

A Knowledge Archiving Model and Introduction to Auto-Knowledge Creating Systems

Mahdi Saedi
Tarbiat Modares University,
Tehran, Iran
saedi_ma@modares.ac.ir

Amir Albadvi
Industrial Engineering Department,
Faculty of Engineering,
Tarbiat Modares University
mail@albadvi.net

M. Hassan Shafazand
Computer Science Department, Faculty
of Mathematics and Computer Science,
Shahid Bahonar University, Kerman, Iran
shafazand@mail.uk.ac.ir

Abstract

When a practice is done or a decision is made in organization, an individual / organizational learning or knowledge is created. This knowledge is very valuable for the organization in the future and needs to be archived. The paper explores the critical sides of the knowledge and proposes a framework for archiving knowledge in the system based on the Unified Modeling Language (UML). This framework explained by instance knowledge. Then it introduces some ideas for achieving to an auto-knowledge creating system and proposes some future research topics.

1. Introduction

Knowledge management caters to the critical issues of organizational adaptation, survival, and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information-processing capacity of information technologies, and the creative and innovative capacity of human beings (Figure 1) [17].

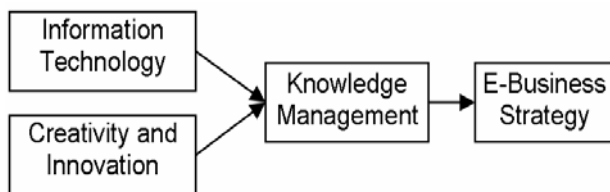


Figure 1: Knowledge Management and E-Business Strategy [17]

Knowledge management includes archiving, sharing, disseminating, and creating of knowledge that exists in people's mind in an organization. Knowledge management tries to collect and integrate the disseminated knowledge in organization and transfer it to the new knowledge. Is this possible to develop a system that it can generate new

knowledge from organizational collected knowledge? The answer is very hard, but it is possible to create a system for recording the personal innovations. It is simply to develop an information system that stores current organizational knowledge. It is simple to design an information system, but designing of knowledge management system is an innovation. By implementing the knowledge management information system, it is ready to create an auto knowledge management system based on collected knowledge in organization.

In this paper, we first present an information system model for recording the disseminated knowledge in organization and then explore and propose some ideas for developing a system for auto-creation knowledge in organization. It supposes organization may be physical or virtual and at one place, networked or extended. So, this model can be used for handling a knowledge management in virtual enterprises.

2. Knowledge management definitions

As reported by Malhotra, "Professor Charles West Churchman had observed three decades ago in his pioneering work *The Design of Inquiring Systems*: "knowledge resides in the user and not in the collection of information... it is how the user reacts to a collection of information that matters." More recently, Nonaka and Takeuchi, the authors of the best seller *The Knowledge-Creating Company* has re-emphasized that only human beings can take the central role in knowledge creation. They argue that computers are merely tools, however great their information- processing capabilities may be [2]. While information generated by computer systems is not a very rich carrier of human interpretation for potential action, knowledge resides in the user's subjective context of action based on that information" [17].

Then, for each knowledge in organization, it is possible to collect the specialist's interpretations. These interpretations are based on people's innovation and use for new decision-making. So, IT is used as a devise for archiving and using of interpretations. Now, the system

needs to be so flexible to be able to restructure itself and create the new knowledge. In addition, it needs to cooperate with human for the innovation.

3. Knowledge Processing: Four Problems

Researchers have described some problems for knowledge in organizations. Zack [10] explains four problems and provides a more coherent and consistent description of the environment in knowledge-based terms. He uses the attributes complexity, uncertainty, ambiguity, and equivocality for knowledge:

3.1. Complexity

Complexity is simply "a large number of parts that interact in a nonsimple way." Complex situations are not necessarily vague or unpredictable. They may be clearly-defined or predictable situations whose length or intricacy of procedure or variety of elements and relationships that must be simultaneously considered is too large to easily process.

