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Teresa Baldassarre
Marcela Genero
Emilia Mendes
Mario Piattini

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Introduction

Over the past 16 years the *International Conference on Evaluation & Assessment in Software Engineering* has provided a forum where empirical researchers can present their latest research, and where issues related to all forms of empirical and evaluation studies in software engineering can be discussed. The EASE tradition is one of providing a workshop-like atmosphere, in which papers can be presented with time for constructive discussion of their results and processes.

The 16th edition (EASE 2012) has been organized by the Alarcos Research Group and hosted by the Escuela Superior de Informática in the University of Castilla-La Mancha located at Ciudad Real (Spain).

A total of 72 full papers and 31 short papers were submitted from all over the world and of these 22 full papers (31%) and 14 short papers (45%) were accepted for presentation at the Conference and inclusion in the Conference Proceedings. These papers address topics such as systematic literature reviews and mapping studies, formal experiments, qualitative studies, estimation and empirical software engineering.

In addition to the research papers, there are two keynote speeches: the first by Professor Dieter Rombach, Chair for Software Engineering at the University of Kaiserslautern, and Executive Director of the Fraunhofer Institute for Experimental Software Engineering in Kaiserslautern, Germany, is on the topic of "Empirical Models: Towards a Science of Software Engineering"; the second, by Professor Helen Sharp, Professor of Software Engineering at The Open University, UK, is on the topic of "Ethnographic studies in Software Engineering".

We would like to thank all of those who have contributed in numerous ways to making this conference a success: the authors for submitting their papers, the Program Committee members for their important work in reviewing and selecting the papers and in promoting the conference, the Executive Committee for agreeing to have the conference in Spain, the Organizing Committee together with all the people that helped in planning the conference, and the delegates. In addition, we would also like to thank all the sponsors to this event and the University of Castilla-La Mancha for hosting the conference.

We hope that you enjoy very much attending this conference and also your stay in Ciudad Real.

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Development of Maturity Models: A Systematic Literature Review

Gabriel Alberto García-Mireles
Departmento de Matemáticas, Universidad de Sonora
Blvd. Encinas y Rosales s/n col. Centro, 83000 Hermosillo, Sonora, México
mireles@gauss.mat.uson.mx

Mª Ángeles Moraga, Félix García
Instituto de Tecnologías y Sistemas de Información, University of Castilla-La Mancha, Paseo de la Universidad 4, 13071, Ciudad Real, España
{MariaAngeles.Moraga, Felix.Garcia}@uclm.es

Abstract— **Background**: Maturity models have been developed to assist organizations to enhance software quality, and the software engineering community has proposed numerous types of these, most of them based on CMM, ISO/IEC 15504 and CMMI-DEV. The great proliferation of maturity models leads to a need for systematic approaches to build them.

Aim: To discover and analyze the existing methods and recommended practices for developing maturity models.

Method: A systematic literature review (SLR) was conducted.

Results: 1500 papers were returned as a result of the searches, from which 23 were chosen as candidates, and 7 of these, published between 2005 and 2010, were eventually selected as primary studies.

Conclusions: The proposal of methods for maturity models development is an emerging topic in literature. Most published maturity models are based on practices and success factors from projects that showed good results in an organization or industry, but which lack a sound theoretical basis and methodology. The proposed methods highlight as main activities: to establish goals for maturity model development, to design model architecture, to set out capability levels and dimensions, to and pilot testing. However, the creation of an assessment questionnaire and specific activities for maintenance are poorly supported. The SLR results have served to propose a method for developing maturity models that is focused on product quality characteristics.

Keywords- maturity model, development method, software process improvement.

I. INTRODUCTION

Software organizations deploy software process improvement (SPI) initiatives as a way to enhance software product quality [4]. Since the nineties of the last century, software companies have assessed the capability of their processes according to maturity models such as CMM, CMMI, and ISO/IEC 15504, at the diagnosing phase in the SPI initiative [4, 6]. Diverse proposals can be found which are geared at enhancing maturity of process in diverse disciplines and domain areas [8]. For instance, CompetiSoft supports capability assessment of small and medium companies [10].

