DEVELOPING THE SKILLS NEEDED FOR REQUIREMENT ELICITATION IN GLOBAL SOFTWARE DEVELOPMENT

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Abstract: The requirement elicitation stage is that which is most critical in the development of a software product. However, this stage is not covered on teaching courses with the required depth, nor is invested the necessary time in training students and practitioners in these tasks. There is currently a trend towards global software development (GSD) which complicates the process of elicitation requirements since, for instance, communication is more difficult because stakeholders are geographically distributed. Moreover, the elicitation in GSD involves a variety of characteristics that are not often taught in software engineering courses. This paper presents some of the most important factors which may affect elicitation in GSD. Furthermore, we propose techniques with which to help students and software engineers to develop some of the skills needed to carry out the elicitation process in GSD.

1 INTRODUCTION

Independently of the methodological approach used, the requirement elicitation phase is the first step in the process of developing a software product. In such stage requirements are discovered and documented fulfilled which must satisfied by the software in order to satisfy expectations and needs for clients and users. The aforementioned stage is the most critical phase in software development, because the mistakes made at this stage are more expensive and difficult to resolve owing to their impact upon the other stages. In fact, the 85% of the defects in software systems come from the requirement elicitation stage: 49% from incorrect assumptions, 29% from omitted requirements, 13% from requirement inconsistency and 5% from ambiguous requirements (Young, 2002).

Given the importance of this stage is fundamental to have professionals trained in this process, who are capable of accomplishing top-quality requirements elicitation. However, professionals who have recently graduated from universities lack the skills and abilities necessary to carry out this stage properly because during their degree little time is usually spent on training in this phase of software engineering and they often do not perform professional practices. In fact, according to a survey dealing with university curriculums carried out amongst 214 software engineers, the requirements elicitation process is ranked second among the topics that should be improved in its teaching at universities and third among the topics that may have the greatest need for training (Lethbridge, 2000). This is a problem for companies since they have difficulties in recruiting qualified personnel, and it is also a problem for new graduates who may be discriminated against because of their lack of experience. Because students do not graduate with the skills necessary for requirement elicitation, they must acquire these skills during their company training, and it is therefore companies which take the responsibility for and assume the costs of such training.

With the arrival of new trends in software development, the gap between what is taught in universities in the field of requirements engineering and what takes place in practice is widening. One of these trends is Global Software Development (GSD) (Herbsleb, 2007). GSD has grown considerably in recent years due to the culture of globalization and other factors

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such as offshoring, and it will continue to do so (Aspray et al., 2006). However, this practice is causing some challenges (Herbsleb and Moitra, 2001): problems caused by inadequate communication, problems caused by the cultural diversity, problems in knowledge management, and problems caused by time differences.

The objective of our work is to study what factors influence the global requirement elicitation process and to propose a set of techniques through which to develop some of the skills needed for this process in students and practitioners.

The following section describes the most important factors that influence the success or failure of an elicitation requirements in GSD. Various skills which would be desirable in order to carry out this process are outlined in Section Three. Our proposal is explained in Section Four, and finally in Section Five some conclusions and future work are presented.

2 FACTORS INVOLVED IN THE REQUIREMENT ELICITATION IN GSD

Multiple factors determine the success or failure of a GSD project. Herbsleb and Moitra (2001) present the problem of GSD and raise the issue of the dimensions that characterize it. These are: strategic issues, cultural issues, inadequate communication, knowledge management, project and process management issues, technical issues.

These dimensions were studied by Damian and Zowghi (2002) in order to identify how these problems affect each phase of engineering requirements. The challenges identified for the elicitation stage are shown below: differences in customer culture and business (Cultural diversity), achieving appropriate participation of system users and field personnel (Inadequate communication, Time difference), and manage conflict and have open discussion of interests (Inadequate communication, Knowledge management, Time difference).

Rafo and Setamanit (2005) present a list of important factors in GSD which is grouped into three categories:

- *The fundamental factors:* Communication problems, Coordination and control problems, Cultural differences, Language difference, Time-Zone differences.
- *The strategic factors:* Development site, Product architecture, Development strategy, Distribution overhead, Distribution effort loss.
- *Organizational factors:* Team formulation, Team dynamics.

Bhat et al. (2006) identify the success factors in offshoring outsourcing projects based on root-cause analysis. The factors which were identified are: Shared goal, Shared culture, Shared process, Shared responsibility, Trust.

In summary, the factors that have a major impact in the requirements elicitation in GSD. The factors are the following ones: cultural differences, communication, time difference, knowledge management, language difference, trust, team formulation and team dynamics.

These relevant factors are considered in the definition of the basic skills for the requirements elicitation in GSD presented in the following section.

3 BASIC SKILLS FOR REQUIREMENTS ELICITATION IN GSD

A list of 31 skills which are necessary for analyst requirements is presented in Young (2006) . Some of the skills presented are the following: criteria for a good requirement, customer/user involvement with requirements (joint team), identifying real requirements (from the stated requirements), anticipating and controlling requirement changes, and so on.

