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CREATION AND APPLICATION OF KNOWLEDGE BASE OF SPECIALISTS' COMPETENCE PROFILES IN AN ORGANIZATION

A.F. Tuzovskiy

Institute «Cybernetic centre» of TPU
Tomsk Scientific Centre of SD of RAS
E-mail: TuzovskyAF@kms.cctpu.edu.ru

An approach to specialists' model construction and its usage in the knowledge management system with application of ontological organisation model is proposed. The problems on knowledge management that can be solved on the basis of the model proposed are considered.

Introduction

At present, any successfully working organization has in its staff a part of employees, who possess both considerable theoretical knowledge and wide practical experience in the fields of their activity. Participating in one or another business-process of an organization they are also involved into the process of accumulation, search and exchange of knowledge, a considerable part of which is the implicit knowledge. These very employees of a company represent the most valuable asset of the company, which should be efficiently managed [1, 2]. In the given paper it is proposed to improve the management of hidden organization knowledge by means of developing and using specialists' models, experts, first of all, within the bounds of knowledge control system (KCS) and processes of their construction by carrying out qualifed audit. The specialists' models and their simulation are the key elements in hidden knowledge management, but they may also be used in the other fields, for example, in human resource management of searching for specialists with required experience.

Experts of an organization

In a successful organization there is a considerable part of employees possessing theoretical knowledge and practical experience. All of them are refered to the category of skilled specialists; possess a certain formal status in the hierarchy of business management, take part in forming company development strategy, analysis of problem situations, reasoning and decision making.

It is natural that being participants of corresponding business-processes they are involved into the processes of knowledge search and accumulation, exchange, new ideas generation and so on. However, their involvement into knowledge processes is not determined so much by specialist formal status as by the fact to what extent the organization and its staff appreciate scope of knowledge and experience of this specialist, his amplitude, depth of theoretical knowledge and thought standards. Such specialists are more often than others got involved in the analysis of problem situations, strategies development and alternatives estimation, generalization and popularization of best practices, and namely such specialists are accepted to refer to the category of ***experts***.

Expert may be determined as [3] *a skilled specialist, who has a large scope of knowledge, useful for organization, can create efficiently new knowledge in the process of scientific and/or practical experience and uses this knowledge in his practical activity. He is widely appreciated as a reliable source of knowledge and skill, whose ratings are accepted by the organization or their colleagues as competent and important.*

It is clear that the number of experts in the organization is substantially less than total amount of skilled specialists. It is necessary to improve working efficiency of experts, approach to them as to the most valuable company resource. Besides motivating factors, there is also a number of impediments to efficient using of experts. Experts, as a rule, are employees not free from other systematic work. In such cases expert employment may be an impediment to his desire or obligation to carry out an examination or consultations. Expert may have suspicion and fear that there is no necessity in him like in skilled employee, as soon as his knowledge and experience have become common asset. Expert may lose his desire to communicate, if the process of communication is complicated (business trips, writing of capacious reports and instructions etc.) or communication environment is not provided with modern information technologies.

Experts of a company are quite valuable and efficient recourse of knowledge creation, detection and spreading which should be efficiently used to improve organization activity.

To increase the efficiency of experts use, the descriptions of their competence should be written and entered into knowledge bases, which should be available for search systems. It is quite desirable initially to differentiate expert from total amount of skilled employees on the basis of a certain procedure (investigation) and give him a definite status. So that expert shares his knowledge in the process of examinations and/or consultations, his intellectual efforts should be rewarded morally and financially and supported with modern information technologies.

At present, two ways of creation and supporting experts' profiles may be recognised: by means of investigation (qualifying organization audit) and by tracking their work in knowledge control system (what documents he worked with and how, communication).

Model of specialists and experts

To increase the efficiency of experts working in KCS using information technologies their formal description in the form of specialist (an employee with knowledge) model is required. ***Model of a specialist (expert)*** is a valid set of interrelated properties of a specialist, which can be formally described and used for supporting efficient work with hidden knowledge. ***Simulation of a specialist (expert)*** is a process, the aim of which is construction and maintenance of their models, for supporting efficient working with that knowledge which they possess.

The model of a specialist may be realized in different ways. One of the ways of such model construction is its description using ontological organization model and fields of its knowledge, which contains a set of notions, interconnection between them and have a formal presentation [3]. In this case, the model of a specialist represents a set of context and content metadata $MC=\{M_{\text{context}}, M_{\text{content}}, B\}$, where M_{context} is context metadata of specialist description; M_{content} is content metadata, describing specialist competence in various fields of organization knowledge; and B is the characteristic of specialist behavior in KCS of an organization.

Context metadata of a specialist includes such characteristics as:

- identification (name, surname, patronymic, photo, date of birth, place of employment, login, password);
- contact information (postal and e-mail address, address of a personal Web-page, telephone numbers);
- education (diplomas, certificates etc.);
- professional achievements (places in contests, letter of commendation, medals etc.).