The idea of capability or process maturity is therefore fundamental in SPI initiatives. This idea has been the springboard from which maturity models have been developed to assist organizations to enhance software quality. These organizations are concerned with the establishment of standard operation norms and criteria to improve processes. In the software engineering domain, the models are in search of organizational maturity, defined as the capability of an organization to implement, establish, standardize, measure and improve software processes [13]. Capability development is a complex issue, and experts recognize that it is very difficult to implement a complete and mature function from scratch, as they must make decisions regarding new processes, deliverables and required competencies [9]. In addition, new scientific knowledge and technology may imply that organizations would introduce them in their software process; a maturity model could facilitate this task [5].

Given the increasing number of maturity models proposals, it is very important to have systematic approaches available to build them. With the aim of extracting and analyzing the existing knowledge about this topic, a systematic literature review (SLR) was conducted, whose main findings are presented in this paper. The remainder of the paper is organized as follows: section 2 describes the related work, and section 3 gives a description of the SLR and the results obtained. The primary papers are analyzed in section 4. Finally, section 5 presents the conclusions and future work.

II. RELATED WORK

We can find many proposals of maturity models in the relevant literature. Mettler and Rohner [3] indicate that they found a list of 135 different maturity models related to the discipline of information systems, while de Bruin et al. [1] found more than 150 models of maturity that assess, for instance, the maturity of IT service capability, strategic alignment of innovation management, program management, knowledge management and enterprise architecture. Becker et al. [5] analyzed 51 maturity models, using guidelines for design science [14].

In the field of software engineering, von Wangenheim et al. [8] identified 52 software process capability/maturity models (SPCMM). They found that the software community is actively

TABLE 1. SELECTED PRIMARY PAPERS.

Paper	Year	Type	Based on	Examples of models
De Bruin [1]	2005	Conference proceedings	Experiences of research on business process and knowledge management	Business Process Management Model and Knowledge Management Capability Assessment
Salviano [2]	2009	Conference proceedings	Based on ISO/IEC 15504 and Experience about development of models	MARES model, education and research domain, banking, component based engineering
Mettler [3]	2009	Conference proceedings	Design science research and Organizational design considering differentiators factors among organizations	Supplier relationship management maturity model in health care sector.
Becker [5]	2009	Journal	Guidelines for design science (Hevner, 2004) and comparison of 51 maturity models	IT performance measurement maturity model
Maier [7]	2009	Conference proceedings	Review of more than 20 maturity grids and interview with authors and models users	Includes list of models used to propose the guidelines
Van Steenbergen [9]	2010	Conference proceedings	Literature review on developing maturity models and lessons learned in developing two maturity models	Architecture maturity matrix and software product management processes maturity matrix
Von Wangenheim [11, 12]	2010	Journal	Literature review of customization of maturity models, based on Knowledge Engineering, integrating standard development procedures and requirements of ISO/IEC 15504	Customization of a SPCMM for the Software as a Service domain and MediSPICE.

developing these models, where the majority of the new contributions are adaptations of CMM, ISO/IEC 15504 and CMMI-DEV. These models can be categorized as the evolution of existing versions, or the model customization to specific domains such as small businesses, testing, quality assurance, extreme programming and requirements. In addition, their SLR was limited to papers which contained terms such as CMMI, 15504, 12207 MPS.BR, CMM, or SPICE.

With regards to the development of maturity models, there are few papers that analyze methodological proposals. Van Steenbergen et al.[9] perform a literature review and provide an overview of four proposals. This work has been used as a basis for the analysis of papers found in this SLR.

III. SYSTEMATIC REVIEW OF MATURITY MODELS DEVELOPMENT METHODS

The SLR is based on the methodology proposed by Kitchenham and Charters [15]. In order to meet the aim of the study, the following research questions have been formulated:

- What are the methods proposed to develop maturity models?
- What are the recommended activities?

According to SLR methodology, the inclusion criteria considered for the selection of primary studies were the following: journal articles or proceedings of conferences until December 2011, written in English, whose content must include activities for building maturity models. The exclusion criteria apply to those papers which present maturity models focusing on particular domains, or which address case studies or lessons learned on the implementation of an SPI initiative based on maturity models.

Table 2 shows the strings used, which were joined with the logical AND operator to produce a single search string. This was used in the following databases: Scopus, IEEE Computer Society, ACM Computer Library, Science@Direct, ISI Web of Science, and Springer. In addition, we reviewed references of the primary papers identified, to find other papers.

