Using a Software Development Environment with Knowledge Management to Support Deploying Software Processes in Small and Medium Size Companies

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Abstract. This paper addresses the use of a software development environment to support software processes deployment in small and medium size Brazilian companies. The objective of this project is to increase the capability of software organizations through the adequate use of Software Engineering techniques in its development and maintenance processes. The benefits of the project are the increase of software organizations competitive advantages and the enhancement of software products.

1 Introduction

Process-Centered Environments are the most recent generation of environments supporting the software engineering process, they aim to drive and assist developers in the application of software development methods, by exploiting an explicit representation of the process [5]. Software Development Environments (SDE) has been playing an important role to support software engineers in the execution of software processes through the application of specific procedures that combine integrated tools and techniques in accordance to particular software paradigms. Moreover, SDE are evolving to integrate knowledge management activities within software processes aiming to foster the institutionalization of a learning software organization [3]. Other approaches aims at providing an infrastructure that integrates process-centred software engineering environments with Knowledge Management [6, 7] (by implementing the Experience Factory proposed by Basili et.al. [10]).

This paper addresses the use of a software development environment to support the deployment of software processes in small and medium size Brazilian companies. The objective of this project, named QualiSoft, is to increase the capability of organizations through the adequate use of Software Engineering techniques in their software processes. By achieving this objective, not only the organizational competitive advantages increases, but also the quality of software products enhances.
Since the focus is on small and medium organizations, we executed the project with a pool of organizations with similar characteristics aiming to decrease the overall cost and increase the project feasibility. This project is a result of a contract between the RioSoft (a non-governmental organization that integrates the Softex Program - Society for the Support of Brazilian Software Production and Exportation) and the Federal University of Rio de Janeiro. The first phase of the project started on August 2003 and aimed to address a pool of 10 organizations. The second phase, started on January 2004, addressed a second pool of 9 organizations.

The following activities were conducted:
(i) definition of software development and maintenance processes adjusted for small and medium companies;
(ii) training in Software Engineering methods and techniques and in the software processes defined;
(iii) use of CASE tools integrated in a software development environment configured with the TABA Workstation [1] and strongly supported by Knowledge Management during the deployment and use of the software processes defined; and
(iv) follow-up of the companies in the deployment of the software processes through the execution of pilot projects.

Section 2 presents the definition of the software process and training carried out during the two phases of the project. Section 3 presents a discussion on the automated support provided by the tools of TABA Workstation. The lessons learned are presented in section 4. Finally, section 5 presents our conclusions and perspectives.

2 Software Process Definition and Training

The first step in the execution of the project was to be acquainted of the individual characteristics of the organizations. In order to do so, each organization filled out a detailed form and the process specialists had to schedule regular visits on the organizations. The form contained questions related to the organizational culture, software process stages and quality management systems adopted software development practices, main problems in the current software development and maintenance processes, and organizational objectives related to software process improvement.

The following step was to define software development and maintenance standard processes adequate to small and medium organizations. The processes defined on the first project phase were based exclusively in the international norm ISO/IEC 12207 [8]. For the second phase, these processes were refined and adjusted to be completed adherent to the practices defined in the CMMI [9] Level 2 process areas.

In parallel to the processes definition activity, the members of the organizations were trained in the Software Engineering methods and techniques. During the first phase, approximately 32 hours were spent on training. This training was performed under the form of lectures on the following topics: Software Engineering, Software Process, Requirements Engineering, Configuration Management, Project Management and Software Products Quality. Approximately, 80 professionals were trained during
this phase. After the theoretical training, project managers and software developers participated on a specific training on the standard software processes defined. The training during the second phase considered other important topics, such as Peer-review, Tests, Measurement and Analysis, Supplier Agreement and Knowledge Management, constituting more 44 hours to the overall training time. During the second phase, more than 70 organizational members were trained.

