should be considered more seriously for purpose of realization.
- Among the measurements of CC, the measurement of cooperation of employees has lower realization level compared to its significance and hence, it should be seriously considered among CC measurements.
- Among the measurements of CRM, more attention should be paid to realization of measurements of improving customer satisfaction, reducing customer complaints and customer retention.
- Among the measurements of TP, realization of the measurement of enhancing effectiveness should be considered more than other ones.
- Among the measurements of ItP, realization of measurements of improving decision making, reducing problem solving time and reduction of reworking and improvement of business processes should be considered prior to other measurements.

REFERENCES

Anantatmula, V. S. (2007). Linking KM effectiveness attributes to organizational performance. The journal of information and knowledge management systems, 37 (2), 133-149

Anantatmula, V. S. and Kanungo, S. (2006), Structuring the underlying relations among the knowledge management outcomes, Journal of Knowledge Management, 10 (4), 25-42.

APQC (1999), Knowledge Management: Consortium Benchmarking Study (Best-practice Report), American Productivity & Quality Centre (APQC), Houston, TX.

Bevilacqua, M., Ciarapica, F. E., and Giaccheta, G. (2006). A Fuzzy-QFD approach to supplier selection. Journal of Purchasing and Supply Management, 12(1), 14-27.

Binney, D. (2001), The knowledge management spectrum - understanding the KM landscape, Journal of Knowledge Management, 5 (1),33-42.

Chang, S.c., Lee, M.S. (2008), The linkage between knowledge accumulation capability and organizational innovation, Journal of Knowledge Management, 12 (1), 3-20.

Chen, C., and Huang, J. (2007). How organizational climate and structure affect knowledge management-Thesocial interaction perspective. International Journal of information management, 27, 104-118.

Chenail, R. J. and Weiss, A. D., (2007), Utilizing qualitative meta synthesis to conduct systematic reviews of primary healthcare research. Workshop presented at the '1" st Annual Primary Care Research Methods & Statistics Conference, San Antonio, TX.

Chong, CW, Holden, T., Wilhelmij, P. and Schmidt, R.A. (2000). Where does knowledge management add value? Journal ofIntellectual Capital, 1(4),366 380.

Chong, S.C. and Choi, Y.S. (2005), Critical factors of KM implementation success, Journal of Knowledge Management Practice 6 available, at: www.tlainc.comJarticl90.htm (accessed April 2005).

Chourides, P., Longbottom, D., and Murphy, W. (2003). Excellence in knowledge management: an empirical study to identify critical factors and performance measures. Measuring Business Excellence. 7 (2), 29-45.

Choy, C.S., Yew, W, K., and Lin, B. (2006). Criteria for measuring KM performance outcomes in organizations. Industrial Management & Data Systems. 106 (7), 917-936

Chua, AY.K. andGoh, D.H. (2008), Untying the knot of knowledge management measurement: a study of six public service agencies in Singapore, Journal of Information Science, 34 (3), 259-274.

Davenport, T. (1999), Knowledge management and the broader firm: strategy, advantage, and performance, in Liebowitz, J. (Ed.), Knowledge Management Handbook, CRC Press, Boca Raton, FL, 1-11.

Desouza, K. C. (2003), Strategic Contributions of game rooms to knowledge management: some preliminary insights, Information & Management, 41(1), 63-74.

Edvardsson, 1. R. (2009). Is knowledge management losing ground? Developments among Icelandic SMEs. Knowledge Management Research & Practice, 7, 91-99.

Edvardsson, 1. R., and Oskarsson G. K., (2011). Knowledge management and valuecreation in service firms, Knowledge management and value creation in service firms, 15 (4), 7-15.

Edvardsson, 1. R., Durst, S. (2013). The Benefits of Knowledge Management in Small And Medium-Sized Enterprises, Social and Behavioral Sciences, 81, 351 - 354.

Egbu, C. o. Hari, S. and Renukappa, S. H. (2005). Knowledge management for sustainable

competitiveness in small and medium surveying. Practices Structural Survey, 23 (1), 7-21.

Ellis, J. (1997), The role of KM in enabling competitive advantage for Australian organizations in the global economy, doctoral dissertation, RMIT, Melbourne.

Estabrooks C.A, Field P.A & Morse J.M, (1994), Aggregating qualitative findings: an approach to theory development, Qualitative Health Research 4(4), 503-511.

Gold, AH.,Malhotra, A and Segars, AH. (2001), Knowledge management: an organizational capabilities perspective, Journal of Management Information Systems, 18 (1), 185-214.

Goldoni, V. and Oliveira, M. (2010), Knowledge management metrics in software development companies in Brazil, Journal of Knowledge Management, 14 (2), 301-13.

Greengard, S. (1998), How to make KM a reality, Workforce, 77 (10), 90-91.

Hislop, D. (2009), Knowledge Management in Organizations, Oxford University Press, Oxford.

Jelenic, D. (2011), The Importance of Knowledge Management in Organizations with Emphasis on the Balanced Scorecard Learning and Growth Perspective. Management Knowledge and Learning. International Conference 2011.

Jennex, M. E., Smolnik, S., and Croasdell, D. T. (2009). Towards a consensus knowledge management success definition. The journal of information and knowledge management systems. 39 (2), 174-188.

Jensen, L.A. and Allen M.N, (1996), Meta-synthesis of qualitative findings. Qualitative Health Research, 6(4), 553-560.

Jones, R. (2003). Measuring the benefits of knowledge management at the Financial Services Authority: a case study. Journal of Information Science, 29 (6), 475-487.

Khanade, K., Sasangohar, F., Sadeghi, M., Sutherland, S., & Alexander, K. (2017). Deriving Information Requirements for a Smart Nursing System for Intensive Care Units. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 61(1), 653-654.

Migdadi, M. (2009), Knowledge management enablers and outcomes in the small-and medium sized enterprises, Industrial Management & Data Systems, 109 (6), 840-858.

Moussa, c.B. (2009), Moving beyond traditional knowledge management: a demand based approach, Journal of Knowledge Management Practice, 10 (3).?

Pina, P., Romao, M. and Oliveria, M. (2013), Using benefits management to link knowledge management to business objectives, VINE: The journal of information and knowledge management systems, 43 (1),22-38.

Roos, J., Roos, G., Dragonetti, N.C. and Edvinsson, L. (1997). Intellectual Capital: Navigating the New Business Landscape. London: Macmillan Press.

Sadeghi, M., Thomassie, R., & Sasangohar, F. (2017). Objective Assessment of Patient Portal Requirements. Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care, 6(1), 1-1.