TABLE 2. SEARCH STRING.

Terms	Strings
Maturity model	"maturity model"
development	develop OR design OR create OR development OR engineering

TABLE 3. SUMMARY OF PAPERS.

Database	Relevants	Candidates	Primaries
Scopus	624	10	3
Springer	92	2	0
Science @Direct	40	0	0
ISI Web of Science	428	8	0
IEEE	289	2	0
ACM	27	1	1
References			3
Totals	*1500*	*23*	*7*

The articles retrieved from the search engines are shown in Table 3. 1500 articles were retrieved without any duplicates being eliminated. For the first filter, inclusion criteria were applied to each paper, considering only the title, keywords and abstract. As a result of this, 23 papers were candidates. Finally, in a second stage, 7 primary articles were selected from a thorough reading of the candidates, by verifying that they did indeed meet both of the specified criteria. Table 1 lists primary papers. All of them were published from 2005 to 2010 and only two were found in journals. The majority of the methods have been developed by the authors' practical experience in

TABLE 4. ACTIVITIES TO DEVELOP MATURITY MODELS.

Paper	Inception	Elaboration	Construction	Deployment	Maintenance
De Bruin et al. 2005	Scope	Design Populate components	Populate measures	Testing Deployment	Maintenance
Salviano et al. 2009	Initial decisions Source analysis Strategy for development	Model design Draft model development		Draft model validation	Model consolidation
Mettler y Rohner 2009	Problem identification and motivation Solution goals	Design and development	Parameters configuration	Pilot testing	
Becker et al. 2009	Problem Definition Comparing existing maturity models	Determine development strategy Iterative development of maturity model	Transfer and assessment	Transfer deployment Evaluation	
Maier et al. 2005	Planning	Developing		Evaluation	Maintenance
Van Stenbergen et al. 2010	Domain identification and scope	Set out focus area Determine capabilities Determine dependencies Produce capability matrix	Develop assessment instrument Define improve actions	Deploy maturity model Iteratively improve maturity matrix Communicate findings	
Von Wangenheim et al. 2010	***Knowledge identification stage*** Understand the domain, identify sources of information, define scope and goals, formalize the working group	***Knowledge specification stage*** Development of model architecture, dimensions, capabilities, and validate the draft model ***Knowledge refinement stage*** Consolidate the draft model and publish it.		***Kwowlegde use stage*** Support and validate the model.	***Knowledge evolution stage*** Change management and update model

developing maturity models, or using standards such as ISO/IEC 15504. Other foundations for the development of these methods are knowledge engineering and design science domains. On the other hand, almost all the maturity models cited were developed before, or at the same time as, the method proposed.

IV. ANALYSIS OF PRIMARY STUDIES

Based on the analysis of primary studies, the following findings were obtained. Firstly, with regards to foundations of maturity models, the concept of process maturity is common in the literature, as the extent to which the process is explicitly defined, managed, measured, controlled and effective [13]. Van Steenbergen et al. [9] define maturity model as a "means to support such incremental development, as they distinguish different maturity levels that an organization successively progresses through". For Becker et al. [5] a maturity model represents a desired evolutionary path of processes or organizations, represented in discrete steps. Maturity implies evolutionary progress in demonstrating a specific skill or achieving a target, from an initial state where there are few skills in the domain under consideration, to a final state, that is complete, optimizing the resources to achieve the goals of the process or organization [3]. On the other hand, capability is related to the skill of achieving a predefined target that is associated with a certain level of maturity [9]. The application of maturity models can be supported by tools such as questionnaires. They can be used to evaluate the current status of a process (or organization), and the recommendations for improvement can be derived.

There are different categories of maturity levels. A model with fixed maturity levels has the weakness of expressing interdependencies between processes within a capability level. Establishing priorities in deploying them is hard to do. In contrast, flexible maturity models can be composed of more than five levels. In addition, this type of model allows the definition of intermediate states that define more detailed goals and practices that facilitate the development of capabilities. [9].

