Building a Maturity & Capability Model Repository

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ABSTRACT
A complicated and time-consuming phase in the development of Maturity/Capability Models (MCMs) is the identification of existing relevant source models as, currently, information on existing MCMs is provided in very different forms and levels of detail on diverse web sites, publications etc. In this paper, we present our ongoing research on developing a web-based repository to store and provide overview information on MCMs as a continuous knowledge management effort maintained within the Software Process Improvement (SPI) community. Such a centralized repository containing metadata on MCMs is expected to facilitate the identification of relevant models (as well as parts) and provide a systematic basis for the development/evolution or customization of MCMs.

Categories and Subject Descriptors
D.2 [**Software Engineering**]: Software Management*;* H.3 [**Information Storage and Retrieval**]

General Terms
Management, Standardization.

Keywords
Software Process Improvement, Maturity/Capability models, Content Management, Knowledge Management.

1. INTRODUCTION
Process improvement and assessment guided by a maturity level or a process capability profile based on a capability/maturity model is now well established in practice as a successful means for improving the software process. In this context, we define MCMs as models describing best practices for software life cycle processes, based on good engineering and process management principles, and with a set of process attributes comprising the capability/maturity aspects, suitable for the purpose of assessing and/or improving processes [1]. Examples are the CMMI-DEV (Capability Maturity Model Integration for Development) model [2] or the, ISO/IEC 15504-5 exemplar ISO/IEC Process Assessment Model for Software Engineering [3], ITIL [4], etc. These models are used as an evaluative and comparative basis for process improvement and/or assessment assuming that higher process capability or organizational maturity is associated with better performance.

Therefore, a multitude of process capability/maturity models and standards have been developed on international, national and domain/sector specific levels to address particular disciplines or business needs[5][6][7]. Yet, models and standards that define software engineering processes are still progressing in terms of the breadth and depth of their coverage, their viewpoint and the maturity of the standards themselves [8].

Currently, we can observe various trends regarding the evolution of capability/maturity models. Existing models are being evolved, creating new versions of generic models, such as, the models of the CMMI framework and ISO/IEC 15504-5 on a periodic basis. Yet, as the range of software sectors and domains is wide, there are also several initiatives underway to develop domain or sector specific pre-defined models, as in general, the adaptation of generic models is not an easy process, as the standards' tailoring rules aren't always consistent or detailed sufficiently [8]. Examples, include, Spice4Space [9] and AutomotiveSPICE [10] or Medi SPICE [11], as well as harmonization initiatives, such as Enterprise SPICE [12], which aims to integrate more than 30 existing models for the enterprise context.

The development of MCMs for a specific domain is a time consuming process as related models have to be first identified and then compared in terms of structure and content. Likewise, much effort is required when harmonizing various existing models

PROFES 2011, June 20-22, 2011, Torre Canne, Bari, Italy.

into one model either through modeling effort or when aligning software processes within several other models (in parallel).

Yet, before taking any action, you need to know which existing models contain relevant information – covering (at least partially) the domain of focus, as either a full process, a process step, or a process element (normative or informative). For instance, which models exist that focus on small and medium enterprises? Or, which models in the Software & Systems Engineering domain include a 'Knowledge Management' process? So where do you find relevant models? Currently process engineers do this mostly based on their individual knowledge of popular models and/or performing literature or internet searches. This often leads to the simple adoption of one reference model, possibly overlooking more adequate models or alternatives, because they are not sufficiently aware of alternative solutions from other models. It is currently quite difficult to obtain information on existing models - especially in relation to overview information on models that is required to make decisions as to whether to adopt a specific model. What is missing is a uniform characterization scheme for such models and an online repository where such information can be browsed or accessed via advanced searches using the characterization scheme.

Yet, currently there does not exist any centralized repository with such kind of information. In this respect only online navigation based browsers exist, which present information with respect to a specific model, such as e.g. the CMMI Browser [19], but which do not provide information on different models.

Thus, in order to provide a wide overview on existing MCMs, we describe in this paper our ongoing research on developing a web-based repository to store and provide overview information on MCMs as a continuous knowledge management effort maintained within the SPI community.

2. Modeling a MCM Repository

A core element of our research on the development of MCMs [13] is the 'Maturity & Capability Models' (MCM) repository. The MCM represents a Knowledge Management System [14] for managing information on MCMs supporting the storage and access of information on MCMs. Its basic objective is to provide enhanced search and browsing capabilities based upon a process engineer's needs, and to assist them to better understand the information and knowledge available by presenting it in an easily recognizable format.

