KNOWLEDGE MANAGEMENT SUPPORT FOR SYSTEM ENGINEERING COMMUNITY

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Abstract: Knowledge is recognized as a crucial resource in today's Knowledge Intensive Organizations. Creating effective Knowledge Management systems is one of the key success factors in Process Improvement initiatives like the CMMI, SPICE etc. This contribution aims to provide a starting point for discussion on how to design a Knowledge Management System to support System Engineering activities. After motivating the problem domain, we introduce a conceptual model supporting continuous learning and reuse of all kinds of experiences from the System Engineering domain and we present the underlying methodology.

1 INTRODUCTION

In today's highly dynamic environment the effective use of all available Corporate Knowledge is indispensable for success. Knowledge Management (KM) tries to tackle this problem by providing methods and tools to support the creation, acquisition, capitalization, sharing and effective use of knowledge in social settings. To this end, a promising approach is the development of a Corporate Memory (CM).

A Corporate Memory is an explicit, disembodied and persistent representation of knowledge and information in an organization, in order to facilitate their access and reuse by members of the organization, for their tasks (Rabarijaona *et al.*, 2000). The main objective of building a Corporate Memory Management System is the coherent integration of this dispersed knowledge in a corporation with the objective to promote knowledge growth, promote knowledge communication and in general preserve knowledge within an organization (Steels, 1993).

System Engineering (SE) is a knowledge-intensive process encompassing requirement gathering, design, development, testing, deployment, maintenance, and project coordination and management activities. The System Engineering process could be defined as an iterative process of problem resolution aiming at transforming user's requirements into a solution satisfying the constraints of: functionality, cost, time and quality (Meinadier, 2002).

It is highly unbelievable that all members of a development team possess all the knowledge required for the activities mentioned above. This underlies the need for KM support to enable SE organizations to:

-Effectively share domain expertise within development team;

- Identify the requirements of a system;

-Reuse non-externalized knowledge of the development team members;

-Bring together knowledge from distributed individuals to form a repository of organizational knowledge;

-Retain knowledge that would otherwise be lost due to the loss of experienced staff; and Improve organizational knowledge dissemination to support quality and process improvement initiatives.

Meeting these demands requires fast, continuous learning and reuse of past experiences within project teams or Communities of Practice (Wenger, 1998).

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We here focus on system process improvement through transfer of experience, to create what we could call "learning System Engineering organizations".
In this paper we argue that an interesting approach for System Engineering activity support lies in the adoption of a process-oriented Knowledge Management strategy (POKM) A POKM strategy aims to provide project members with task-relevant knowledge in corporate operational processes (Maier *et al*., 2001).. As opposed to a purely document-centric perspective for KM, it examines what processes create knowledge assets and how to represent this contextual knowledge in a Corporate Memory.
The paper is structured as following: the first section introduces System Engineering domain and presents our motivations for supporting SE Community with a Knowledge Management System. The second section gives an overview of existing Corporate Memory construction approaches that are relevant for SE domain. Based on existing approaches and industrial needs, we propose a KM System for SE community in section three. Finally potential issues for future research directions are outlined.

2 CONTEXT AND MOTIVATION

2.1 System engineering domain

A cartography of SE processes according to the Standard ISO 15288 includes:
Agreement Processes: Acquisition, and Supply
Enterprise Processes: Enterprise Environment Management, Investment Management, System Life Cycle Process Management, Resource Management, and Quality Management
Project Processes: Project Planning, Project Assessment, Project Control, Decision-making, Risk Management, Configuration Management, and Information Management
Technical Processes: Stakeholder Requirements Definition, Requirements Analysis, Architectural Design, Implementation, Integration, Verification, Transition, Systems Analysis, Validation, Operation, Maintenance, and Disposal

2.2 Motivation for KM in SE

We constantly gain experience with each development project. "Knowledge emerges in work practices, often being defined by the first project to address the issue involved". (Henninger, 2003). In this section, we discuss the advantages of KM support for SE community.