Organizations facing complexity must develop the capability to locate, develop, and bring appropriate knowledge, expertise, and skills to bear on those issues, or to restructure their problems, roles, and routines to simplify those problems or render them more familiar.

3.2. Uncertainty

Information theory defines uncertainty as lack of enough information to choose from an exhaustive and well-defined set of possible states, even if that set is not complex [14]. Decision theory defines uncertainty as the probability or predictability of a set of states, preferred outcomes, and actions to achieve them [8].

To manage uncertainty, organizations must develop their intellectual resources and capabilities to predict, infer estimate, and learn. They must develop their structural capabilities, especially their communication networks, to flexibly respond and adapt to the unexpected.

3.3. Ambiguity

In contrast to the assumptions underlying uncertainty and complexity, situations or events are often neither immediately clear nor understandable [12], [18]. Ambiguity represents an inability to interpret or to make sense of something [15], [5]. If uncertainty represents not having answers, and complexity represents difficulty in finding them, then ambiguity represents not even being able to formulate the questions.

The key organizational capability is to provide for rich, interactive face-to-face conversation among a socially familiar yet intellectually diverse set of individuals.

3.4. Equivocality

Equivocality refers to multiple meanings for or interpretations of the same thing [15], [5]. Each interpretation is individually unambiguous (although possibly inappropriate or erroneous), but collectively they differ and may be mutually exclusive or in conflict. Equivocality also describes situations where there is agreement on a set of descriptive criteria (e.g., desirable market/ undesirable market) but disagreement either on their boundaries (e.g., the point at which markets go from being desirable to undesirable) or on their application to a particular situation (e.g., whether a particular market is desirable or undesirable).

The management of equivocality, viewed as the coordination of meaning among organization members, is considered fundamental to organizing [11]. Equivocality requires cycles of interpretation, interactive discussion, and negotiation to converge on a definition of reality [18], [5].

4. Knowledge type taxonomy

Zack [10] addresses to four types of organizational knowledge:

4.1. Know about

Know about, or declarative knowledge, refers to the ability to recognize and classify concepts, things and states of the world. It can be represented as a hierarchical classification scheme [4].

4.2. Know how

Know how, or procedural knowledge, refers to the understanding of an appropriate sequence of events or the ability to perform a particular set of actions [9].

4.3. Know why

Know why, or causal knowledge, refers to an understanding of why something occurs, for example, the factors influencing product quality or customer satisfaction. Causal knowledge can be formally represented by describing the causal links among a set of factors [16].

4.4. Know with

Know with, or relational knowledge, refers to an understanding of the relationships among or between these types of knowledge. For example, learning and innovation is often the result of creating or modifying relationships among existing and seemingly disparate concepts and ideas. Applied to organizations, firm performance is strongly related to knowledge of how the resources and competences of the firm relate to one another [13].

In addition to above issues, there are some other types of organizational knowledge that includes:

4.5. Know what

Know what, or existential knowledge, refers to explore of new knowledge or clarify the tacit knowledge and transform it to explicit knowledge. This element places in people's mind and related to innovative capability and creativity. The output of auto-knowledge management systems is knowledge what.

4.6. Know when

Know when, or time knowledge, refers to an understanding of the when something occurs and what time conditions needs to occur an event.

4.7. Know where

Know where, or positional knowledge, refers to an understanding of the where an event or action occurs and the place that has potential for occur that action.

4.8. Know who

Know who, or subjective knowledge, refers to an understanding of the subject of an action and its enabler.

4.9. Know whom

Know whom, or objective knowledge, refers to an understanding of the object of an action and things that the event affects on them.

As explained above, there is a rich picture about "knowledge" and now it is ready to create a data model for encompassing the organizational knowledge. In next section, we show the proposed knowledge archiving model and demonstrate an instance of knowledge.

5. A knowledge archiving model

In this section, we propose a framework for archiving knowledge in the system. When a practice is done or a decision is made in organization, an individual / organizational learning is created. This learning needs to be archived in organization. Some instances of knowledge are:

- Development a new product
- Improvement in a procedure
- Decision for employing
- Practice of solving a planning problem

Every practice or decision-making that occurred in organization is a practice of knowledge or learning that must be managed. So it needs to record to be used, nurtured and harnessed for future of organization.

