Determining the Blend Knowledge Management Strategy by a Fuzzy Expert System

Sanaz Pourdarab, Hamid Eslami Nosratabadi, and Ahmad Nadali

***Abstract*—The growing importance of knowledge as a critical resource has encouraged managers to pay greater attention to the firms' KM strategies. Choosing the proper KM strategies is important to make sure that the alignment of organizational Procedures and the KM-related Information Technology deployment produce effective creation, sharing and utilization of knowledge. The purpose of this research is determining the knowledge management strategy by an intelligent system. Here a Fuzzy Expert System has been designed with the consideration of some effective variables on the selection of knowledge management strategy as Input variables and two knowledge management strategies system-based and human-based as the outputs. Then, the rules of system have been extracted from the KM Experts and the system has been developed with the use of FIS tool of MATLAB software. Finally, the designed system can be determining the knowledge management strategy. The presented steps have been run in an Iranian Bank as the empirical study.**

***Index Terms*—Knowledge management strategy, fuzzy expert system, blend strategy, human oriented strategy, system oriented strategy.**

I. Introduction

As knowledge is taking on an important strategic role, numerous companies are expecting their knowledge management (KM) to be performed effectively in order to leverage and transform the knowledge into competitive advantages [1]. The effective KM largely begins with a proper KM strategy. Hence, in order to implement the KM successfully, there is a critical issue of how companies can better evaluate and select a favorable KM strategy. Generally, selecting what kinds of KM strategies to use depends on the different purposes, the limited resources, and even the preferences of companies [1]. As to alternatives of KM strategy, [2] notes two types of KM strategies: the codification strategy (seeking to document and store knowledge in databases) and the personalization strategy (seeking to develop networks of people for communicating ideas). Choi and Lee [3] examined 54 Korean companies and categorized their KM strategies into passive, system-oriented, human-oriented, and dynamic which focusing on both knowledge reusability through IT and knowledge sharing through informal discussions among employees – was found to result in higher performance. Schulz and Jobe [4] developed four categories of KM strategies–codification, tacit, focused, and unfocused. Choi and Lee's work, developed on the basis of the knowledge-based view (KBV), which holds that knowledge assets can be a unique resource that may lead to a long-term sustainable competitive advantage [5].Another research around selecting proper strategy ,describes a framework for choosing a knowledge management strategy which is the main output of the CLEVER (cross-sectoral learning in the virtual enterprise) research project in the construction and manufacturing sectors[6].The other one investigates the relationship between knowledge management (KM) strategies and organizational performance and suggest three types of relationship among KM strategies: non-complementarity, and non-critical symmetric complementarity, and asymmetric complementarity [7].Another paper proposes a model to illustrate the link between the strategies and its creating process and the model depicts how companies should align the strategies with four knowledge creation modes such as socialization, externalization, combination, and internalization. It is found that human strategy is effective for socialization while system strategy is effective for combination and suggests that managers should adjust knowledge management strategies in view of the characteristics of their departments[8].Another study develops a forecasting framework based on the fuzzy multi-criteria decision making (FMCDM) approach to help organizations build awareness of the critical influential factors on the success of knowledge management (KM) implementation, measure the success possibility of knowledge management projects, as well as identify the necessary actions prior to embarking on conducting knowledge management[9]. There are other studies which have used MCDM solutions, show that the used techniques for selection knowledge management strategies are presenting a knowledge management strategy between three general strategies including Human-Based, System-Based, Combined as the better strategy and finally will give a prioritization[1], [10] .One of them use analytic network process (ANP) which is a relatively new MCDM method and can deal with all kinds of interactions systematically and It uses the Decision Making Trial and Evaluation Laboratory (DEMATEL) As the next method which can convert the relations between cause and effect of criteria into a visual structural model and can be used as a way to handle the inner dependences within a set of criteria [10]. No organization can define Its whole strategies based on Human-Based or

