Understanding The Conceptual Value In Adopting CMMI Process Maturity Framework

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Abstract

CMMI® (Capability Maturity Model® Integration) constellations of models are collections of best practices that help organizations from various domains and industry to improve their processes. These model frameworkswere developed by product teams with participation from different industry, government, and the Software Engineering Institute (SEI) (Now CMMI Institute). This model constellation, called CMMI for Development (CMMI-DEV), provides anintegrated and comprehensive set of process improvement road map for developing quality software products and services. The CMMI-DEV model provides directiontowardsimplementing CMMI Process Areas in a software product development organization. The Goals, Specific and Generic Practices defined in the Process Areasof the model focus on activities for developing quality software products and services to satisfy the requirements of customers and users. This technical paper is an attempt to conceptualize and understand the CMM framework and CMMI-DEV model to highlight the value proposition in its contribution towards the achievement of organizational process capability and maturity.

Introduction

CMMI process models contains process requirements based on industry best practices that could be used to guide IT/ITeSorganizations working to improve their development and service processes. Organizations that concentrate on process improvement demonstrate reductions in delivered defects, improved speed of product development and service delivery, and fewer post-delivery/service failures. Given

those results, organizations that implement CMMI-based process improvement may provide a lower risk in development and services over those that do not.CMMI provides a reference against which organizations could be appraised using formal appraisal techniques. Using CMMI appraisal data for evaluation in acquisitions could be an effective means to identify and evaluate risk within the development and services portion of an acquisition.

CMMI appraisal data, obtained using the Standard CMMI Appraisal Method for Process Improvement (SCAMPI[SM]), identify and evaluate development and servicesprocesses that organizations defined and utilized in the execution of their programs. Thus, this data could be used to help identify the completeness of the supplier's processes and evidence of the use of those processes. This allows assessment of the degree of risk related to a supplier's organizational processes used for product development and service delivery.

CMMI constellations and its appraisal method provide an approach for determining how well the appraised organization has employed its processes in the programs and services evaluated as part of the appraisal. This approach can indicate the degree of risk (or lack of risk) that these same processes might contribute when implemented on a new program or service. This indication is only valid, however, if the supplier actually uses the appraised processes on the program at hand. Implementation of these processes should begin before contract award (in the capture phase), and continue in earnest post award in order to reap the benefits. This paper provides a conceptual understanding the value in organizational process maturity using CMMI process framework. The focus of this technical paper is on the most popular CMMI-DEV model and its associated value proposition.

Evolution of CMMI

The SEI under the sponsorship of the US Department of Defense (DoD) formulated the CMM Integration® project to solve the difficulty of using multiple CMMs in the industry, sub-contractors and DoD. The compounding of selected process improvement models (typically different CMMs) into a single structured and integrated improvement model was aimed for use by the industry/DoDsub-contractors in their pursuit of organization-wide process improvement initiative.

Formulating a set of integrated process improvement models (CMMI Constellations) demanded more than merely combining existing model artifacts. With a consensus processes between different stakeholders, the CMMI Product Team developed anarchitecture that accommodates multiple model constellations.

Initialprocess improvement model to be formulatedin the constellation was the CMMI for Development model (then simply called "CMMI"). Figure 1 illustrates the models that led to the current CMMI Version 1.3 and its constellation variants.The first CMMI was one model that integrated three different source model frameworks: Primarily, the Capability Maturity Model for Software (SW-CMM) v2.0 draft C, followed by the Systems Engineering Capability Model (SECM), and finally the Integrated Product Development Capability Maturity Model (IPD-CMM) v0.98