The MCM is a web-based repository that enables the storage, discovery and retrieval of information on MCMs offering the following operations:

1. **Search/find** – the ability to locate MCMs through simple and advanced searches via different kind of MCM attributes (such, as domain as well as through specific processes).
2. **Browsing** – the ability to browse a taxonomy of MCMs.
3. **Gather Model's Metadata** - the ability to allow a model author to include/modify/exclude meta information on a MCM.
4. **Comment** – the ability to comment on a specific MCM.

The idea for the operationalization of such a repository is based on a model of a network of Communities of Practice (CoPs) [15] linked loosely by a central body and whose elements are shared through an online space. In this context, model authors can register information on MCMs and model users or researchers can access the information via the web (Figure 1).

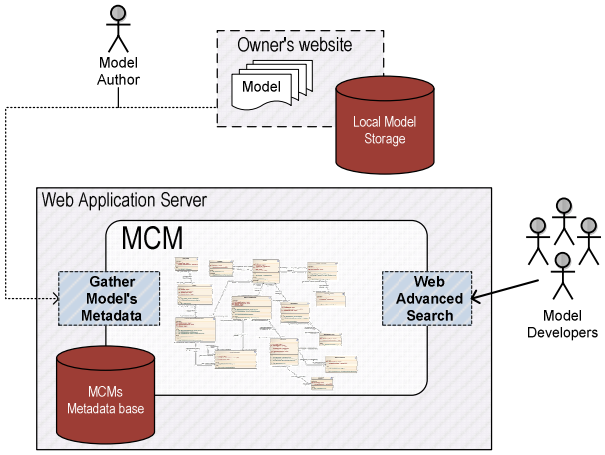

Figure 1 – Schematic representation of the repository architecture

Within the repository, MCMs are represented through metadata, whereas the actual models reside either on the owner's website or at a designated location. Metadata ("data about data") are descriptive labels used to index content for use, such as artefact management, discovery and delivery. Therefore, relating to information about the object — as opposed to the object itself. Metadata provides descriptions of the format and attributes of the object – MCMs. Metadata systems make the process of retrieving content more efficient and effective [16].

Storing and managing metadata instead of the actual artefact also facilitates dealing with rights and ownership as well as interoperability. Therefore, through analyzing relevant information on MCMs, we defined a set of metadata that enabled the characterization of MCMs in the repository through their main dimensions and attributes (e.g. number and list of its processes, process groups, maturity levels, etc…). (Table 1).

Table 1. Metadata definition

Metadata	Description	Example
Id	*Sequential unique identification*	m01
Acronym	*Acronym of the SPCMM*	Automotive SPICE
Name	*Name of the model*	Automotive SPICE Process Assessment Model
Description	*A brief description on the model*	Process Assessment Model developed by consensus of the car manufacturers within the Automotive Special Interest Group (SIG) of the joint Procurement Forum/SPICE User Group under the Automotive SPICE® initiative
Version number	*Version number of the SPCMM*	PRM 4.5; PAM 2.5
Year of publication	*year of publication of the*	2010

	respective version of the SPCMM	
Owner	*Owner/ institution of origin of the SPCMM*	The SPICE User Group
Main reference(s)	*reference(s) for the publication and/or web site where it is described*	The SPICE User Group. "Automotive SPICE® Process Reference Model v4.5," Technical Report, 2010.
Link	*web site where detailed information on the SPCMM is available online*	http://www.automotivespice.com
Domain	*classifying a MM according to the domain for which it was developed (e.g. Medical Systems; Software Engineering, etc.);*	Automotive systems
Source Model(s)	*citing models and/or standards on which it is based*	ISO/IEC 15504
Capability dimension	*Identifying the structural elements used in the definition of the capability dimension*	Process Assessment Model (Process Atributes, Assessment Indicators: Process Capability Indicators (Generic Practice) and Process Performance Indicators (Base Practice, Work Product))
	Identifying the capability levels and descriptors	0. Incomplete Process 1. Performed Process 2. Managed Process 3. Established Process 4. Predictable Process 5. Optimizing Process
Maturity dimension	*Identifying the structural elements used in the definition of the maturity dimension*	-
	Identifying the maturity levels and descriptors	-
Process dimension	*Identifying the structural elements used in the definition of the process dimension*	PRM (Process Groups, Process ID, Process Name, Process Purpose, Process Outcomes and Process Notes) + PAM (Base Practices, Work Products and Work Product's Characteristics)
	Identifying process categories/groups	Acquisition Process Group (ACQ), Supply Process Group (SPL), Engineering Process Group (ENG), Supporting Process Group (SUP), Management Process Group (MAN), Process Improvement Process Group (PIM), Reuse Process Group (REU).
	Identifying the processes (acronym and process name)	ACQ.3 Contract agreement ACQ.4 Supplier monitoring […] SPL.1 Supplier tendering SPL.2 Product release ENG.1 Requirements elicitation ENG.2 System requirements analysis ENG.3 System architecture design […]
Further dimension(s)	*Identifying other possible dimensions, if any*	-

The definition of such a set of metadata enables a more consistent description of SPCMMs and facilitates the possibility of a central community repository. Such a repository enables new models to be added by their authors. Therefore, creating a living repository of MCMs that will grow over time through the inclusion of new valuable MCMs as they appear 'on the scene'.