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System-Based strategy and run them. So the combined approach is the best. The important issue is the level of each strategy which needs to be considered in the blend approach. The advantage of this suggested approach is that we are not limited to select one strategy, since the Blend strategy is used. Although the level of both Human-Based and System-Based strategies are different , this system with two outputs including both of them will establish the level of each strategy in this new combined model. Generally, this study develops a Fuzzy Expert system based on some variables as inputs and experts opinions to represent a combined strategy which helps organizations to use advantages of both Human-based and System–based strategies. The suitable strategy is the critical influential factor on the success of knowledge management (KM) implementation in an organization. Hence, this paper proposes an effective solution to give the companies the opportunity to use both knowledge management strategies together based on their cases. Additionally, an empirical study is presented to illustrate the application of the proposed method in Saman Iranian Bank. The rest of this paper is structured as follows: In the next section, an overview of the knowledge management strategy is presented. In section III an explanation of Fuzzy expert system is given. Section IV will focus on the proposed model and its use in the case of Saman Iranian Bank. In the final section, some conclusions are drawn from the study.

II. Knowledge Management Strategy

Knowledge Management (KM) is often viewed as multidimensional and multidisciplinary which may sometimes lead to a fragmented dialogue on the topic .Also It can be defined as "a process that helps organizations find, select, organize, disseminate and transfer important information and expertise necessary for activities such as problem solving, dynamic learning, strategic planning and decision making". In the other words, it can be considered as dealing with capturing, sharing, applying and creating knowledge in an organization to best leverage this resource internally and externally [11]. The major potential benefits of adopting KM are well documented in the literature. It represents a potent mechanism to, among others :(i) Enhance decision making through just-in-time intelligence. (ii) Improve work efficiency and productivity. (iii) Increase innovation of products, services and operations. (iv) Improve competency and competitiveness. (v) Enable rapid generation of technical solutions to clients' problems. (vi) Increase responsiveness to customers [11]. KM is the organizational optimization of knowledge to achieve enhanced performance through the use of various methods and techniques. Also, KM is a systemic way to manage knowledge in the organizationally specified process of acquiring, organizing and communicating knowledge [6]. The purposes of KM vary from organization to organization. For instance, KM is the way to improve an organization's performance, productivity and competitiveness, and to promote acquisition, sharing and usage of knowledge. There are many KM purposes such as: to initiate action based on knowledge; to support business strategy implementation; to become an intelligent enterprise; to increase competitive advantage; to create an innovative culture and environment; to entrench collaboration as a work practice; and to improve work efficiency [12]. Linking the individual perspective of knowledge to the organizational level, organizational knowledge creation theory is concerned with the processes which make available individual knowledge to the organizational knowledge system. This knowledge processes consist of several steps, starting with the creation of knowledge followed by the use of knowledge, the transfer and sharing of knowledge, and the storage and retrieval for further use. A crucial and difficult step in the organizational knowledge process is the conversion of tacit knowledge into explicit knowledge. Tacit (implicit) knowledge is unarticulated and rooted in experience and intuition and tied to the senses. Explicit knowledge is uttered, can be formulated in sentences, has a universal character and is accessible through consciousness. Only explicit knowledge can be integrated in the organizational knowledge base [13]. In other words, it can be classified as either tacit or explicit. Tacit knowledge primarily resides in peoples' minds and it is relatively difficult to be expressed, codified and documented. In contrast, explicit knowledge is that which has been articulated, codified and formalized in some electronic or physical form. In general terms, knowledge, when viewed as an object, can be perceived to be any piece of idea, insight, know what, know-how or meaningful information that can be used to achieve an objective [11]. Researchers and practitioners have suggested a multitude of approaches to managing knowledge, most of which can be categorized broadly into codification and personalization approaches. In the codification strategy, individual knowledge is amalgamated, put in a cohesive context, and made centrally available to members of the organization via databases and data warehouses .The codification strategy uses a document-to-person approach on the premise that knowledge can be effectively extracted and codified [14] and emphasizes the capability to help create, store, share, and use an organization's explicitly documented knowledge. This strategy emphasizes codifying and storing knowledge. Typically, knowledge can be codified via information technology. Codified knowledge is more likely to be reused. The emphasis is on completely specified sets of rules about what to do under every possible set of circumstances .This strategy is referred also as system Strategy [8]. Knowledge management using this approach is highly structured as compared to the personalization approach that is semi-structured. The personalization approach does not impose a distinction between the knowledge and the knowledge provider. It recognizes the tacit dimension of knowledge and assumes that knowledge is shared mainly through direct person-to-person contacts. The role of information technology here is to facilitate communication between members of the organization through tools such as e-mail, group support systems, etc [14]. It emphasizes knowledge sharing via interpersonal interaction and utilizes dialogue through social networks including occupational groups and teams. It helps share knowledge through person-to-person contacts. This strategy attempts to acquire internal and opportunistic knowledge and share it informally.

