Organization of Knowledge Management Based on Hybrid Intelligent Methods

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Abstract. The present article is concerned with topical issues of creation and organization of knowledge management systems. The background is briefly run through; current trends of information system development are noted. Different types of knowledge are analyzed; the significance of implicit knowledge types for cognitive activity and new knowledge creation is noted. Advantages and application of artificial intelligence methods and models within creation of knowledge management systems are discussed.

Keywords: Knowledge management systems, Categories of knowledge, Implicit knowledge, Experience, Artificial intelligence, Systems based upon fuzzy rules, Genetic algorithms.

1 Introduction

The process of knowledge accumulation, spread and transfer is a crucial factor of the modern civilization history. The problem of knowledge management became acute in recent times. The reason for this is that information revolution occurred, the development of computing machinery and mechanical media made it possible to reduce the complexity of information receiving, data processing and storage, simplify interpersonal communication and extend accessibility to various data.

All these achievements left a handle for transition to a new social pattern: from industrial to information-oriented society where key factors are information and knowledge rather than wealth [1]. We are eyewitnesses of new economy formation based upon intake and production of knowledge. These processes turn to be effects of globalisation on the one hand and its driving force on the other hand. The reflection of this new economic and social model is soaring knowledge content of goods and services, intellectualization of production technology field, appearing of economy sector specialized in production and providing intellectual services and products (consulting, intellectual property, etc.).

All the mentioned processes and trends led to necessity for classification of actual knowledge management models and technologies, efficient learning methods and development of new ones. We consider key problems associated with organization and knowledge management.

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2 Problems of Knowledge Management Organization

As defined in "Wikipedia", the open on-line encyclopedia, [2] knowledge management comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizations as processes or practices.

The first works given attention to knowledge management problems dated back in the early 1990's. The following years reflected a surge in interest to the knowledge management problem in all the fields of activities, science and education inclusively; a significant number of publications and web-sites on the subject appeared. Today knowledge management methodology and generation of software and engineering tools are forming to provide natural knowledge circulation and knowledge generation.

It is evident that knowledge is not only an independent value but has a direct impact on efficiency of other manufacturing forces. The process of knowledge accumulation and processing results in formation of competences that are themselves the basis for building up the product and service market as well as labour market. That way, knowledge management involves integration of various disciplines, such as Human Resources Management, Marketing, Economics, Psychology, Information Science etc.

Knowledge is a specific individual nonprogrammed concept of environment, its laws and phenomena. Knowledge accumulation can be caused by direct interaction with the present environment (personal knowledge) or human cognitive activity. Knowledge can be nominally divided into two categories. The first category is an explicit knowledge that can be written down, depicted, documented (theory, methods, technology). Another category is an implicit knowledge that is hard or impossible to document (experience, skill, intuition). Implicit knowledge reflects personal experience, human adaptability; they are in minds of professionals, experts, people who have an intimate knowledge of a certain activity area (occupation), great life experience. In this regard it is important for an expert to increase and check constantly on his (her) knowledge, examine it in correspondence with the results of his (her) practice and theoretical activity. Cerebration may be said to be through trial and error when useful knowledge and skills are formed on the ground of observations and their further analysis. Knowledge accumulation, experience and intuition are evolution dynamics of cogitative brain activity; they implement "from simple to complex" motion principle; enable to get answers for intricate question instinctively [3].

When constructing complex information systems including knowledge management systems, scientists try to imitate the nature, employ artificial analogues of natural biosystems, principles and structures taken as the basis of natural systems functioning. Research area dealing with artificial system construction is called artificial intelligence. Let us take a brief look at the range of issues connected with artificial intelligence methods and models to create and organize knowledge management systems.

3 Using of Artificial Intelligence Methods to Construct Knowledge Management Systems

Today, quality improvement and complexity increase problems of information systems developed in different branches of sciences and engineering are associated with their possible intellectualization, in other words adding a number of functions generally performed by a human being to created technical objects and systems. These functions can be considered to be as following: analytical work and decision making within incomplete, fuzzy or controversial inputs, searching and selection of previously unknown, nontrivial but practically useful common factors in input data files, validation and interpretation of these factors. In this regard, one of the problems of great importance is to create efficient tools of processing and data mining, knowledge acquisition and management, as well as tools for common factors search to implement them in decision-making systems [4, 5, 6].

One of the most effective current tools to solve the problems mentioned above is fuzzy hybrid methods, models and algorithms. The methods applied are genetic, evolutional, bionic, adaptive and other searching methods. These methods and approaches can be integrated into independent interdisciplinary field, artificial intelligence, where some aspects of other research areas, namely computational intelligence, soft computing, database theories etc., are implemented.

