39 UNDERSTANDING USERS' RESPONSE TO ONTOLOGY BASED SYSTEMS IN THE CONTEXT OF AN ENTERPRISE SPONSORED VIRTUAL COMMUNITY

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This paper aims at presenting the preliminary results of a research work that seeks to understand the users' response to semantic based technologies, in the context of enterprise sponsored virtual communities. The research follows a qualitative methodology based on an action research approach. It particularly focuses on the socio-cognitive processes that underlie users' learning and acquisition methods when training and interacting with a new knowledge management approach based on semantically enabled technologies in a collaborative, and sometimes virtual, learning/working environment. The outcomes of this research are expected to provide an assessment framework for a deeper level understanding of the cognition process in what concerns the evolution of individual's knowledge, opinions, beliefs, and thoughts about ontology based systems.

1 INTRODUCTION

Building and construction companies have to continuously renew their working habits in order to face an increasing competitive environment where flexibility and adaptability to change are the obliged route to success. Particularly SMEs, have to act quickly on redefining the ways for the achievement of their business objectives. The main challenge is to provide a cost-effective solution for the two main problems: 1) Construction industry (particularly SMEs) urgently needs radical improvements of communication with customers in order to provide better product support and services. The innovative forms of communications and relationships among SMEs and their customers are increasingly important in order to improve the market share and/or survival chances in the "new economy era". 2) To respond to ever increasing customer requirements it is increasingly necessary to establish a closer co-operation (particularly among SMEs) within this sector, aiming at assembling alliances of SMEs into integrated teams that will genuinely align with challenging performance targets.

As the community paradigm is winning space among more established inter-organizational interaction forms such as chains or networks, complementing them in some cases, and taking into account the needs described above the KNOW-CONSTRUCT (KC) EU project[1] developed an Internet Platform for Knowledge-

[1] COLL-CT-2004-500276 – KNOW-CONSTRUCT – www.know-construct.com

based Customer Needs Management and for Support to Knowledge Communities of SMEs in the Construction Industry. It intends to improve the effectiveness of the Construction Industry (CI) SME's by improving and extending the relationship with their customers through an innovative support regarding information and knowledge about products, processes and associated issues. This is achieved through specifically developed tools, supporting in particular the formation and operation of SME's knowledge communities in the context of Industry Association Groups (IAG). More specifically, these objectives aim (i) to provide a platform to support the creation and management of a community of CI SME's, coordinated by an association, fostering collaboration and knowledge sharing among its members and (ii) to provide problem-solving support to the individual IAG member's customers, as well as addressing other related problems such as legislative issues, safety issues, among other possibilities. A large set of professional associations of the sector were involved in the process, which will now provide the environment for the dissemination of the innovative solutions and for the development of a knowledge community support (KCS) system in order to acquire a wider and deeper technical and professional competence shared by the SME's community, obtained through closer co-operation and knowledge exchange.

Based on the typology of virtual communities proposed by Porter [3] where the communities are classified under two levels - establishment and relationship orientation - the KC community, named as *Construction Industry Knowledge* (CIK) Community is classified as an organization-sponsored community relatively to type of establishment and as a commercial community relatively to the relationship orientation having the following characteristics: (i) the goal is to develop and exploit knowledge about civil construction sector; (ii) there are continuous interactions between participants to meet these goals, (iii) information and communication processes are continuously made explicit, (iv) it adds value to the participants (professionals within the sector and customers alike), the on-line meeting place that is usable, (v) the culture focuses on the participants' needs as the route to high performance; involvement and participation create a sense of responsibility and ownership and, hence, greater commitment, and (vi) the context is highly complex and constantly evolving and the Construction Industry Knowledge (CIK) Community will have to continuously cope with the expectations of its participants and their context of use of the system.

Enterprise sponsored virtual communities (ESVC) are emerging as serious business schemes fostering collaboration and knowledge sharing both intra and inter-organizations. This community will, thus, have key stakeholders and/or beneficiaries (e.g. customers) that will play an important part in sponsoring the community's mission and goals. Being an organization-sponsored community, it will foster relationships both among members (e.g. professionals belonging to the associations of the project partnership) and between individual members (e.g. customers) and the sponsoring organizations (associations of the project partnership).