Knowledge can be obtained from experienced and skilled people and can be referred also as human strategy [8]. Another new KM strategy has been suggested on the classification which is dynamic KM strategy. The dynamic KM strategy integrates the conceptual scope of system and human-oriented KM (HKM) strategies [15].

III. Fuzzy Expert System

A Fuzzy Expert System is simply an expert system that uses a collection of fuzzy membership functions and rules, instead of Boolean logic, to reason about data. Fuzzy Inference System (FIS) incorporates fuzzy inference and rule-based expert systems [16]. Fuzzy inference in this system refers to the use of computer programs to execute inference work resembling what humans do daily. The input constitutes some ambiguous linguistic semantics or unclear concepts for a specific event. Following the fuzzy inference mechanism, the output can be a fuzzy set or a precise set of certain features. Fuzzy inference infers the results from the existing knowledge base. 1) Fuzzy concept base: This contains the terminology and relevant predicate of a linguistic expression. Terminology is in the domain of the fuzzy set, possesses many pre-defined dismemberment values denoted by predicates. 2) Fuzzy proposition base: Membership functions accrue to the fuzzy proposition, which was induced from fuzzy concept base. There are numerous types of membership functions, such as S-shape, Z-shape, and P-shape, all easily definable with equations and parameters. For example, if the general fuzzy set is expressed as

$$A=\{(x,\mu A(X))\},\ x\in X\ \ (x,\ \mu A(x)) \tag{1}$$

where i denotes the membership function, and is a singleton, then a fuzzifier given by

$$\mu(X)=1/(1+(x/K2)^{-}K1)\ \ x\in X \tag{2}$$

Produces an S-shaped curvature. $K1$ and $K2$ are called the exponential and denominational fuzzifiers, respectively. By having controllable parameters such as $K1$ and $K2$, adaptive fuzzy algorithms can be developed.3) Fuzzy rule base: The fuzzy proposition is then presented in IF–THEN format and constitutes the rule base. Specifically, a finite fuzzy logic implication statement in the rule base was described by a set of general fuzzy IF–THEN rules containing only the fuzzy logical AND operation, in the form 'IF $a1$ is $A1$ AND $a2$ is $A2$ THEN $b1$ is $B1$.''4) Fuzzy strategy base: This contains the algorithms for computing the condition part and the conclusion part. A proposition might encompass many conditions. An appropriate fitness of a rule had to be found so that the conclusion can be drawn. This is carried out by a process of implication. A membership function that defines the implication relation can be expressed in a number of ways. To illustrate the operation, we assume that we have the following simple conditional proposition (canonical rule):

IF X is A THEN Y is B

The implication relation is defined by

$$R(x,y)=Jxy\mu\ (x,\ y)/(x,\ y) \tag{3}$$

where linguistic/fuzzy variable X and Y take the value of A and B, respectively, and l(x, y) is the membership function of the implication relation. The membership function is denoted by

$$\mu(x,y)=\ \mu_A(x)\ \wedge\ \mu_B(y) \tag{4}$$

The symbol $\wedge$ corresponds to intersection operation [17].