When applied, generation of mathematically sound clear models and methods is either economically unacceptable or practically unreliazable. While the systems functioning on the base of integrated, fuzzy hybrid mechanisms and models, work well in solving such problems and appear to be the most rational compromise.

In this regard the usage of hybrid methods to solve the problem discussed suggests itself: fuzzy models, evolutional and genetic algorithms, multiagent organizations. They allow performing at their best with fuzzy, poorly formalized information and have a serious mathematical framework on the other hand to provide sufficient safety factor.

Today, the greatest success in system integration, fuzzy logic approaches and genetic algorithms (GA) was achieved in the two spares [7]:

1. Usage of mechanisms of genetic and evolutional algorithms to solve the problems of information search and data mining; usage of systems based on fuzzy rules. Hybrid methods are used for learning and setting the components of fuzzy rule system including automatic generation and knowledge bases check, setting the output function [8].
2. Usage of methods based on fuzzy logic for modeling different components and genetic algorithm operators, as well as adaption and dynamic setting of genetic algorithm control values.

The solution to the first class problems directly associated with the problems of effective organization of knowledge data bases, construction of quality control systems. The problem of setting fuzzy model parameters becomes relevant in this case. The

possibility for dynamic change and optimization of model parameters during development and test process is compelling in this regard.

Such a problem can be solved with various methods. Using methods of genetic and evolutional search is one of these methods. Numerous examples of solutions for such problems applying genetic algorithms are known, for instance, configuration and configuring of artificial neural networks with the aid of genetic algorithms. The advantages of using genetic algorithms to set the structure and parameters of fuzzy models are their simplicity, accountability for the whole range of feasible constraints that can be met in such problems [9].

The fuzzy model behavior is characterized by the multitude of linguistically displayed rules based on expert knowledge which can be presented in the following form [10]:

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If IF (set of conditions fulfilled),
then THEN (set of actions carried out).
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Besides, the fuzzy model can include more than one inputs and outputs. For every fuzzy rule appears to be fuzzy relation, the behavior of fuzzy control system is characterized by the set of the relations mentioned above [8]. The procedure to obtain fuzzy inference results implementing knowledge base comprises the following steps:

3. Identifying the trigger lever for each rule.
4. Finding the result of fuzzy inference for each rule.
5. Aggregation of special fuzzy inference results into the general result typical for the whole fuzzy inference base.

From the start it is important to identify the set of all possible model rules implementing the preset membership functions. Model rule base may involve elementary rules, as well as generalizing rules. Generalizing rules are essentially logical combinations of elementary rules.

Generalizing rules used in the fuzzy rule make it possible to reduce the total number of the rules applied, in other words to decrease dimension of the model. At the same time the use of generalizing rules has an adverse effect on model accuracy [9].

It is plain that before the genetic algorythm starts functioning, it is necessary to find the set of all the rules applied in the model. As for solution encoding technics, various approaches can be operated. For instance, every element of the rule base can be given a certain position in the numerical sequence (chromosome).

Standard binary encoding can be used as well as more complicated encoding types making it possible to consider the importance and significance of certain rules, fuzzification/defuzzification methods applied, different modifications of genetic operators, etc.

These aspects must be considered when choosing an objective function (fitness function) and valuation of the solutions obtained. When evaluating the quality of each solution and, consequently, structural optimality of a particular rule base, proper allowance must be made for model accuracy, the total number of rules and the number

of rules exploited in the structure under estimation. As these characteristics are closely related, to find a rational balance between them is of primary importance.

4 Conclusion

The experience of recent years showed that implementation of similar methods, i.e. methods appropriate for one scientific paradigm, in Information Technology is not always successful. In hybrid architecture connected several paradigms the effectiveness of one approach can compensate the weaknesses of another. One can avoid disadvantages inherent with each of them in particular combining various approaches. Thus, amplification of integrated and hybrid systems became one of the leading tendencies to define the development of contemporary informational systems and knowledge engineering. Such systems include various elements joined in the interests of objects in view. Integration and hybridization of various methods and information processing technologies afford to solve complicated problems impossible to be solved on the ground of separate methods or technologies. In case of integration of heterogeneous information processing technologies, one should expect synergistic effects of higher order than when grouping of various models within specific technology [11].

The choice of knowledge extraction and processing depends upon specific features of the solved problems, their development level, number of quality and quantity parameters. It is therefore necessary to define applicability conditions of every discussed technology and develop methods and algorithms for adapting technologies to problem solution of problem domain.

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