De Bruin et al. [1] indicate that, depending on the purpose of the model, it can be descriptive, prescriptive or comparative. If the model is purely descriptive, you can only know the current situation, without there being any additional information to improve capacity. A prescriptive model, on the other hand, enables there to be a path for improvement. Finally, a comparative model makes benchmarking possible throughout and between industries or regions, comparing similar practices among organizations. The authors also note that these categories represent evolutionary stages of a maturity model, starting with a thorough understanding of the domain, continuing with the addition of replicable best practices, and finally, applying the model in a wide range of organizations to achieve sufficient data to allow valid comparisons.

As far as the methodological view of developing maturity models is concerned, most maturity models published are based on practices and success factors from projects that showed good results in an organization or industry, but which lacked a sound theoretical basis and methodology. However, few models have been evaluated in terms of validity, reliability and generalization, which may explain the ambiguity of the results obtained in practice [11]. In addition, there is little documentation on how to develop a maturity model that is theoretically sound, rigorously tested and widely accepted [1].

In recent years there have been suggestions of methods for the development of maturity models. De Bruin et al. [1] present a framework for the development of maturity models in different application domains. Meanwhile, Mettler and Rohner [3] discuss the advantages of a situational maturity model. Becker et al. [5] propose a procedure for design maturity models, considering design science guidelines [14]. While Maier et al. [7] provide a structured approach to creating a maturity matrix, van Steenbergen et al.[9] propose a method for the development of maturity models with a focus on one area. The proposal of von Waigenheim et al. [11, 12] is based on knowledge management theory. Finally, Salviano et al. [2] based their method on previous experience in the development of maturity models.

Table 4 summarizes the main activities described in each method. This review extends the work of van Steenbergen et al. [9]. We used the names of the phases of the life cycle of the Unified Process (UP) to refer to each stage, given the similarity between UP and the activities described in these methods [16]. In addition, the authors of selected papers consider an iterative approach to develop the maturity model, using different verification methods at each stage.

The general activities that these methods consider, at an early stage, are problem identification, identification of participants, as well as scoping and planning of goals. At a second stage, the activities establish the design strategy and architecture of the model. That is, they define the levels of capability, dimensions (some authors name these processes or focus areas), and establish best practices expected for each dimension according to their particular capability level. At the third stage, an instrument to measure the maturity of the object of interest is built, and the procedures for its deployment and management are defined. In the last stage of development, the maturity model and assessment tool are validated. If the model is accepted, it enters a maintenance stage, where changes are managed and, if necessary, the model or instrument is updated.

V. CONCLUSIONS

Organizations require models that support them in achieving their goals. New technology and user needs are pushing companies to change their processes. Models like CMMI and ISO/IEC 15504 are of wide application in software companies, but these require to be tailored to the organizational needs and need a roadmap if the expected goals are to be achieved in the short term. Understanding how to develop maturity models may therefore help us to provide appropriate tools.

In this article we have presented the results of a SLR to find out which methods have been proposed to develop maturity models. As a result, it can be concluded that the number of relevant papers is low. Indeed, it is a recently-appearing topic that research is now studying. The main contributions come from the System Information discipline; only one reference analyzes the development of maturity models within the Software Engineering discipline.

The analysis of primary papers shows, a high level of conformance of methods in the inception, production and deployment stages. The main activities addressed by these proposals are "Set out the problem", "establish goals for maturity model development", "design model architecture", "set out capability levels and dimensions", and "pilot testing" . In the stages of construction and maintenance, however, little support is provided. This is because most of the methods do not address the creation of an assessment questionnaire, nor do they include activities related to the maintenance stage.