Numeric analysis approach of fuzzy system was first presented by Takagi and Sugeno and then a lot of studies have been made [17].

IV. Empirical Study

In the following section, the circumstance of designing the fuzzy expert system for determining the Knowledge Management Strategy has been described.

In Summary, these steps have been followed:

1) Clarifying the objective
2) Selecting the Input and output variables with the use of previous studies
3) Determining the membership functions for the variables
4) Specifying the rules for making the relations clear between Inputs and outputs.
5) Developing the Fuzzy Expert System via FIS Tool in MATLAB Software.
6) Implementing the designed system in the case of Saman Iranian Bank based on the situation of the bank to identify the Knowledge Management Strategy.

According to above mentioned steps, the effective variables on the selection Knowledge Management strategy have been extracted from experts' bank and the previous researches as Input variables [1], [10], [18]. These variables include: Top management Support, Communication, Culture and people, Incentives, Time and Cost. Selcuk [15] described them as follows:

Top management support (C1): Top management promotes the initial process of KM, supports ideas for improvement, and gives support and advice to the employees. Insufficient top management support and commitment can lead to potential sources of failure for the KM strategy.

Communication (C2): A knowledge sharing culture needs to be created for communication.

Culture and people (C3): KM strategy needs to be compatible with its organizational culture. A supportive culture encourages firm's employees to create and share knowledge within an organization.

Incentives (C4): reward system to motivate employees to share their knowledge.

Time (C5): It refers to the shortening the amount of time required to input and access information.

Cost (C6): It focuses on keeping the knowledge transaction costs as low as possible and/or under control.

Two Human-oriented Strategy (HOS) and System-oriented Strategy (SOS) have been considered as the outputs of Mamdani's Fuzzy Expert system. To design the

system, we needed the rules which determine the relation between the variables. Table I shows some of the obtained rules from the Experts' Saman bank. The first rule shows when Top management supports KM in the medium level and Cultural situation is in the suitable level, the use of Human-oriented Strategy has more preferable to System oriented Strategy.

TABLE I: THE RULES OF FUZZY EXPERT SYSTEM

	C1	C2	C3	C4	C5	C6	HOS	SOS
1	M	M	H	M	L	M	H	L
2	H	L	M	M	M	M	M	H
3	M	H	H	M	M	H	H	M
4	M	L	M	L	M	L	L	L
5	H	M	L	H	M	H	H	L
6	VH	H	VH	H	H	H	H	H
7	H	VH	H	L	M	H	L	H
8	L	M	M	M	M	VL	M	L
9	H	M	H	L	H	M	L	M
10	M	H	M	L	M	L	L	H

According to the experts 'opinions, the Top management Support includes five Gaussian membership functions as: Very high (VH), High (H), Medium (M), Low (L), Very low (VL).The membership function of variables is shown in Fig. 1-8.