About Capability Maturity Models

A Capability Maturity Model® (CMM®), including CMMI, is a defined and simplified presentation of the world and common sense on process maturity. CMMs contain the requisite components of effective process framework modulation. These process components (called Process Areas) are based on the quality and process improvements concepts developed by Deming, Juran, Crosby and Humphrey.
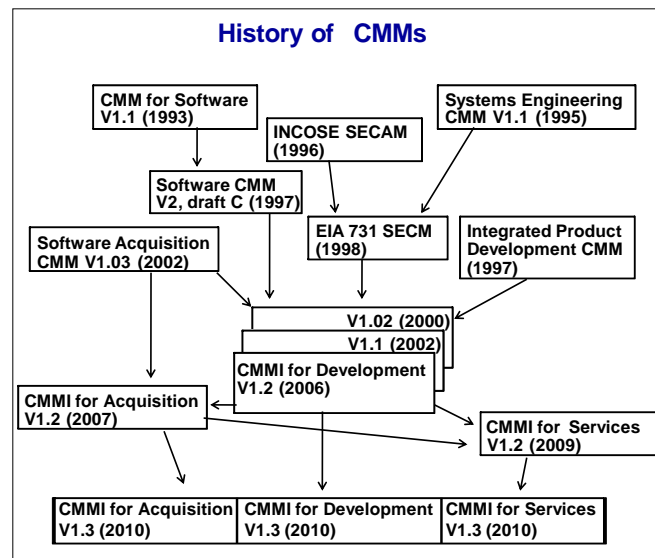
Figure 1: The History of CMMs (Source: Technical Report, 10tr033, Page 18)

Walter Shewhartin 1930s,began work in process improvement with his principles of statistical quality control (SQC). Watts Humphrey, Ron Radice, and others extended these statistical principles further and began applying them to software in their work at IBM (International Business Machines) and the SEI (Humphrey 1989). Watts Humphrey's wrote a book, "Managing the Software Process", which provides anillustration of the underlying principles and process improvement concepts on which many of the Capability Maturity Models® (CMMs®) are build.

The SEI has taken the process management premise, "the quality of a system or product is highly influenced by the quality of the process used to develop and maintain it," and various CMMs developed that has embody this premise. The foundation in this understanding is evident worldwide in quality movements, as formulated by the InternationalOrganization for Standardization (ISO)/International Electro -technical Commission (IEC) standards body.

Capability Maturity Models focus on improving processes in any organization adopting it. They contain the requisite elements and componentsof effective and efficient processes for one or more disciplines and describe an evolutionary improvement path from ad hoc, immature processes to disciplined, matured processes with improved software quality and effectiveness.

CMMI model constellations provide directions to apply when developing business processes. The models are not the processes or process descriptions to be

implemented in the organization. Implemented processes used in an organization may depend on various factors, such asindustry, culture, application domains and organization structure and size. In practice, the Process Areas of a CMMI model typically do not map one to one with the software processes applied in the organization.

The SEI, under the sponsorship of the US Department of Defense, created the first CMM designed for software organizations and published it in a book, "The Capability Maturity Model: Guidelines for Improving the Software Process" (SEI 1995). This was the pioneering artifact from which other developments were initiated.

In present time, CMMI is an application of the process improvement principles introduced almost a century ago to this never-ending cycle of process improvement initiatives. The value and measure of organization wide institutionalized process improvement approach has been confirmed time and again. Organizations have experienced measureable increaseinproductivity and quality, improved cycle time, reduction in defects, accurate and predictable schedules and project budgets/cost under control.

CMMI-DEV Fundamentals

CMMI-DEV consists of a set of process requirements based on industry best practices that are organized into 22 different process areas across four categories, as shown in Table 1. The Process Management process areas are used at the organization level to define, deploy, and improve processes across the organization. The process areas are important because they play a large part in how effectively the organization deploys its processes in a new program.

Table 1: CMMI-DEV Process Areas

Process Category			
Project Management	**Engineering**	**Support**	**ProcessManagement**
Project Planning (PP)	Requirements Development (RD)	Configuration Management(CM)	Organizational Process Focus (OPF)
Project Monitoring and Control (PMC)	Technical Solution(TS)	Process and Product Quality Assurance (PPQA)	Organizational Process Definition (OPD)
Supplier Agreement Management (SAM)	Product Integration (PI)	Measurement and Analysis (MA)	Organizational Training (OT)
Integrated Project Management(IPM)	Verification (VER)	Decision Analysis and Resolution (DAR)	Organizational Process Performance (OPP)
Risk Management (RSKM)	Validation (VAL)	Causal Analysis and Resolution (CAR)	Organizational Performance Management (OPM)
Quantitative Project Management (QPM)			
Requirements Management (REQM)			

CMMI-DEV does not dictate specific processes, but rather defines the best practices that suppliers incorporate into their development processes. The degree to which an organization's development processes conform to CMMI-DEV is measured using an appraisal on a representative sample of programs in the appraised organization. Many organizations use appraisals as a means of assessing their process capabilities and guiding process improvement activities.