Various attempts have been made to Quality Improvement in SE domain. According to the standard IEEE 1220, continuous process improvement in SE could be addressed through:
The application of an auto-evaluation program that determines the degree of maturity in SE practices like CMMI
Capitalization and transfer of experiences gained with each development project (Meinadier, 2002).
We here focus on se Process Improvement through knowledge capitalization. We propose a Corporate Memory structure to support SE activities by arguments that create a result. Expressions can be used as values in any command. providing pieces of relevant experiences, competencies, tools, methodologies, process models and reusable components.

3 RELATED WORKS AND POSITIONING IN THE STATE OF THE ART

Knowledge Management is a very complex problem and can be tackled from several viewpoints: socio-organizational, financial and economical, technical, human and legal (Barthes, 1996)
One approach for managing knowledge in organizations is to set up a corporate memory. The corporate memory is in charge of insuring persistent storage, indexing and diffusion of relevant pieces of knowledge within the organization. (Gandon, 2002)
In the following, we present an overview of some relevant methodologies to construct Corporate Memories. (Dieng *et al*., 1998)
Non Computational Corporate Memory ; **Document-based Corporate Memory** (Dieng *et al*., 1998); **Competence Management systems** (Rus et al., 2001) ; **Knowledge-based Corporate Memory** (Strohmaier, 2003) ; **Case-based Corporate Memory ; Process-oriented Corporate Memory** (Abecker *et al*., 2001),

4 CONCEPTUAL MODEL FOR SYSTEM ENGINEERING KNOWLEDGE MANAGEMENT SYSTEM (SEKMS)

4.1 Basic principles of SEKMS

This section discusses basic principles guiding the design of our approach

Process centered approach for KM: the hypothesis stating that Knowledge is tied to action leads us to consider knowledge capture inside processes. We argue that knowledge management activities cannot be separated from other business processes, because knowledge emerges within business processes (Maier, 2001). Thus, knowledge that emerges in a process can be stored together with its process context.

Multi-perspective approach: typically, corporate memories are supported by centralized approaches. Thus, knowledge about people, knowledge about processes, and domain knowledge are represented and maintained as information in global repositories which serve as sources to meet a knowledge worker's knowledge needs.(Abecker, 2004). We propose to better balance between the needs of smaller organizational units and the more global KM concerns, by providing each community the capability of managing its own knowledge. We propose to design a distributed organizational memory as a constellation of set specialized OMs.

Proactive delivery of relevant knowledge: a proactive knowledge delivery methodology addresses the dissemination of knowledge assets in a just-in- time manner in the context of its applicable targeted processes. (Abecker,*2004)* It allows knowledge retrieval when it is applicable to the task in which a user is currently engaged. To achieve this goal, we propose to adopt intelligent agent technology to procure crucial knowledge to users.

4.2 Architecture of SEKMS

In the context of SE activities, both informal knowledge (such as documents) and formal knowledge (such knowledge represented by a knowledge model) are needed. Therefore our approach aims to design a CM architecture where the CM can be composed of different sorts of memories: documents, knowledge bases etc. And thus, combining several techniques for CM construction is needed. Figure 1 shows the different components of the SE Knowledge Management System (SEKMS). We distinguish three principal perspectives.

Business process perspective: provides the description of the real business process.

In a business process, knowledge exists in the form of data and information in combination with experience, communication, reflection, expertise, techniques and cognitive abilities.

Our approach begins with a careful analysis of the existing business processes, in order to identify what kind of knowledge is created/used by whom in the context of his daily work. This analyze includes both the explicit and the tacit form of knowledge. It includes the identification of tools, documents, models, -defined roles, and codified procedures. But it also includes all the implicit relations, the tacit conventions, the recognizable intuitions, the specific perceptions, the embodied understandings, the underlying assumptions, the shared worldviews, the sequences of collaboration, which may exist in implicit form, connected to the activities of employees in the context of running activities. The output of this business process analyze, is a set of raw experiences captured and then enriched with context attributes.