For explaining it, we need a common language to

communicate each other. Our interest is the Unified Modeling Language (UML), because of "the UML is a graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system." The UML offers a standard way to write a system's blueprints, including conceptual things such as business processes and system functions as well as concrete things such as programming language statements, database schemas, and reusable software components [7]."

For full and right recording and archiving the knowledge, authors propose the following framework. Some critical parts of this framework achieves by crossing the "knowledge types" and "knowledge problems" (Table 1). Based on this framework, for recording the knowledge, in addition to record the "knowledge types," it needs to fill out the cells in the table 1. By applying the UML as a power standard of object oriented, a knowledge can be fully displayed by a class that is shown in figure 2. A knowledge as a whole is aggregated by 7 parts that are: Know About, Know How, Know Why, Know When, Know Where, Know Who, Know Whom.

Identifying a new knowledge in organization is the "existent knowledge" or "know what." It can be identified

Table 1: critical parts of the knowledge

	Ambiguity	Equivocality	Uncertainty	Complexity
Know About?				
Know How?				
Know Why?				
Know When?				
Know Where?				
Know Who?				
Know Whom?				

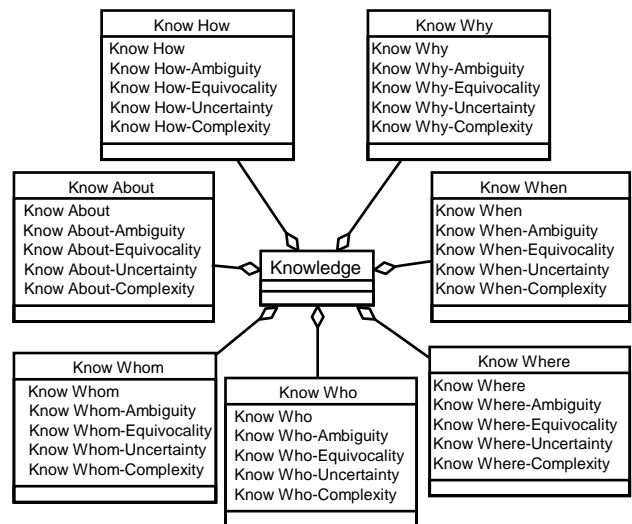


Figure 2: the "knowledge" as a class in UML context

by people but specialists try to create a new tools and systems for identifying it by them without people that called "Auto-Knowledge Creating." Authors propose their ideas for future research to achieve to these systems.

After recording the knowledge in organization, it must connect and relate to other knowledge, problems, projects, decisions, solutions, and anything in system that can be related. It is the same relational knowledge that we called "know with." By applying the UML, these relations can be displayed by a class diagram that is shown in figure 3.

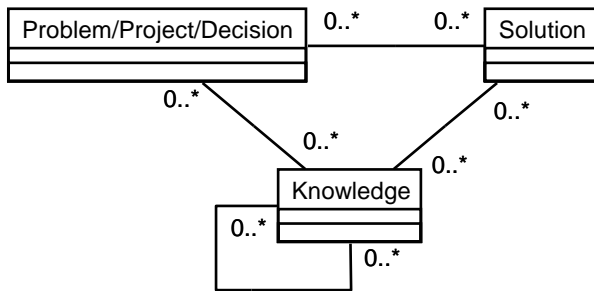


Figure 3: the class diagram of a generic Knowledge Management System

6. An Object of Knowledge

In this section, we demonstrate an instance of knowledge. This instant is a practice that has occurred in General Electric Co. [1]. Work-Out, which was launched in 1989, was named for the idea of taking excess "work-out" of the system, thus eliminating bureaucracy and freeing up people's time. It was deliberately designed to focus on the cultural side of change: helping people change their attitudes about their work and the ways they approached their jobs. At the following, we describe the knowledge that in this practice is created. In demonstrating this knowledge, we infer individually some descriptions. At the following, first we show what the problem and solution is. Then, we demonstrate all attributes of the knowledge.