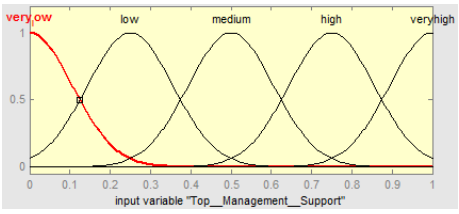

Fig. 1. Five gaussian membership functions for top management support

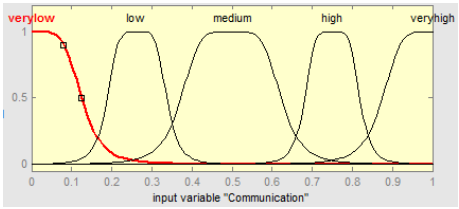

Fig. 2. Five gbell membership functions for communication

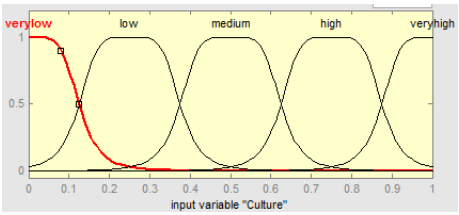

Fig. 3. Five gbell membership function for culture and people

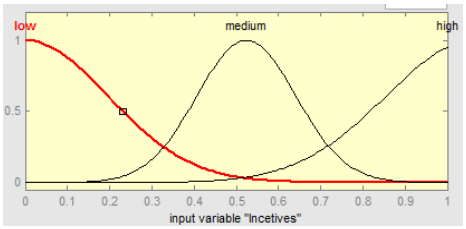

Fig. 4. Three gaussian membership functions for incentives

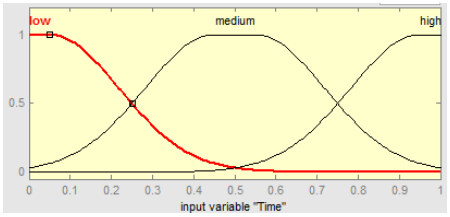

Fig. 5. Three gaussian membership functions for time

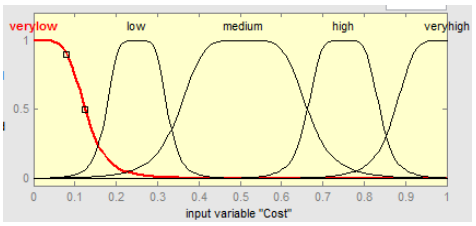

Fig. 6. Five gbell membership functions for cost

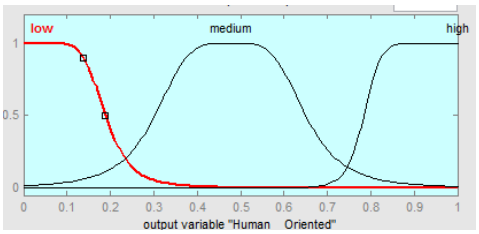

Fig. 7. Three gbell membership functions for human-oriented strategy

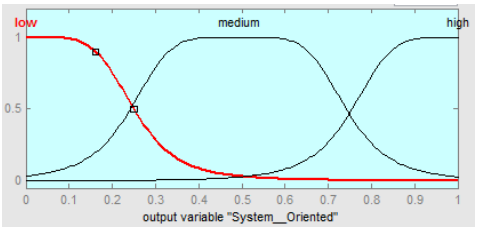

Fig. 8. Three gbell membership functions for system-oriented strategy

Finally, with regard to acquired rules from the Experts and the Membership functions of variables, a Fuzzy Expert system has been designed via Fuzzy Inference System (FIS) in MATLAB (Appendix A).

The followings are the results of the designed Fuzzy Expert System for Saman Bank:

Top management support =0.84	Communication =0.3
Culture and people =0.68	Incentives =0.72
Time =0.73	Cost =0.54
Human oriented Strategy=0.48	System-oriented Strategy =0.75

This research is shown that Bank should keep more attention to the System-oriented strategy than Human-oriented strategy.

V. CONCLUSION

In this study a Blend Knowledge Management strategy have been determined according to the Human-based and System-based strategies. Here, the effective variables on the selection of the KM strategy have been considered as the system inputs and the level of notice to Human-based and System-based strategies as two system outputs .The rules have been obtained by the use of Experts opinions. According to these rules, a Fuzzy expert system has been designed which is able to specify the level of consideration for each knowledge management strategy with the different cases of variables in each organization and helps the organization to identify the Blend knowledge management strategy consistent with the current circumstance of the organization and designs the necessary structure for better operation of knowledge management and obtains the best performance for the organization.

APPENDIX

Here, some useful MATLAB commands to work with the proposed fuzzy inference system (FIS) which is based on Mamdani are presented:

```
[System]
Name='KM Strategy'
Type='mamdani'
Version=2.0
NumInputs=6
NumOutputs=2
NumRules=35
AndMethod='min'
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'
```

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