

SOFTWARE PROCESS MATURITY AND CAPABILITY EVALUATION AND ITS IMPLEMENTATION IN THE AREAS OF E-LEARNING ORGANIZATIONS

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ABSTRACT

A detailed literature review revealed that, most of the organizations develop their projects and associated software engineering activities using in-house established methods. There are discrete references in the literature on application of broad based scientific methods in designing and developing process capability and maturity models by software organizations. Documentation and extent of adherence to a well defined organized scientific method plays a major role in standardizing the systems. Capability Maturity Model Integration (CMMI) is a recognized model for providing process maturity and capability in managing the software engineering activities. Further, the area of development of process models for optimization and implementation of thrust areas were not given due attention by researchers. To address above issues, we made an attempt in this study (i) to review the extent to which software organization make use of software process capability models, (ii) to develop an organized software process modeling and (iii) to evaluate its performance through a case study conducted in an IT industry developing E-learning maturity models and to arrive at optimized model for E-Learning thrust areas. The basis for above work is drawn by comparing the existing methods and tools used, with international models. The major contribution of present work is that, the proposed process capability model will enable organizations to follow broad based scientific methods for pre modeling their software activities and will also enable them to form levels that result in bench mark approach for E-Learning modules.

Keywords: CMMI, Optimization, Bench Mark Approach, E-learning, Capability Models

1. INTRODUCTION

The challenges facing most of the software industries is in the areas of developing complex software systems. Many organizations, no doubt focus their activities in this directions, however consider the involved initiatives in isolation, rather than providing a deeper analysis of the same, through a systems approach. The scientific way is, to concentrate on holistic approaches focusing on best systems than on individual practices. This is achieved through understanding the basic aspects to incrementally improving the overall capability, since these installations normally need to choose the range of possible areas needing improvement. Ignoring this

proposition, most of the organization invest large money and time, not much knowledged about the returns of the investments. Standards have to b formed for bench marking. These bench marks help in assessing the organizational capability. The outcome of such a developed model is expected to be repeatable and dependable through rigorous software development process and project management activities. In line with above, we made an attempt in the present work to survey the software practices adopted by software companies, to apply the CMMI Institute (formerly Software Engineering Institution (SEI)) maturity questionnaire to gather data, to document the same and finally to propose Capability Maturity Model Integration to set various

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levels or bench marks. As organization implement the proposed maturity model and move up in the levels, they improve capability. An important outcome of our approach is that, the institutions explicitly understand what they are doing and when they are doing. The advantage of moving through level by level is that, they can focus on improved and refined developments.

2. LITERATURE REVIEW

Alyahya *et al.* (2012) made extensive studies on impact of CMMI based process maturity levels. They have touched upon productivity and discontinuity of scale in their work. Dadhich (2012) publishes their results on traditional software development process. Their results opened a new approach for CMMI. Hwang and Yeom (2009) made extensive analysis on relationship among ISO/IEC 15504 CMMI models. Kelemen *et al.* (2010) published their results on process based unification of process-oriented software quality approaches to qualify the results of CMMI approach in various software organization. Yucalar and Erdogan (2009) developed a novel questionnaire method for CMMI level 2 maturity assessment. The compiling of the same resulted in a basis for CMMI model generation. They have touched upon the version, method definition and documentation. Habib *et al.* (2008) developed a novel method of blending six-sigma and CMMI to accelerate the process improvement in SMES. Extensive work was also reported by various authors in the areas of benefits of CMMI, development of software tools, CMMI-DEV models, Maturity levels, capability levels, reliability lists of SEI-Maturity Questionnaire, choose process improvements.

3. PRESENT WORK

The present work is divided into the following steps:

- Step 1: Consists of identifying the thrust process areas by collecting relevant materials and making a comparative study among the areas.
- Step 2: Consists of designing an optimal process model, integrating the thrust process arrived in above step.
- Step 3: Consists of implementing the proposed model in the organization and making validation of the same.

The identification of thrust process under step1, is normally made either by survey research or by case study research. Survey research is the process of obtaining information through questionnaire and gathering information about software process implementation. In case study research a few companies

assessed for maturity levels are selected for case study for a detailed investigation and their activities are noted down over a period of time. Their actual software development processes are critically analysed. If required, the concerned staff are interviewed to gather information. It may be noted that the questionnaire is to be based on the highest capability level of the company.

3.1. Software Maturity Level

While assessing the optimal process model the software maturity level plays an important role. Maturity level is a predefined evolutionary plateau aiming at a matured software process. Each level plays a basis for the next level. The maturity levels are closely connected with process areas. There are 5 maturity levels and designated through 1 to 5. The maturity levels are evaluated by the achievements of specific generic goals characteristic of each set of process areas (**Fig. 1**).

3.1.1. Maturity Level 1

This is an initial level. Here the processes are usually adhoc. There are no stable working environments. Here the success depends on the concerned people and not on the process.

3.1.2. Maturity Level 2

It is a managed level. Here the processes are planned, performed and measured.

3.1.3. Maturity Level 3

Here the process are well characterized, defined and understood. They are defined through standards.

3.1.4. Maturity Level 4

It is a quantitatively managed maturity level. Various sub processes which significantly control the overall process, are selected. The selected sub processes are controlled using statistical techniques.

3.1.5. Maturity Level 5

This is the highest level dealing with optimal process. The process are continuously improved based on quantitative estimates of the reasons for variations, inherent with the process.

Unless the lower levels are given due consideration, the higher levels cannot have good chance of success.

While maturity levels relate to predefined parameters, there is yet another important aspect called as capability level, which describes the organizations capability relative to a process area as described in various maturity levels.

