On the Design of a Knowledge Management System for Incremental Process Improvement for Software Product Management

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ABSTRACT

Incremental software process improvement deals with the challenges of step-wise process improvement in a time where resources are scarce and many organizations are struggling with the challenges of effective management of software products. Effective knowledge sharing and incremental approaches are essential for improving the success rate of process improvement efforts. Recently, the authors' have worked on the development of a knowledge management system, the Online Method Engine, that enables incremental, situational process improvement in the field of software product management. This has resulted in an initial system design. The authors describe the findings from seven exploratory case studies on incremental process improvement. The lessons learned during these case studies are used to refine the design of the Online Method Engine.

Keywords: *Experience Management, Knowledge Management, Method Engineering, Software Process Improvement, Software Product Management*

INTRODUCTION

Software process improvement (SPI) has been the subject of many scientific undertakings during the last decades. SPI is not a simple, one-time activity. Changing an organizational structure and its rules and processes has tremendous impact on that organization. During each process improvement effort, several aspects play a role, such as the organizational culture, technical support, and human capabilities (Basili & Green, 1994; Shih & Huang, 2010).

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Because requirements for SPI efforts are often incomplete, contradictory, ever-changing, and difficult to recognize, and because there is no perfect solution that fulfills all requirements, we can classify SPI as a wicked problem (Churchman, 1967).

Recent SPI literature shows appropriate attention for the wicked nature of SPI. Software engineers have been working with different process improvement models such as CMM (Paulk & Curtis, 1993), SPICE (Dorling, 1993) and the more bottom-up approach Quality Improvement Paradigm (QIP) (Basili, 1993). Unfortunately, lack of resources, time pressure, and the difficult nature of change often prevent successful process improvement efforts (Baddoo, 2003).

One key success factor that is mentioned in many studies is the need for iterative and incremental improvement. A systematic literature review revealed that process improvement programs need to be guided in "an iterative and incremental approach (…) that allows a continuous adoption of improvement practices" (Pino, García, & Piattini, 2007). In addition, Sawyer, Sommerville, and Viller (1997) state that process improvement should not be seen as a one-step process, but as a sequence of several improvement cycles in which good practice can be introduced in the organization. An advantage of incremental improvement as opposed to revolutionary improvement is that it is a fundamental way to reduce risk on complex improvement projects (Krzanik & Jouni, 2002).

From a knowledge management perspective, incremental improvement has specific advantages as well. Experience suggests that "companies can institutionalize incremental improvement (…) with those doing the work identifying and implementing small changes in product and process" (Davenport, 1993). Furthermore, the introduction of knowledge management in the software development domain led to the new area of experience based process improvement (Sharma, Singh, & Goyal, 2010, 2011). In this approach knowledge that is created during software processes can be captured, stored, disseminated, and reused, so that better quality and productivity can be achieved (Sharma et al., 2010).

Research during the past decade has shown a need for process improvement support that takes the situation of the organization into account, enables incremental implementation of improvements, and that pragmatically leverages existing knowledge and experience (Pino et al., 2007; Sulayman, Urquhart, Mendes, & Seidel, 2012). Unfortunately, although experience management is gaining interest and there is increasing support for building knowledge bases (García, Amescua, Sánchez, & Bermón, 2011), there is no proof that current method bases and knowledge infrastructures are effective. Practitioners do not always know exactly what they are looking for, or how to apply a formal method description to the processes of their organization (Niazi, 2011).

During the past years, we have designed an approach to process improvement that addresses the issues of evolutionary improvement, situationality, and knowledge dissemination. This has resulted in the design of the Online Method Engine (OME); a knowledge management tool for incremental SPI. The OME is based upon various other research projects. The design process of the OME can be described in terms of the Systems Development Research Process (SDRP) by Nunamaker Jr., Chen, and Purdin (1990) (Figure 1).

As consistent with the SDRP, the analysis, design and development of the OME are ongoing activities. This means that the conceptual framework, the system architecture and the design of the OME are constantly changing. However, a significant body of research has been published in recent years that form the conceptual framework on which the development of the OME is based. The main purpose of the next section is to outline this conceptual framework and the resulting initial system architecture. Consequently, we have integrated the related literature discussion with a description of the initial OME design. In the following section, we further analyze the problem and solution space based on the findings from seven exploratory case studies, resulting in an