2 TRAINING ON KC METHODOLOGY AND SYSTEM

ESVCs are complex socio-technical systems, difficult to design and maintain, needing multi-disciplinary approaches for their development. In order to assure its functioning and to assure a highly productive usage of the system by end-users it is

of utmost importance to organise optimal adoption of the system by them. In addition to participation of end users in the system concept creation and testing, what assured an initial creation of awareness on system characteristics, a final training is to be organised for familiarisation of the end-user with the full system functionalities and advantages to be achieved through its usage. An appropriate planning, including the training methods selection and training materials creation is crucial for the success of the training. Thus a training plan and training sessions were devised, which aim at (i) assuring maximal acceptance of the Know-Construct system through creation of a full awareness on the system characteristics and advantages it will bring to the end user companies; (ii) ensuring that all the SMEs fully understand the concepts involved with KC methodology and ICT system; (iii) providing familiarization of the future system users with all related aspects, primarily related to knowledge gathering, structuring within the system and presentation; (iv) assuring, through common "hands on" training sessions for the groups of users for all involved employees in SMEs and Associations, an efficient deployment of the future system for all planned functionalities.

The methods used for the training have been adapted to the needs of training on the KC Methodology and System, following the most appropriate teaching approach for the targeted audiences. The approaches include introductory lectures, coached "hands-on" training and application of e-learning tools. The training courses will be carried out through the following forms: a) In IAGs for groups of belonging SMEs as courses organised and coached by the system experts; b)In individual SMEs as courses organised and coached by the system experts; c) In individual SMEs as e-learning courses; whereby the e-learning form can be used also in all other suitable occasions and places. In order to maximize acceptance of the solutions delivered, it is essential to consider also the “human factors” such as the detailed identification of the targeted trained population, including the starting skill level and technical prerequisites if necessary. The scope and methods of the training will, thus, be adapted to the user requirements evolution (up to the training start and later for each new course and system upgrade) and different education levels.

The initial training on the KC system usage occurred during the early prototype testing by the end users, which were encouraged to work individually on the system. This initial training has resulted in an improved system understanding and has also facilitated the formal training activities. The methods to be applied for the formal training on the KC system usage have been selected assuming that all participants at the System Training sessions have attended the training on KC Methodology sessions and are basically familiar with KC system functionalities. The main part of the training will be the "hands-on" training through testing of different system application scenarios described in the use-cases, emphasizing specific interests of each group of trainees. The concluding part of the methodology training will comprise basic presentation of the practical usage of the KC system, structured according to the system-user groups.

Looking at professional development as the process of continually developing knowledge, skills and attitudes of professionals by means of formal and informal learning in the course of practice, the use of on-line knowledge communities for this purpose implies that an on-line knowledge community has to support this process. As a CIK community member, professionals in the construction sector will have a place for continual professional development that gives them individualized, flexible and easy access to a coherent and up to date knowledge domain, a range of

opportunities to interact with like-minded persons and a range of opportunities to develop and exploit the knowledge domain. An example of this is: applying knowledge, learning from it, guiding others, disseminating ideas and results or doing research, embedded in a professional network. Our premise is that the membership of professionals of an online knowledge community will have positive effects on their continuing development, expressed not only in competences like knowledge, skills, experiences and attitude, but also in the acquisition of organizational knowledge assets expressed in the growth and elaboration of professional knowledge, applicability of knowledge and legitimacy of knowledge.

Due to the different participants/targets and in order to meet the needs of the project, KC will be based on a *Project-based learning* approach. This approach, which is a comprehensive instructional approach that engages trainees in a sustained and cooperative learning experience, fostering the idea of community, will use small projects/activities as a starting point for each session. These projects have two essential components: 1/A driving question/problem or case-study that serves to organize and determine various activities, which taken as a whole amount to a meaningful project. 2/Culminating product(s) or multiple representations as a series of results or consequential tasks that meaningfully addresses the driving question (Campione & Brown, 1994). In this approach, the driving question that is anchored in a real-world problem/case-study and ideally uses multiple content areas is presented in order to lead to: 1/ opportunities for trainees to make active investigations that enable them to learn concepts, apply information, and represent their knowledge in a variety of ways; 2/ collaboration among trainees, teachers, and others in the community so that knowledge can be shared and distributed among the members of the "learning community"; 3/ the use of cognitive tools in learning environments that support trainees in the representation of their ideas: cognitive tools such as hypermedia and graphing applications (Blumenfeld et al., 1991).