Problem: In every organizational change, in facing to contribute to the new change, the people say, "we don't have time for this stuff." When they want to spend some parts of their time on the new activities, other their works are deferred and they frustrate. Therefore, they avoid contributing to change and disaccord.

Solution: Developing some procedure for increasing the time flexibility of people is a solution. For this purpose, General Electric developed a framework called RAMMP that people try to "work out" anything that is not necessary. Based on this framework, any Reports, Approvals, Meetings, Measures, Policies and Procedures that are not required, have to be canceled or omitted.

Knowledge Name: Creating the flexibility in people

time for avoiding to contrast to an organizational change

Attributes:

Know About: The capability of people that well recognize the best way of increasing their time and personal and organizational productivity.

Ambiguity: Recognizing what task is capable for omitting or deferring.

Equivocality: Tow or more tasks or activities have the same importance.

Uncertainty: People don't have self-confident to prioritize things.

Complexity: There are many tasks and activities that related together or other things.

Other attributes of knowledge can be demonstrated like above.

7. Introduction to Auto-Knowledge Creating Approaches by System

When a practice is going to be done or a decision is going to be made in organization, it is the best time that organization must use and take advantages from its memory and old knowledge (explicit and tacit). In this situation, organization plenty needs to old practices (success or fail) and the knowledge that exists in its people. Thus, it is necessary to have some search methods to address to the related knowledge. Generally, there are two ways to meet this purpose:

7.1. Context search (syntax search)

This approach is the most usual in the knowledge management systems and tries to find the words in the contents that satisfy search conditions. Search conditions usually include AND, OR and NOT operators. The result includes all knowledge from Knowledgebase that meets the search conditions. The result necessarily is not desirable and it is possible that contains unfavorable knowledge and does not match with the user's intentions. In addition, it is possible that the results don't contain some desirable knowledge that exists in the knowledgebase but don't satisfy the word search conditions. Then this approach does not have a good and full access to the recorded knowledge.

7.2. Content search (semantic search)

Other search approach proceeds to the meanings of the words and not to the word and its characters. In other word, it pays attention to the content of the words and tries to communicate with the recorded knowledge by its meanings. To meet this purpose, it needs to be equipped to semantic modeling tools for content search in knowledgebase and communicate at the meaning level. Semantic modeling tools need to be more developed [19],

[3], [6]. With enabling by this tools and search mechanisms, it can be ready for developing a creating knowledge system.

When an organization faces to a new decision or problem, it needs to exploit from the existent knowledge and innovate a new knowledge. To innovate a new knowledge from the current knowledge by using the semantic modeling tools and search methods, there are some ideas that listed below:

- A. Creating knowledge from the similarities and synonyms in meaning between existent knowledge complexity, uncertainty, ambiguity, and equivocality in any knowledge types based on the presented archiving model.
- B. Creating knowledge from the differentiations and antonyms in meaning between existent knowledge complexity, uncertainty, ambiguity, and equivocality in any knowledge types based on the presented archiving model.
- C. Creating knowledge based on the relationships in meaning between existent knowledge complexity, uncertainty, ambiguity, and equivocality in any knowledge types based on the presented archiving model. For example it is possible to create a new knowledge based on the relationship between the know how-ambiguity attributes in two knowledge objects that are modeled in class diagram based on UML as shown in figure 4.
- D. Creating knowledge from the unrelationships in meaning between existent knowledge complexity, uncertainty, ambiguity, and equivocality in any knowledge types. These unrelationships can help to find new meaning from things.