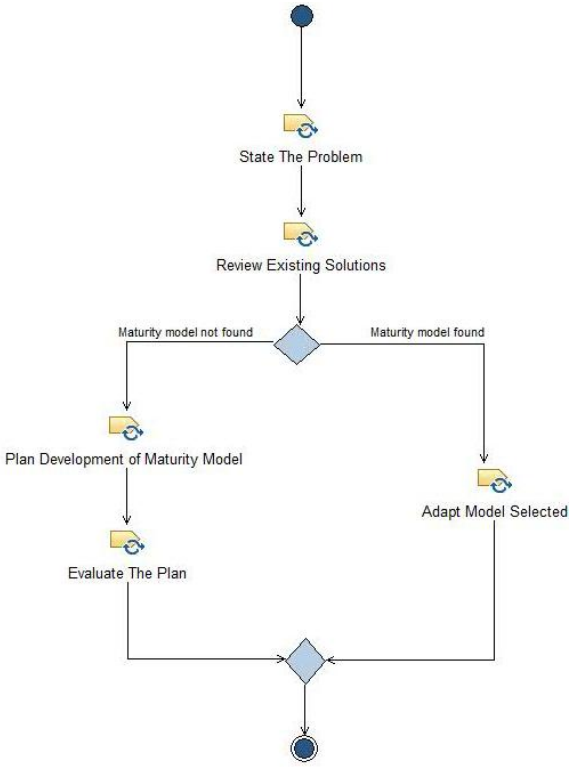

FIGURE 1. INCEPTION STAGE ACTIVITY DIAGRAM.

We are currently developing a method to elaborate a maturity model that focuses on quality characteristics. The results of this SLR have been employed to identify the activities to be included. For instance, at the inception stage, we develop a preliminary activity diagram (Figure 1) that integrates recommended practices for stating the problem, establishing the goals and developing a plan to perform a new maturity model. When the method is fully developed, we will use it to produce maturity models which include specific process capabilities to enhance the desired product quality characteristics.

REFERENCES

[1] De Bruin, T., M. Rosemann, R. Freeze, and U. Kulkarni. Understanding the main phases of developing a maturity assessment model. in 16th Australasian conference on information systems (ACIS). 2005. Sydney, Australia p. 1 - 10.

[2] Salviano, C., et al., A method framework for engineering process capability models, in EuroSPI 2009, The 16th European Systems and Softwaer Process Improvement and Innovation, Industry Proceedings. 2009: Alcalá, Madrid. p. 625-636.

[3] Mettler, T. and P. Rohner, Situational maturity models as instrumental artifacts for organizational design, in DESRIST'09. 2009: Malvern, PA. p. 1-9.

[4] Staples, M. and M. Niazi, Systematic review of organizational motivations for adopting CMM-based SPI. Information and Software Technology, 2008. 50: p. 605-620.

[5] Becker, J., R. Knackstedt, and J. Pöppelbuß, Developing maturity models for IT management - a procedure model and its application. Business & information system engineering, 2009. 3: p. 213-222.

[6] Pino, F., F. García, and M. Piattini, Software process improvement in small and medium software enterprises: a systematic review. Software Quality Journal, 2008. 16: p. 237-261.

[7] Maier, A., J. Moultrie, and J. Clarkson. Developing maturity grids for assessing organizational capabilities: practitioner guide. in 4th international conference on management consulting, Academy of Management (MCD 2009). 2009. Vienna p. 1-29.

[8] von Wangenheim, C., J. Rossa, C. Salviano, and A. von Wangenheim. Systematic literature review of software process capability/maturity models. in International Conference on Software Process, Improvement and Capability dEtermination (SPICE). 2010. Pisa, Italia p. 1-10.

[9] Van Steenbergen, M., et al., The design of focus area maturity models, in DESRIST 2010, H. Winter, J.L. Zhao, and S. Aier, Editors. 2010. p. 317 – 332.

[10] Oktaba, H., et al., Software process improvement: The competisoft project Computer 2007. 40(10): p. 21-28.

[11] Von Wangenheim, C., et al., Creating software process capability/maturity models. IEEE Software 2010. 27(4): p. 92-94.

[12] Hauck, J.C.R., C.G. Von Wangenheim, F. Mc Caffery, and L. Buglione, Proposing an ISO/IEC 15504-2 compliant method for process capability/maturity models customization, in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 6759 LNCS. 2011. p. 44-58.

[13] Paulk, M., C. Weber, B. Curtis, and M.B. Chrissis, The capability maturity model: guidelines for imporving software process. 1995, Reading, MA: Addison-Wesley.

[14] Hevner, A., S. March, J. Park, and S. Ram, Design science in information systems research. MIS Quarterly, 2004. 28(1): p. 75-105.

[15] Kitchenham and S. Charters, Guidelines for performing Systematic Literature Reviews in Software Engineering 2007. Technical Report EBSE/EPIC-2007-01.

[16] Jacobson, I., G. Booch, and J. Rumbaugh, El proceso unificado de desarrollo de software. 2000, Madrid: Pearson Educación.