3 METHODOLOGY FOR THE TRAINING RESULTS ANALYSIS

Most methodologies for analysing enterprise environments are supposedly user-centred. However this can be rather vague, for subjects have both explicit objective knowledge and knowledge that is more implicitly understood. Such tacit knowledge is among the most difficult to articulate, but it entails perhaps the most interesting and valuable information. Furthermore, such a framework implies an engagement in a qualitative inquiry, which is certainly a major risk, because one must be committed to spending extensive time in the field. Within the ESVC presented context and for the correct implementation of KC system it is vital to understand the cognitive processes that underlie users' learning and acquisition methods when training and interacting with new knowledge management approaches based on semantically enabled knowledge technologies in a collaborative learning/working environment, in order to correctly assess the evolution of individual's knowledge, opinions, beliefs and thoughts about the new technology working/sharing environment.

Therefore, an empirical study to identify the main difficulties faced by users was planned. As the particular focus of this investigation is on how the user accepts the ontology of the construction industry sector, it seems vital to carry out a naturalistic inquiry into the opinions, beliefs and experience of enterprise/community members. This was done by collecting data through interview and think-aloud protocol

elicitation methodologies, as the record and analysis of the verbal reports produced by the community members will provide a way to understand cognitive processes that underlie users' actions.

To evaluate the KCS use we decided to use the action research approach, seen here as a collaborative and iterative evaluation method that allows a continuous improvement of the solution presented to the community, as described by (Carr et al., 1986), who state that first a project takes the form of social practice; secondly, the project proceeds through a spiral of cycles of planning, acting, observing and reflecting, with each of these activities being systematically implemented; thirdly, the project involves those responsible for the practice in activity, including those affected by the practice. We share the vision of Hult and Lennung (1980), cited in (Fowler et al., 1998), to whom action research simultaneously assists in practical problem solving and expands scientific knowledge, as well as enhances the competencies of the respective actors, being performed collaboratively in an immediate situation using data feedback in a cyclical process aiming at an increased understanding of a given social situation, primarily applicable for the understanding of change processes in social systems and undertaken within a mutually acceptable framework.

It is thus a collaborative approach that requires and fosters a strong interaction between the researchers and the practitioners (Avison et al., 1999). Considering the knowledge community support (KCS) system requirements defined in the scope of Know-Construct project, this approach, as seen in the picture bellow, leads to the acquisition of results about the social acceptance of semantic resources and leads to the continuous improvement of the system functionalities provided to the community, thus generating an efficient response to the requirements of the SME community.

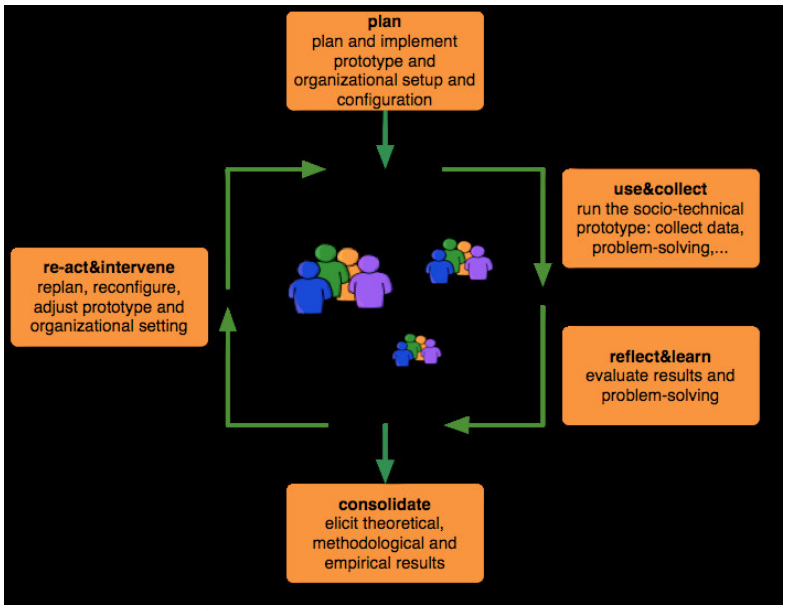

Figure 1 – The action-research approach

3.1 KC approach to the grasping of user's cognition

As a reflective and cyclical process, action research is concerned with social practice and change that leads to improvement. Thus, if the researcher wants to act in order to improve something, he needs first to find out a way to understand and examine thought and action of the social actors he is concerned with. There are many different possibilities for data collection. Among them, and as mentioned above, interviews and think-aloud protocol analyses are methods of research that have been widely used both in social and cognitive sciences for many years (Creswell, 1997). If carried out in natural environment, interviews and protocols can capture the context/scenario of the subjects' interaction. The researcher may take notes and video or audio-record whilst observing the subject. Interviews, together with thinking aloud, can provide a detailed insight into the activity or process being observed.