So, it needs to continue in this field. Authors propose the following topics for future researches:

- Semantically modeling
- Semantically recording/archiving the knowledge
- Semantically search/retrieve the knowledge
- Semantically creating/innovating the new knowledge

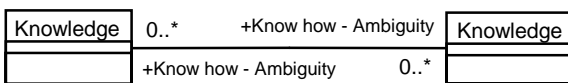


Figure 4: Creating knowledge based on the relationships

8. References

[1] Vierling-Huang Jacquie; Culture Change at General Electric: the evolution of productivity and effectiveness increase, from work-out to six sigma; in the "Not Enough Time" section in : Peter M. Senge, Art Kleiner (Editor), Charlotte Roberts, George Roth, Rick Ross, Bryan Smith; The Dance of Change: The Challenges to Sustaining Momentum in Learning Organizations; 1st edition (1999).

[2] Nonaka, I. and Takeuchi, H. (1995), The Knowledge-Creating Company, Oxford University Press, New York.

[3] Yannis Labron and Tim Finin, " Semantics for an agent communication language", IJCAI-99 Workshop on Agent Communication Languages 1 August 1999, Stockholm.

[4] Bobrow, D. G. and D. A. Norman, "Some Principles of Memory Schemata", Chap. 5 in Bobrow, D. G. and A. Collins, (Eds.), Representation and Understanding - Studies in Cognitive Science, (New York: Academic Press, 1975), pp. 131-149.

[5] Weick, K. E., The Social Psychology of Organizing, (Reading, MA: Addison-Wesley, 1969).

[6] Ter Bekke, J. H., "Semantic Data Modeling", Prentice Hall, 1992.

[7] OMG Unified Modeling Language Specification, Version 1.4, September 2001, <http://www.omg.org/cgi-bin/doc?formal/01-09-67.pdf>.

[8] Garner, Wendell R., Uncertainty and Structure as Psychological Concepts, (New York: Wiley, 1962).

[9] Gioia, D. A. and P. P. Poole, "Scripts in Organizational Behavior", Academy of Management Review, Vol. 9, No. 3, 1984, pp. 449-459.

[10] Zack Michael H., October, 1998; "If Managing Knowledge is the Solution, then What's the Problem?", in Knowledge Management and Business Model Innovation, Yogesh Malhotra (ed.), Idea Group Publishing, April, 2001.

[11] Gray, B., M. G. Bougon, and A. Donnelon, "Organizations as Constructions and Deconstructions of Meaning", Journal of Management, vol. 11, No. 2, 1985, pp. 77-92.

[12] Isenberg, D. J., "The Structure and Process of Understanding", Chap. 9 in The Thinking Organization, H. P. Sims and D. A. Gioia (eds.), (San Francisco: Jossey-Bass, 1986), pp. 238-262.

[13] Spender, J. C., "Making Knowledge the Basis of a Dynamic Theory of the Firm", Strategic Management Journal, Vol. 17 (Winter Special Issue), 1996, pp. 45-62.

[14] Shannon, C. E., "The Mathematical Theory of Communication", in C. E. Shannon and W. Weaver, The Mathematical Theory of Communication, (Urbana, IL: University of Illinois Press, 1949), pp. 29-125.

[15] Machlup, F., Knowledge: Its Creation, Distribution and Economic Significance Vol. 1: Knowledge and Knowledge Production, (Princeton, NJ: Princeton University Press, 1980).

[16] Weick, K. E. and M. G. Bougon, "Organizations as Cognitive Maps", in H. P. Sims and D. A. Gioia (eds.), The Thinking Organization, (San Francisco : Jossey-Bass, 1986), pp. 102-135.

[17] Malhotra Yogesh (2000), Knowledge Management for E-Business Performance: Advancing Information Strategy to 'Internet Time', Information Strategy: The Executive's Journal, 16 (4), pp. 5-16.

[18] McCaskey, M. B., The Executive Challenge: Managing Change and Ambiguity, (Marshfield, MA: Pitman, 1982).

[19] Thomas Adams, James Dullea, Peter Clark, Suryanarayana Sripada, and Thomas Barrett, " Semantic Integration of Heterogeneous Information Sources Using a Knowledge-Based System", Proc 5th Int Conf on CS and Informatics (CS&I'2000), 2000.