Content metadata (description of competence) of a specialist $\boldsymbol{M_{\text{content}}=\{K_o, K_c\}}$ represent indicators of specialist competence in knowledge fields of organization (K_o) in aggregate with a set of semantic descriptions on the basis of ontologies of subject fields (K_s).

Specialists' competence in knowledge fields of organization is described in the following way $K_o=\{(O_1,k_1),...,(O_n,k_n)\}$, where O_i is knowledge field, i and k_i is a level of specialist competence in this knowledge field.

Semantic descriptions of a specialist K_s are specified in the form of semantic metadata set, which may be defined as finite set of ordered pairs (c_{ij},k_{ij}): $MD(s_i)=\{(c_{i1},k_{i1}), ...,(c_{in},k_{in})\}$, where $c_{in}\in C$ is the notion of ontology, relating to the object of description s_i, $k_{in}(0,1]$ is the coefficient, indicating relevance of c_{in} notion to object s_i.

Specialist behavior in KCS is the notion, which describes some characteristics of specialist interaction with knowledge control system. Specialist behavior in KCS is suggested to be described by two parameters $\boldsymbol{B=\{Ta,La\}}$, where Ta is the type of activity, fixing the kind of activity, which corresponds to a concrete specialist. Possible values of this indicator are: ***reader***, ***writer***, or ***observer***, and La is the level of fixed activity of a specialist. Possible values of this parameter are – ***very active***, ***active*** and ***inactive*** [2].

With the help of «Specialist behavior in KCS» indicator based on accumulated characteristics of knowledge exchange, the system tends to fix the character and level of his participation in the process of knowledge exchange.

The description of a concrete specialist according to the given model is called ***specialist's profile*** (metadata describing a specialist). Using a similar way of specialists competence description allows solving the problems of their search with a use of formal methods of defining meta descriptions semantic proximity. The example of calculation method of semantic proximity degree of such descriptions is presented in [3].

Construction of experts' profiles

Detection of experts and determination of specialists' competence degree of an organization is rather a difficult task. Probably, it is necessary to use as experts those employees, whose judgments and experience, to a large extent, can help to make an efficient decisions. The problem is in finding and describing such specialists. At present, there are not any known techniques of detecting experts, who provides the success of an examination or user consultation.

In various papers [1, 2] self-appraisal and mutual appraisal of specialists competence methods are proposed to be used. On the one hand, who may know specialist abilities better than he himself? On the other hand, at competence self-appraisal, it is impossible to except the fact that it is sooner a degree of specialist self-assurance that is estimated than his real competence.

Using the method of mutual appraisal, besides a possibility of displaying personality and group sympathies and antipathies, lack of information of specialists about each other's abilities plays role. In up-to-date conditions only specialists, working together for a long time, have rather good acquaintance with works and abilities of each other. However, there is a certain risk here, as mutual appraisal in this case implements on the basis of strong coincidence of the opinions, knowledge and experience.

For reduction of appraisals of competence level by the method of self-appraisal and mutual appraisal, the following calculation formula may be used:

$$K_{ij} = S_{ij} + \frac{L_{ij}}{E_j} \cdot R_S ,$$

where j is the field of knowledge, $j=\overline{1,n}$; n is the number of knowledge fields; i is the number of a specialist, $i=1,m_j$; m_j is the number of «challengers» for expert status in j knowledge field; K_{ij} is the complex appraisal of competence level; S_{ij} is the value of specialist self-appraisal; L_{ij} is the number of employees giving their voices for i «challenger»; E_j is the maximal number of employees, giving their voices for some kind of «challenger»; R_S is the interval of self-appraisal scale (in the carried out investigations is taken equal to 3).

Specialist's efficient participation in previous examinations may be also taken into consideration at specialist selection as an expert. Therefore, it is sensible in knowledge control system to have instruments, allowing the consumers to evaluate experts work in the form of grading after the examinations, consultations etc. It is sensible to store such information in the journal of system working.

The method of «snowball» is of a certain interest for experts detection. In this method every specialist, taking part in a survey, gives some surnames of those specialists, who can be stated as experts in the given subject area. Probably, some of these surnames were found before in this survey and some of them are new. After that new specialists, who have been pointed by the previous survey participants, are questioned. The process of list expansion stops when new surnames are not found any more. As a result of this procedure, may be rather large, but nevertheless final list of probable experts is obtained.

Use of models and profiles of specialists

As a result of the analysis of functions and properties of specialists model 4 main tasks, in which specialist's model and specialists' simulating may be useful for KCS functionality improvement, may be singled out: supporting of experts work; search for specialists experience; personalization of KCS services; supporting of network communication and cooperation.

On the basis of fields of competence and specialists' interests, some specialists are informed about new assets of knowledge suitable for them, available in the system, or about different changes which have occurred in the ontology of subject field. The task of KCS is to inform specialists about new proposals of various forms of knowledge exchange in time. Knowledge distribution may be performed in two main forms:

- base on a subscription (for example, in the form of news electron letters mailing);
- by means of personalized approach, based on demands and mailings (*push/pull approach*).