Think-aloud protocols were originally presented by (Ericsson et al., 1985). The purpose of this method is to understand cognitive processes by trying to capture thoughts as they are in short-term memory. Therefore, the researcher collects verbal representations of thoughts, which will be later analysed. Protocol analysis provides a means for extracting subjects' thoughts while they are performing a task. Scenarios are collected by asking subjects to solve the specific problem and verbalize their decision process by stating directly what they think. The elicited information is structured later when the researcher analyses the protocol. Here the term scenario refers to a detailed and somehow complex sequence of events or more precisely, an episode.

A different orientation is suggested by (Boren et al., 2000). To them protocols are regarded as speech acts, rather than as brain dumps. Their approach presents several advantages over the model above present. First, the listener and speaker roles are acknowledged and set in the beginning of the user test. Subjects are established as the work domain experts and primary speakers. The researcher takes the role of the listener and he can intervene at various parts. Interventions will consist of neutral language to avoid biased results.

Another possibility is on-site observation, or action protocol. This is a process that involves observing, recording, and interpreting subjects' problem-solving process while it takes place. The researcher does more listening than talking; he avoids giving advice and usually does not pass his/her own judgement on what is being observed and most of all, does not argue with the subject while he is solving the problem. Compared to the process of interviewing, on-site observation brings the researcher closer to the actual steps, experience and procedures used by the subject.

As previously mentioned, understanding the cognitive processes by which subjects retrieve new information and manipulate it to produce coherent knowledge seems to be a vital step within the current project. Thus, such an approach requires the access to users' tacit knowledge combined with qualitative data gathering tools. It was therefore our aim to adopt the interview and the think-aloud protocol elicitations in order to understand the user's cognition process before and after using the prototype.

Thus, the general aims of the elicitation procedures to be undertaken are: 1/ To understand cognitive processes underlying users' terminology research; 2/ To ask for task descriptions related to the use of semantic resources; 3/ To measure users' performance after being taught how to use the prototype; 4/ To assess the cognition

process: the evolution of individual's knowledge, opinions, beliefs, thoughts and performance after using the prototype; 5/ To evaluate the change of attitudes and beliefs toward the use of the ontology after training; 6/ To evaluate the change of attitudes and beliefs toward the notion of community; 7/ To evaluate the usefulness of the knowledge represented in the ontology.

The research carried out comprises a naturalistic approach into the opinions, beliefs and *modus operandi* and changes in the learning behavior of users, which will seek to be as conversational and reflective as possible. Using as source the model adapted by (O'Brien, 1998), primarily presented by Gerald Susman (1983) we propose a methodology for evaluating information systems with semantic resources.

The former states that each cycle of the action research process is composed by five phases: diagnosing, action planning, taking action, evaluating and specifying learning. Initially the research questions are identified and data is collected for a more detailed diagnosis. This is followed by a collective postulation of several possible solutions, from which a single plan of action emerges and is implemented. Data on the results of the intervention is collected and analyzed, and the findings are interpreted in light of how successful the action has been. At this point, the questions are re-assessed and the process begins another cycle. This process continues until the research questions are answered, as described in the picture below.

