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Reinforcing the applicability of multi-model environments for software process improvement using knowledge management

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ABSTRACT

Nowadays software development organizations look for tools and methods that help them maintain their competitiveness. A key approach for organizations in order to achieve this competitiveness is a successful implementation of software process improvement (SPI). Unfortunately, most of the times, software process improvement involves a path full of obstacles due to the lack of knowledge for choosing the right implementation. The most common and critical problem consists of the selection and application of the right reference model for guiding this implementation. As an effort for helping organizations in the selection of the right implementation of improvements, multi-model environments arised enabling the use of best practices from different reference models. Multi-model approach facilitates the improvement task in order to achieve the organization's business goals. In this context, effective integration of models and standards can play a crucial role in the implementation of multi-model environments as reference support tool. Nevertheless the use of multi-model approaches presents difficulties related to the lack of knowledge of how to manage the amount of information and the correct integration of different models and standards. In this sense, knowledge management technologies have proven to be highly promising support for knowledge sharing and system integration. This work presents an ontological framework based on a multi-model approach, which facilitates and supports the SPI for small and medium companies for a life cycle process improvement. Life cycle process improvement pursues the necessary actions in a deliberate, structured and methodical manner, required in each stage of the life cycle of software development, capable for improving process to current organization needs. Finally, a case study is presented in order to show the performance of the framework.

1. Introduction

Software has emerged as a means for creating value to products and services, by aiding companies and organizations to develop their activities, thus improving their competitiveness and differentiation. Then, the software industry is becoming one of the most important factors in the core of the economy around the world [1]. As result of the increasing importance of software, new challenges and demands on software development, operation and maintenance appear [2].

Due to this importance, software companies have the challenge to assure high quality as well as the fast development of their products. In this context, it is well known that quality in software products depends largely on the processes

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development [3]; therefore, process improvement allows organizations to be more efficient and effective, creating strategic advantages with respect to their competitors ensuring quality [4].

However, for organizations involved in software development, most of the times, process improvement tasks becomes a full obstacles path due to the lack of knowledge toward a proper implementation way. Moreover, the most critical and common problem regards the selection and application assignment of the correct improvement reference model, which better fits to the organization reality, taking into account that most of the time organizations are under mandatory or market pressure to use more than one improvement model [5,6].

One promising solution is the use of multi-model environments for software process improvement. According to Lawrence and Becker [7] a multi-model aims to reduce redundancy, to improve integration, to create synergy, to leverage best practices, and to make frameworks transparent.

It is important to highlight that for this research work a multi-model environment involves cultural aspects and the knowledge that advises the use of the mix of best practices in each process from more than one model or standard in order to achieve the organization's business goals.

The proposed multi-model framework aims to adopt and integrate several international standards and models used to perform software improvement tasks such as Development (CMMI-DEV) [8]; Team Software Process (TSP) [9]; Project Management Body of Knowledge (PMBOK) [10]; ISO/IEC15504 Information technology – Process assessment [11]; ISO 9001:2000 – Quality Management System [12]; ISO/IEC 12207–2008 [13] and Six sigma [14]. Unfortunately, the difficulty of reaching a successful implementation of process improvement using multi-model environments increases, due to the amount of the possibilities for improvement (best practices suggested), which results in a difficult decision making task. In other words, when organizations try to use multi-model environments, the labor of managing the big amount of information derived from those approaches arises as the main problem.

In order to tackle the above mentioned problems, this paper proposes a framework based on knowledge management in order to support the establishment of multi-model environments, capable of improving and coordinating the exchange of information among different models and standards for software processes improvement. This framework makes use of knowledge models, namely domain ontologies and folksonomies, which allow the creation and maintenance of knowledge by making it usable for specifically functionalities. Even more, these approaches allow the re-usability of the knowledge for different application cases, by developing general and robust knowledge models. Finally, a case study is presented, which aims to demonstrate the integration between multi-model environments and knowledge technologies. Thus, the main task of the developed framework is the suggestion of best practices (by the use of an applications), supporting the information management and decision making tasks.

This paper is structured as follows: after this introduction, section two presents the related works; section three introduces to the background of the multi-model framework; section four presents the methodology to develop the knowledge model; section five shows the implementation of the methodology to create the ontological model, which shows the creation of the process ontology model; section six shows the ontological model developed; section seven presents the case study; and finally, section eight shows the conclusions.

2. Related works

In the area of software process, not many approaches which adopt ontologies as a means for representing processes have been reported. Rodriguez et al. [15] describe how software process ontologies can be derived from software and systems process engineering meta-model (SPEM). SPEM formalizes the way of representing software engineering processes in relation to both their static and dynamic concepts (activities, roles, tasks and work products). The authors include rules for considering reasoning and logics. Thus, Vizcaino et al. [16] describe an ontology for global software development (GSD) to facilitate communication among members and to avoid misunderstanding. Valiente et al. [17] describe an IT service management/software engineering integration model as an approach to integrate SE and IT ontologies. Pardo et al. [18] present an ontology, which provides the main concepts related to harmonization of multiple models; is supported by a web tool and; has been applied for the harmonization of COBIT 4.1, Basel II, VAL IT, RISK IT, ISO 27002 and ITIL.

Gokhan and Mieczyslaw [19] describe an ontology that uses rating and a sequence of improvements based in a representation of the CMMI-SW model. The ontology was developed using OWL language. Amir Azim Sharifloo et al. [20] present an ontology to represent the CMMI-ACQ based on SUMO upper ontology using SOU-KIF languages. The ontology aims to assess the maturity level of an organization automatically towards reducing the problem of unintentionally mistaken of verifying the relationships between various practices and goals in an organization. Svatopluk Stolfa et al. [21] describe a semi-automated assessment and evaluation of software process similarity using ontologies as background for managing process definition. The main differences of the ontologies presented in the related works and our developed framework are: 1) our framework is capable of representing any software process system using the general process ontology, which captures and homogenizes the structure of processes found in software organizations, as well as those found in standards and models of process improvement and 2) our framework is focused in the correct implementation of process improvement integrating and using a multi-model environment based on the organization's processes and business goals.