Some variants of such systems construction are:

- users signaling about correction of specific documents;
- messages specially posted into mailing pages or forums;
- signaling of all specialists concerned with some subjects about all new events and all documents, which appear in the given field.

Specialists' metadata included in their competence description allow searching for employees, who have the experience, skills connected with formal or informal training or work history. The explicit entry of competence, skills and interests fields of specialists allows solving such tasks as experts and practical experience searching; obtaining data about other interest fields and specialists competence.

Semantic descriptions of specialist competence expand the possibilities of logical entry and automatic data processing. Services of search and integration of data, information and knowledge may be based on their semantic descriptions. Such semantic structure allows organizing the interaction between various program subsystems. Specialist's model is connected with the notions of ontology of subject field through the properties of various notions, such as: «work_at», «work_on», «connected_with», that allows carrying out further inferences.

For example, if the notions «Specialist», «Project» and «Subject» are connected by RDF statements [4]: (Specialist, work_on, Project) and (Project, connected_with, Subject), from the available facts that «Ivanov works_on Project «Automation»», and the range of property meanings «work_on» is limited by the notion «Project» and project «Automation» described as a work connected with: Inspectors, Sensors, Electric drives (that may be described in the form of statements (triplets) on RDF language: (Ivanov, work_on, Automation); (Automation, connected_with, inspectors); (Automation, connected_with, sensors); (Automation, connected _with, electric drives)), that on the basis of the analysis of this knowledge base and profile of specialist Ivanov the logical conclusion about Ivanov's working experience with Inspectors, Sensors or Electric drives in the field of Automation may be made. Thus, the system may make a conclusion about Ivanov's probable competence without demands to Ivanov to refresh obviously his parameters by existing experience.

Conclusion

Specialist model construction is one of the most important stages of KCS construction, as the existence of such model, and also its support in actual condition allow solving the problems of knowledge and experience search in the organization, KCS personalization to specific user requirements and specialists grouping into interests community. Thereby, users simulation allows improving the process of collection and distribution of explicit and hidden knowledge from organization employees.

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ADAPTIVE SYSTEM WITH FREQUENCY CONTROL CHANNEL DEVISION AND BOOTSTRAPPING

D.M. Taskaev, V.S. Avramchuk *

Organization: «Tsentrsibnefteprovod», Tomsk
*Tomsk Polytechnic University
E-mail: Taskaev.dima@mail.ru

Construction of adaptive control system on the basis of the principle of frequency-dependable feedback and with application of multi-frequency identification action has been shown. The adaptation algorithm possesses relative simplicity, accuracy suitable for most of the industrial enterprises, does not require large calculating resources and is capable of operating in the real time mode.

Technological advance in industry development and investigations in scientific field have set a problem of creation automatic control systems of extremely high accuracy and minimal complexity. Such automatic systems should search out the conditions of high-performance behavior for technological and production processes in the given conditions of system operation without operator's control. The systems meeting this requirement were called adaptive or self-adjusting.

One of significant peculiarities of applying the majority of adaptation techniques in practice is unsuitability for control of some technological processes (TP), as the sources of inner uncontrolled random disturbance may exist in the object itself. It makes control object (CO) stochastic and involves the necessity of constant control in control process of its current state and on-line correction of generic parameters or control action.

The suggested technique of adaptive control system construction (AdCS) is based on using active frequency methods of objects identification. Frequency methods application allows for interference protection of algorithm as well as an active experiment at the operating (working in normal operating conditions) system in terms of minimization of interference into its work. Block diagram of suggested adaptive system is presented in Fig. 1: where BHA is the block of harmonic analysis; FG_1 and FG_2 are the frequency packet generators; K_1, K_2 are the controlled keys; $\overline{\beta}=\{K_П, T_И, T_Д\}$ is the vector of regulator generic parameters; $\overline{k}=\{Am_1...Am_n;f_1...f_n\}$ is the vector of amplitudes and frequencies of harmonics (forming trial testing signal); $\overline{\alpha}=\{Am_1^*...Am_n^*;\varphi_1...\varphi_n\}$ are the results of BHA operating in the form of vector, representing the combination of amplitudes and phases, singled out in harmonic signal, on frequencies $(f_1...f_n)$ of the trial testing signals; g is the setting (master control); ε is the error (error signal); y is the control action; x is the output signal; x_{fs} is the feedback signal; U_t is the trial identifying signal; U_t^* is the signal of compensation.

In structure organization of adaptive system three levels of hierarchy in its functioning are clearly singled out, and namely:

- the 1st level includes the main circuit of the system and consists of adjustable proportional integro-differential regulator (PID-regulator), CO, two controlled keys K_1 and K_2 and three adders;
- the 2d level, the adaptation circuit, contains two programmed signals generators, FG_1 and FG_2, BHA and block «Analyzer»;
- the3d level consists of coordination and control block, realizing general control over the processes of adaptation, identification and control as well as elaborates AdCS behavior at contingencies, for example instability.

Self-adjustment (adaptation) circuit is functioning in the following way: FG_1 generator forms the trial sig-