Another advantage of dealing only with metadata instead of the models themselves is that there are no issues concerning the attribution of authorship and usage licensing [17]. In an open digital repository, clear authorship attribution for the contents is a key prerequisite for obtaining ready-to-cooperate participants that aspire to build a reputation by writing quality content. Therefore, copyright and licensing must be easily identifiable in order to clearly define the limits of use and reuse in each case.

3. Implementation

We are currently implementing the MCM as a web-based repository. The system is being implemented in Java 5.0 on a Web platform, hosted on a Tomcat 6.0 application server (http://tomcat.apache.org/). The database currently in use is MySQL Community Server 5.5 (http://www.mysql.com/downloads/mysql/).

Figures 2 and 3 provide a first demonstration of the interface design of the search page and the visualization of search results.

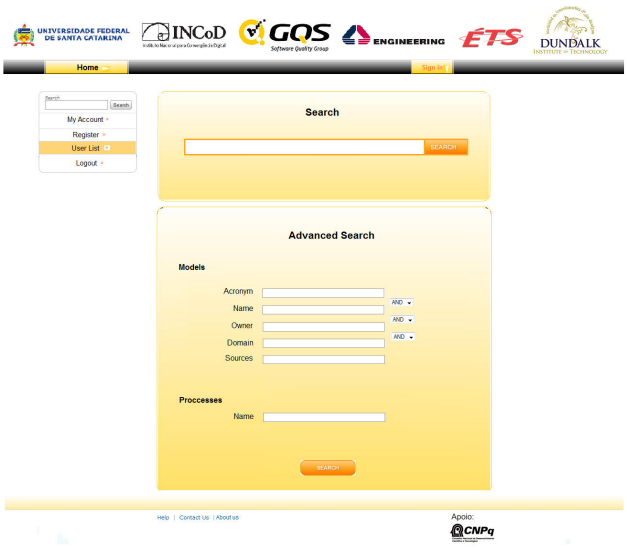

Figure 2 – MCM: search interface

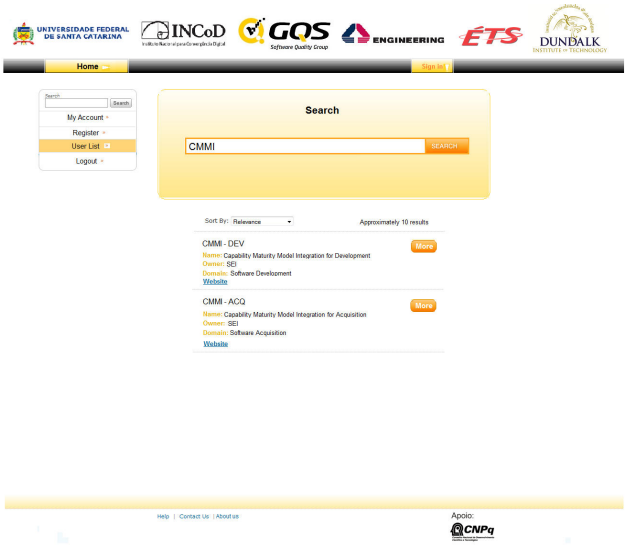

Figure 3 – MCM: Visualization of search results (example)

4. NEXT STEPS

Currently we are concluding the implementation of a first version of the repository and planning its evaluation through an expert panel in June 2011. For the evaluation, we will seed initial information on 52 MCMs based on a systematic literature review [18] and invite MCM authors and researchers to use the repository in trial runs intending to evaluate the repositories' utility and usability (including effectiveness, efficiency and user satisfaction). This will be performed through an Expert Panel [20] which is going to take place after the repository be turned public available. We intend to make the MCM repository public available in August 2011 as an important contribution supporting the development of MCMs. Future research planned also include the enhancement of search capabilities in terms of semantic searches as well as graphic presentation alternatives of the information on the MCMs.

5. ACKNOWLEDGMENTS

This work was supported by the CNPq (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* – www.cnpq.br), an entity of the Brazilian government focused on scientific and technological development. The Medi SPICE part of this research is supported by the Science Foundation Ireland (SFI) Stokes Lectureship Programme, grant number 07/SK/I1299, the SFI Principal Investigator Programme, grant number 08/IN.1/I2030 and supported in part by Lero - the Irish Software Engineering Research Centre (http://www.lero.ie).

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