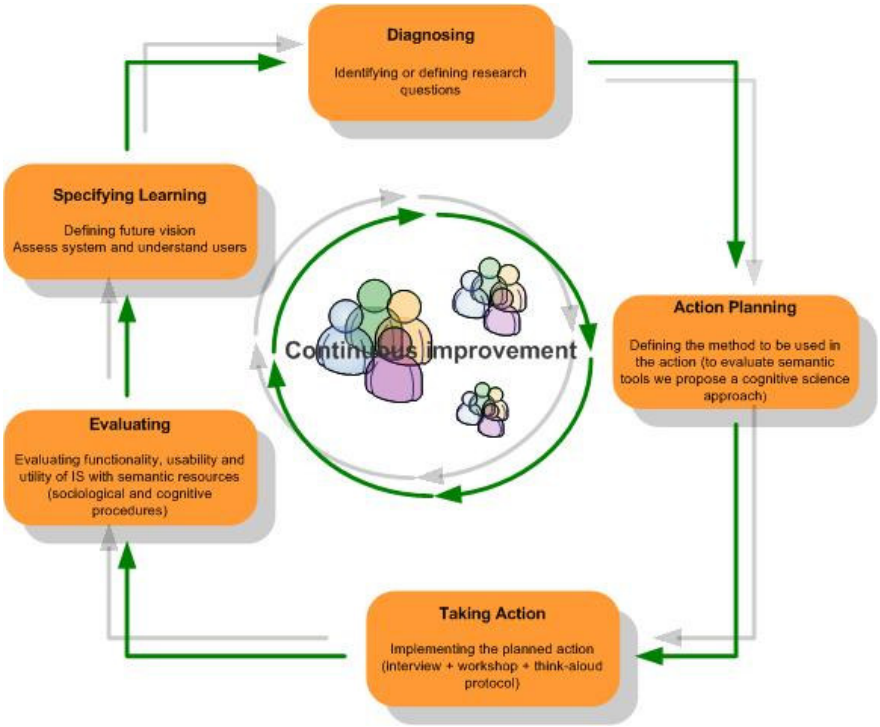

Figure 2 – Methodological approach

3.1.1 Diagnosing

The first step consists of the definition of the team that will conduct the investigation. This team comprises the authors of this paper, whose first task is to define the starting questions. Here are some of them: How do results obtained through the use and management of information based on semantically enabled tools correspond to the stakeholders/users' expectations? Does this new approach/vision collide with the conventional well-known and established one? What sort of learning/interacting problems and difficulties does this tool pose? How do users react to the use of semantic tools presented through an ontology format? To what extent do experts and non-experts accept the conceptual structure entailed by the system? What sort of interacting problems and difficulties does the notion of community pose? What sort of metaphors and image schemas do users verbalize to express their views? Depending on the type of user and organizational context, how is the use of these tools valued? What advantages/disadvantages do the users recognize?

3.1.2 Action planning

The second step requires carefully drafting the format of the interview and designing the think-aloud procedure. A naturalistic inquiry is particularly suited to settings that are dependent on individual interpretations and perceptions. Following the spirit of a naturalistic inquiry, they will be conducted on location. A clear micro-structure was developed in order to set out goals and questions to guide the interview plan.

3.1.3 Taking action

Action was taken by carrying out a workshop where the plan defined in the previous phase is implemented. The following steps were taken: 1/ To ensure that interviewees understand the questions and are comfortable with our aims; 2/ To record and transcribe interviews, with permission of the interviewees. 3/ To analyze the results and propose the necessary system revision. This action can be divided into three moments: pre-training, training and post-training. The first step - pre-training - will be a first evaluation of users' expectations and knowledge degree of semantic tools. We wanted to urge the user to think in terms of the following:

Pre-training sample questions: Are you familiar with knowledge management systems? Do you believe knowledge sharing systems will facilitate your working routine? What aspects of your behavior do you think you will need to change to use ontology? What sort of difficulties do you expect to encounter?

The users' training is then performed in which the functionalities of the information systems are presented. In the third part - post-training - new data is collected by using the think-aloud protocol methodology allowing a comparative and contrastive evaluation relatively to the system classification by the users (in terms of usability, utility and functionality). Some of the post-training questions will be: What is unique or innovative about this tool? What limitations did you encounter? What challenges did you face during the training? Is learning how to use this tool very time-consuming? What did and didn't work? How do you agree with the semantic resources?

3.1.4 Evaluating

Considering the data collected in pre and post-training moments, an evaluation of the system and a new working session was carried out. If the action is successful the necessary information to answer the initial questions will have been collected. The evaluation of the information systems in terms of usability, functionality and utility can then be accomplished. Considering the data collected in the previous phase, it is necessary to consider the perspective of continuous improvement, the changes that should be made and new functionalities to be developed so that the system is fully and successfully implemented. These changes will be established in the next cycle of the process.

3.1.5 Specifying learning

The action research cycle continues considering the results of the evaluation accomplished in the previous phase. This is the moment to define the future vision and to evaluate the need to execute another cycle. If the results obtained in the previous phase are satisfactory, the process will stop during one month. At the end of this period, using direct observation, a new observation in the context of the working place and a new evaluation of the system's acceptance and usage will be performed. The results will determine whether there is a need to extend research to a new cycle of the process.

4 CONCLUSION AND FUTURE PERSPECTIVES

Being an experimental approach, the authors are aware that the quality of the study and the accuracy of the steps to be taken need careful evaluation. The outcomes of this research are being analysed and are expected to provide a deeper level of understanding of how CIK community members respond to the prototype and to assess their cognition process, namely to understand their attitudes toward the use of the ontology; to know how they evaluate the usefulness of the knowledge represented in the ontology and to measure users' performance when using/testing the prototype.

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