Knowledge structure perspective: Provides a formal structure to describe knowledge assets. A common approach to model knowledge in corporate memory is to take document-centric approach. As SE experiences are complex and diverse, our CM is defined in term of knowledge components (KC) instead of documents. A KC can be a process model fragment, a best practice, a lesson learned, a product model, a requirement, or comment on a business process et. Providing that we work on different KC structures, we propose to rely on several knowledge representation techniques for representing KC in the CM. Thus, we propose using: conceptual graphs, lattices, semi-structured documents etc., in order to provide more flexibility and consisted ness in KC representation.

Meta Knowledge Model perspective The Meta knowledge model is a unified view that structures the content of the CM. It provides explicit formal specifications of the concepts and terms in the SE domain and the relationships among them. This meta knowledge model is not yet well specified, we plan to generate it through synergies between standards Meta models proposed in SE literature.

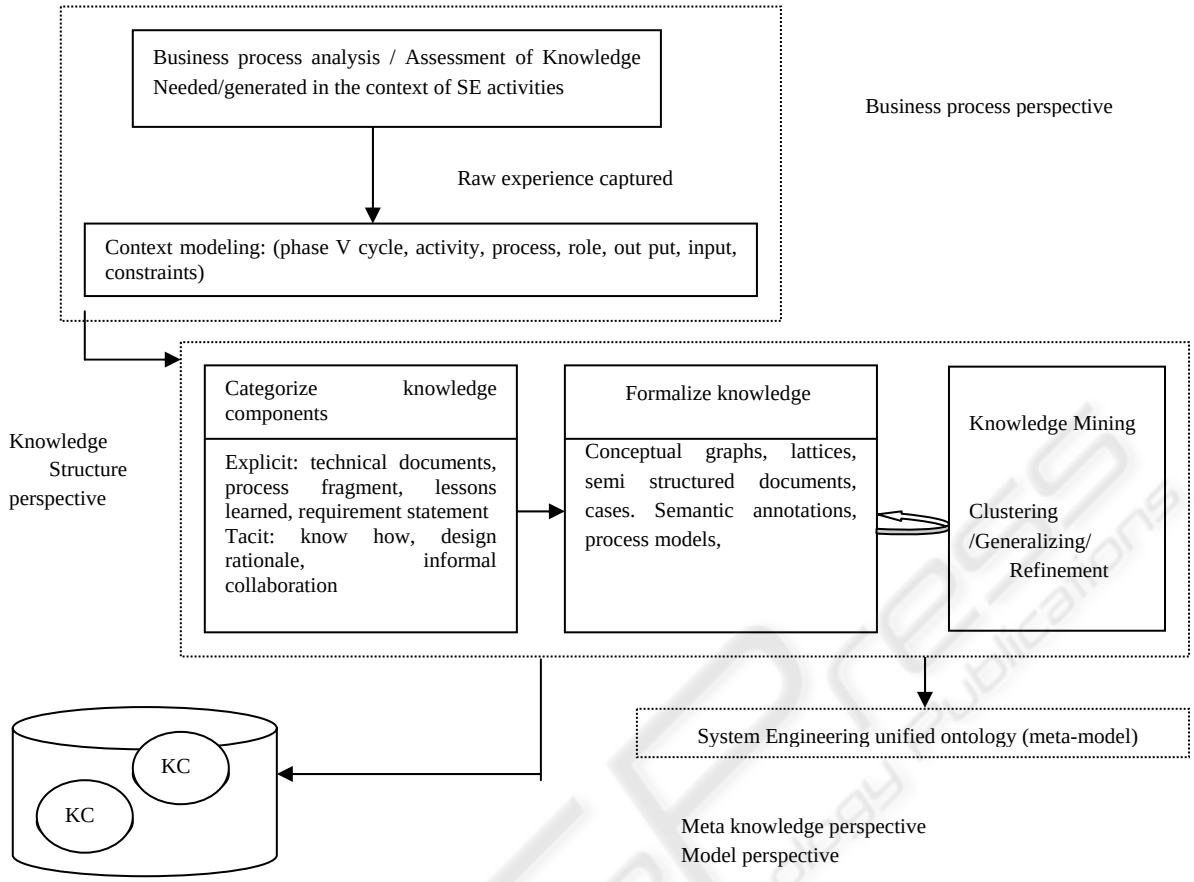

Figure 1: Conceptual model of SEKMS

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