This list of abilities is a good starting point, but it does not consider particulars aspects of elicitation in GSD.

Different skills for GSD are discussed in the literature. By example, the next list of skill is presented in Damian et al.(2006): international Teamwork, computer mediate communication, iterative development in remote client-developer relationships, living with ambiguity/uncertainty in remote teams, and distributed project management.

Taking into account those skill and the factors mentioned in the previous section, we identified the following basic skills that a global requirement engineer should have:

Knowledge of culture. A knowledge of the norms, beliefs, business ethos, and skill in the native language of the potential client is highly important (Nguyen et al., 2006; Huang and Trauth, 2007). Therefore software engineers should get used to dealing with people who have different customs, culture and even ways of interacting.

International Teamwork. Work in distributed teams to solve large problems and collaborative development of shared understanding of project goal and constraints (Damian et al., 2006), in addition the skills to elicit requirements in distributed environment.

Communication skills. As was mentioned in the previous section, one of the biggest problems in GSD is communication because stakeholders are geographically distributed. To face this problem the engineers need the following skills:

- Conversational skills in English language, because it is the most common business language (Adya, 2006; Huang and Trauth, 2007; Richardson et al., 2007).
- Knowledge of Communication protocols and strategies, in order to avoid potential miscommunications and misinterpretations (Huang and Trauth, 2007; Richardson et al., 2007).
- Using groupware tools such as: e-mail, video conference, wiki, instant message, and so on to communicate. Therefore, one of the skills that a software engineer should have is knowing how to use this kind of tools in order to obtain the maximum benefit from them (Damian et al., 2006; Richardson et al., 2007).

4 TECHNIQUES TO DEVELOP SKILLS

In order to develop these skills in software engineers or even in students we propose using techniques of simulation and artificial agents.

Simulation is a technique which has been used in teaching for many years. It is successfully used, for example, in medicine and aviation. The main advantage is that it allows students to train themselves without the risk of a real environment and at a lower cost.

Educational Virtual Environments (EVEs) are frequently used for simulation. These environments use Virtual Reality (VR) to create virtual worlds in which students (Ieronutti and Chittaro, 2007):

- Directly experience certain physical properties (e.g. shape, size and time duration) of objects and events.
- Change their point of view in order to access new and/or unusual perspectives.
- Interact with objects either to discover and study their hidden elements or to evaluate the effects of their manipulation.

In training EVEs can, moreover (Ieronutti and Chittaro, 2007):

- Provide a low-cost alternative to creating full-scale physical training scenarios.
- Offer the opportunity to create a wide variety of scenarios including those rarely (or never previously) encountered in the real world.
- Simulate training scenarios that can be run repeatedly.
- Include a monitoring of progress during training sessions to evaluate learners' skills.

In Sims (2007) an EVE is presented which uses a Virtual Human with the goal of training students in the Arabic language and in Arabic cultural familiarization. Some of the cultural aspects that are discussed in this EVE are:

- Appropriate and inappropriate use of honorific and family names.
- Colloquial terms for policemen, soldiers, and strangers.
- Iraqi gestures that may be misinterpreted by Americans, and American gestures that may be misinterpreted by Iraqis.
- Methods to calm tense situations.
- Proper and improper ways in which to interact with Iraqi women.
- Showing respect for family relationships.

Other EVE is Lok (2006) where the virtual Human are use for simulating the patients who are interviewed by the students of medicine. The interaction between virtual patient and students are talk in a natural manner.

In the context of global requirement elicitation, a simulation environment that uses virtual reality will be useful in teaching students and practitioners how they should perform interviews or maintain a conversation with different types of stakeholders.

The artificial agents paradigm constitutes a natural metaphor for systems with purposeful interacting agents, and this abstraction is close to the human way of thinking about their own activities (Wooldridge and Ciancarini, 2000). This foundation has led to an increasing interest in social aspects such as motivation, leadership, culture or trust (Fuentes et al., 2004).

We propose the use of artificial agents to model the EVE because:

- Agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal states (Autonomy).
- Agents interact with other agents (and possibly humans) via some kind of agent communication language. This feature will be highly important in the simulation of human interactions in distributed teams (Social Ability).

- Agents perceive their environment and respond in a timely fashion (reactivity).
- Agents can take the initiative and achieve their own goals (Pro-activeness).

It is therefore possible to implement an EVE with different agents which have different types of behavior and simulate people of different cultures, characters or language, thus assisting software engineering and students to develop the desirable skills work in elicitation groups in GSD.

5 CONCLUSIONS

GSD is a current trend. However, although this paradigm has several advantages it also brings certain disadvantages which have been summarized in this paper. In order to decrease the effect of some of these problems we propose using different techniques to train students and practitioners in working with people who are geographically distributed and who may have different cultures, languages and time zones.

As future work we are going to develop of a simulator based on virtual agents which will allow students to be trained in the process of elicitation requirements in the area of global development. The agents will permit the simulation of stakeholders' behaviour by considering cultural, cognitive and geographic aspects, and also time differences.

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