An appraisal can result in a capability level profile across a number of process areas or a maturity level rating for the organization, depending on the model representation used. CMMI-DEV has two representations that are used for appraisals—continuous and staged—that lead to capability level and maturity level ratings, respectively. The staged representation predefines the appraisal structure for each grouping of process areas, while an appraisal using the continuous representation appraises each selected process area independently. Organizations may choose one representation over the other for a variety of reasons, including the current state of ongoing improvement initiatives, the supplier's historical familiarity with a particular approach, and perceived business needs and objectives.

In general, an organization's progress in defining and improving its processes is measured using numerical levels of capability or maturity. Higher levels indicate increasing degrees of sophistication and institutionalization of the process improvement efforts in the organization.

The continuous representation of CMMI-DEV measures process capability within each process area in an ordered grouping of four capability levels represented by the numbers 0-3. It allows an organization to choose which process areas to appraise based on its business objectives and process improvement goals. An appraisal using the continuous representation consists of a capability level profile showing the capability level achieved within each chosen process area interpreted as follows:

- Capability level 0 indicates that the process is either not performed or only partially performed.
- Capability level 1 indicates that the process is performed to the extent that it meets the goals of the process and produces the necessary products.
- Capability level 2 indicates that the process is managed in accordance with a policy.
- Capability level 3 indicates that the process is tailored from the organization's set of standard processes.

The staged representation specifies sets of process areas in an ordered grouping of five maturity levels and predefines which process areas must be successfully appraised to achieve a maturity level rating. An appraisal for the staged representation results in a maturity level rating, interpreted as follows:

- Maturity level 1 indicates that processes are usually ad hoc.
- Maturity level 2 indicates that the organization has achieved capability level 2 for each process area at maturity level 2. Maturity level 2 is primarily demonstrated at the program level and focuses on the Project Management and Support process areas.
- Maturity level 3 indicates that the organization has achieved capability level 3 for all maturity level 2 and maturity level 3 process areas, which include the

Engineering and Process Management process areas. It also indicates that the organization has adopted a process focus at an organizational level and has a set of standard processes that can be tailored for specific programs.

- Maturity level 4 indicates that the organization has demonstrated that it quantitatively manages selected processes (program and organizational activities that are deemed important and are consistent with business objectives) and that it has achieved capability level 3 on all maturity level 2, 3, and 4 process areas.
- Maturity level 5 indicates that the organization has demonstrated and has used its measurement data to improve and optimize selected processes and subprocesses, and that it has achieved capability level 3 on all process areas in the model.

Organizations that use the continuous representation can convert their appraised process area results into an organizational maturity level rating using equivalent staging.

When practitioners of CMMI-DEV refer to high maturity, they are referring to behaviors associated with organizations performing at maturity level 4 or 5. Such behavior entails quantitatively managing and optimizing a limited number of processes or subprocesses that are required in achieving maturity level 3 and that contain the complete set of development process areas. Maturity levels 4 and 5 focus on effectively managing and improving the basic set of development processes. They do not contain processes that directly apply to development.

The grouping of process areas into maturity levels is no indication of their relative importance. It merely illustrates a path or sequence for process improvement.

Conclusion

George E. P. Box wrote that "essentially, all models are wrong, but some are useful". CMMI is time tested process improvement model framework based on the best practices from the industry adopted and worldwide (over 97 countries). This model has proven and shown the value in improving the process maturity of an organizational resulting acceptance from the US Department of Defense. A maturity level based process improvement journey clears shows the value proposition in adopting CMMI process improvement frameworks that helps in achieving the required process capability and return on investment.

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