The following steps focused on the deployment of the processes and the configured environment in the organizations. These steps had been carried out individually considering the particularities of each organization. Initially, the standard processes had been adapted to each company considering the characteristics identified in the beginning of the project, such as types of software developed, documents produced and software development paradigms adopted. After the approval of the adaptations by the organization, a software development environment was configured based on these adaptations. The next section presents the steps performed to configure an environment.

3 TABA Environments

The TABA Workstation is a software development environment that until 2003 was exclusively used in the academic area and involved more than 50 master and doctoral theses in the Federal University of Rio de Janeiro. It was created from the perception that different domain applications have distinct characteristics that influence in the environment from which software engineers develop software [1]. During the last years, the TABA Workstation evolved to comply with the different levels of capability maturity models of software organizations.

Although the academic results of the TABA Workstation were excellent, the system was not intended to be used as a commercial product. The QualiSoft project made significant changes in the project goals. During the beginning of the QualiSoft project, RioSoft affirmed that in order to achieve the project goals, some automated support should be provided to the organizations aiming to facilitate the application of software processes. Therefore, we decided to make available the TABA Workstation to all organizations at no costs.

A configured environment was delivered to each organization considering the specific characteristics of the organization and the development and maintenance standard processes. From this environment, specific environments for each pilot project were created through the adaptation of the standard processes according to project specific characteristics. These process-centered environments are strongly supported by Knowledge Management [2][3].

The CASE tools integrated in the environments offer automated support to: (i) adaptation of the organization standard processes for a specific project; (ii) definition of the organizational structure [2]; (iii) acquisition, filtering, packaging and dissemination of organizational knowledge [3]; (iv) planning the organization of specific projects; (v) time, costs, risks, human resources planning, monitoring and control [2, 4]; (vi) planning and execution of Configuration Management activities; (vii) identifica-
tion of software product quality requirements; (viii) documentation planning; (ix) supporting the planning and monitoring of corrective actions; (x) supporting measurement and analysis activities based on the GQM method; (xi) project monitoring through the generation of periodic reports and measures; (xii) controlling of the activities executed during a specific project; (xiii) requirements management; and (xiv) post mortem analysis.

The configured environments had been installed in the organizations and a hands-on in the environment tools was carried out. After this training, the pilot project was initiated using the software processes defined and the environment implanted.

4 Lessons Learned

During the first phase of the project, we learned the following lessons:

(i) the deployment of software processes in a group of organizations in a common project and at low cost is feasible (the amount of money spent by each company was about 40% of which would be spent in a similar project to be conducted by only one organization);

(ii) the configured environments facilitates training, deployment and institutionalization of software processes (by providing case tools to assist and automate the realization on each project of repetitive tasks like process instantiation, project planning, controlling and monitoring);

(iii) the knowledge management approach adopted in the environments is determinant for the success of the approach, because it helps the developer in executing its activities by providing useful knowledge when the developer needs it the most;

(iv) the knowledge acquisition approach integrated into the CASE tools [2] enables the gradual evolution of the knowledge repository with acquisition and dissemination of lessons learned, best practices and ideas to improve the software processes.

The lessons learned were identified during the regular meetings to support the software process deployment in the organizations. They were also confirmed through a formal report one of the organizations sent to the QualiSoft project team after successfully applying to an ISO 9000:2001 Certification.

5 Conclusions

This paper presented a successful approach for deployment of software processes in small and medium organizations supported by software development environments and knowledge management.

The results of this project are excellent under different aspects. First, it showed the feasibility of carrying out the project with very particular characteristics since the costs were significantly diminished. Second, it showed that it is possible to promote technology transfer between universities and other kinds of organization producing
good results to all the involved parts.

Currently, more than 30 Brazilian companies use the TABA environments to support the execution of their software processes, including some Brazilian governmental organizations.

Further information about Enterprise-Oriented Software Development Environment and its case tools can be found at http://www.cos.ufrj.br/~taba.

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