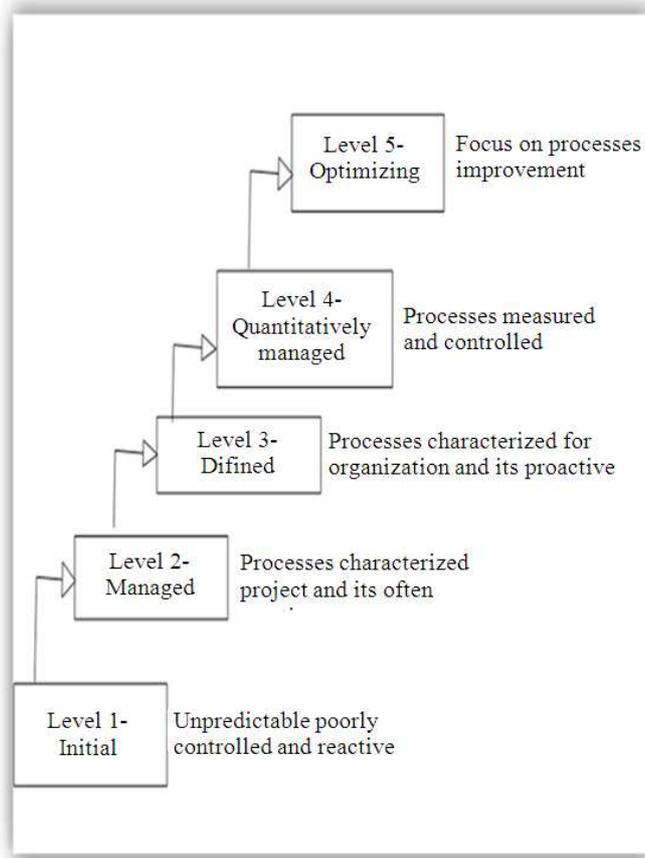


Fig. 1. CMMI framework

3.2. Capability Level

The major levels 0 to 5 are described as shown below.

3.2.1. Capability Level 0

It is an incomplete capability level. Here the process is partly performed or not performed. No defined goals exists here.

3.2.2. Capability Level 1

This level takes care of what is left over in level 0. The performance in this level may not be stable and may not meet specific on process improvements. An amount of uncertainty exists in this level.

3.2.3. Capability Level 2

It is a managed capability level, which is planned, performed, monitored and controlled for individual

projects, to achieve a given purpose. The cost, schedule and quality are considered in this level.

3.2.4. Capability Level 3

It is a defined process capacity level, which is tailor made for the organizations and set processes according to their guidelines.

3.2.5. Capability Level 4

This is a quantitatively managed level. Since, normally the latest CMMI calls for capability level 5, this level 4 forms a sound basis for capability level 5. The process in this level 4 are controlled using statistical quantitative techniques.

3.2.6. Capability Level 5

This levels aims at optimizing. This is a process capability level which is quantitatively managed, improved.

It mainly focuses on continuously improving process performance through innovative improvement. This capability level is used in the latest version of CMMI.

The appraisal of an organization using standard CMMI method will reach a particular level of maturity, when it has met all the objectives of the required maturity level.

3.3. Case Study Applied to E-Learning Developing Software Organizations

To illustrate the processing evaluation for optimization and implementation, a case study of E-learning developing software organization is chosen. The developed project is intended to meet the following outcomes:

- A validated model
- A detailed evaluation of E-learning process capability for each participating institution
- A summary of E-learning capability across all the participating institutions

This is achieved in 3 phases. In phase 1, the process capability model is distributed within the organization. Phase 2 consists of collecting the information for process capability evaluations. Phase 3 consists of dissemination of validated E-learning process capability model for self assessment.

When above steps are implemented as per the phased order, the first observation is that, the presented data assists overall easy comparison between the selected departments. It is also possible to compare individual practices and also the general trends. With this exercise we will be able to make a systematic weakness and strength analysis and evaluate the software process maturity and capability practice by different E-Learning software project performed in different departments.

4. RESULTS

- The presentation in this study touches the issues of learning from the application of process maturity models for optimal solution
- The proposed method of evaluation and implementation of process maturity model has an edge over the existing methods, in the sense that the proposed method offers a road map for software organizations looking for improving their E-learning software development processes
- The current analysis of maturity level and capability level matching, provides for a clear model to guide for ongoing development of resources and enhance their supporting processes

5. DISCUSSION

- The present work provides for academics dealing with E-learning software development models and an accepted frame work to fix for, long term institutional planning
- The present work offers a unifying frame work for E-learning software development projects, which the conventional methods do not provide
- The proposed model quickly shows the ways of organizing the diverse collection of ideas and help individual organization an informal self assessment.
- To make the present work effective, the practices are organized according to process areas of Maturity Levels upto 5
- The major contribution of the present work lies, in proposing a tailored and optimized maturity model, which provides for (1) Learning from the application of process maturity models for E-Learning software development modules, (2) Evaluation and implementation of process maturity models, (3) A detailed understanding of maturity levels and the matching capability levels, (4) Uniform frame work among organizations dealing with similar software activities and (5) Institutional self assessment

6. CONCLUSION

The major contribution of the present work lies, in proposing a capability maturity model integration ,which provides for (1) Learning from the application of process maturity models, (2) evaluation and implementation of process maturity models, (3) a detailed understanding of maturity levels and the matching capability levels, (4) accepted frame work to fix long term institutional planning (5) uniform frame work among organizations dealing with similar software activities and (6) Institutional self assessment.

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