

Background:

CMMI: The Evolution of Process Improvement

As organizations struggle to be competitive and profitable, executives look for guidance. They read books about management and strategy and apply the principles that they learn. Sometimes they hire consultants to evaluate the inner workings of their organizations and suggest improvements. One approach to organizational improvement, the Capability Maturity Model® (CMM®) approach, relies on a collection of best practices in a particular discipline, such as software engineering, systems engineering, people management, and software acquisition. Each individual model is associated with assessment methods that can be used to evaluate the effectiveness of an organization's practices.

The SEI and Capability Maturity Models

In 1991 the Software Engineering Institute released the Capability Maturity Model for Software (SW-CMM) consisting of key practices organized into a “roadmap” that guides organizations toward improving their software development and maintenance capability. The SW-CMM approach was based on principles of managing product quality that have existed for the past 60 years. In the 1930s, Walter Shewhart advanced the principles of statistical quality control, which were further developed and successfully demonstrated in the work of W. Edwards Deming, Joseph Juran, and Phillip Crosby. These principles were adapted by the SEI into a foundation for continually improving the software development and maintenance process. Since its release, the SW-CMM approach has significantly influenced software process improvement worldwide.

The SEI also became involved in helping to develop additional CMM approaches in other disciplines, including the Systems Engineering Capability Maturity Model¹ (SE-CMM) and the Integrated Product Development Capability Maturity Model (IPD-CMM). As is the case with the SW-CMM and SE-CMM, the IPD-CMM addresses organizational and project management processes, but with a focus on ensuring the timely collaboration of all appropriate disciplines in the development and maintenance of a product or service.

¹ Recently, the Electronic Industries Alliance Interim Standard 731 (EIA/IS 731), Systems Engineering Capability Model (SECM), was published. EIA/IS 731 is based on both the SE-CMM and the Systems Engineering Capability Assessment Model (SECAM) developed by the International Council on Systems Engineering (INCOSE).

The development of multiple capability maturity models for other disciplines was generally greeted positively. Process improvement expanded to affect more disciplines and helped organizations to better develop and maintain their products and services. However, this expansion also created challenges.

Ideally, various capability maturity models should work together harmoniously for the benefit of organizations wishing to apply more than one model to improve product quality and productivity. However, especially with respect to the capability maturity models for software engineering, systems engineering, and IPD, managers have found that overlaps in content and differences in architecture and guidance across these models made improvement across the organization difficult and costly. Training, assessments, and improvement activities often had to be repeated for each specific discipline, with little guidance on how to integrate such activities across these disciplines. Clearly, organizations needed a way to successfully and easily integrate their CMM-based improvement activities. The models themselves needed to be integrated.

The Need for CMM Integration

To respond to the challenges and opportunities created by the demand for a better integration of CMM models, training, and assessment methods, the Office of the Under Secretary of Defense for Acquisition and Technology initiated the Capability Maturity Model Integration (CMMISM) project, which is co-sponsored by the National Defense Industrial Association. Experts from a variety of backgrounds and organizations were asked to establish a framework that could accommodate current and future models. [For more on the organization and goals of the CMMI project, see the September 1998 issue in the SEI Interactive Archives.]

Since February 1998, industry, government, and the SEI have been working to build an initial set of integrated models covering three disciplines: software engineering, systems engineering, and integrated product and process development. The models chosen as the primary sources for the initial set of CMMI models were

- Capability Maturity Model for Software (SW-CMM) version 2.0 draft C
- Electronic Industries Alliance Interim Standard 731 (EIA/IS 731), Systems Engineering Capability Model (SECM)
- Integrated Product Development Capability Maturity Model (IPD-CMM) v0.98a

CMMI chief architect Roger Bate explains, "Integrating process improvement models is no easy task. The source models for the CMMI project use different approaches and

architectures, and they cover some different topics. The CMMI product development team, as diverse as it is, achieved consensus on many tough issues. The result is a set of process improvement models that can meet the needs of many organizations now and can grow to meet the needs of more organizations in the future."

The team's mission also included ensuring that all CMMI products comply with the International Organization for Standardization (ISO) 15504 standard for software process assessment, and preserving the improvement work achieved by organizations that used CMMI source models.

The CMMI project endeavored to preserve government and industry investment in process improvement and to broaden the application of improvement across the enterprise. In addition to improving the usability of the CMM approach in a wider set of disciplines, the CMMI concept uses common terminology, common components, common assessment methods, and common training materials. All groups developing and reviewing CMMI products consist of representatives from government, industry, and the SEI. An intensive review process ensures that the content of CMMI products is generally accepted by key groups before public review.

CMM Integration Status

The CMMI product suite includes CMMI models, a framework, training materials, and assessment methods. The CMMI framework states the rules and concepts that ensure CMMI products are consistent with each other—that is, that they are capable of being integrated.

The framework will enable users to select one or more of the disciplines available in the CMMI product suite and to choose the representation that best suits the organization. Currently there are two disciplines available, systems engineering and software engineering, and two representations, staged and continuous. In the continuous representation, which comes from systems engineering, process areas span levels rather than being defined with a maturity level, as in the staged representation used in the SW-CMM approach. [For more on the staged and continuous representations, see the Spotlight article in this issue.]

The first CMMI model available for public review and comment, CMMI-SE/SW v0.2, contained best practices for management, software engineering, and systems engineering. The public review and comment period ended November 30, 1999. This model is available on the SEI Web site at <http://www.sei.cmu.edu/cmm/cmms/cmms.integration.html>

The model, assessment method, and introductory training are currently being piloted by volunteer organizations. The product development team is processing change requests from the public review. These requests will guide the modification of the model. A release of a model for use in process improvement will be available in June 2000.

Jack Ferguson was the CMMI project manager until recently and is currently the Director of Software-Intensive Systems for the Deputy Under Secretary of Defense for Science, Technology, and Logistics. Ferguson says the new CMMI-SE/SW v0.2 model "is not just the combination of models from the software and systems engineering disciplines; it represents an evolution in the focus of the capability maturity model approach. Previous models were intended to improve the processes of individual disciplines. This new model is intended to improve the process of developing or sustaining a product or service, regardless of the discipline. The CMMI effort is a major change in the process improvement landscape, with the potential to dramatically improve all disciplines involved."

Results of Studies

Studies documenting the results of using the SW-CMM approach for process improvement have demonstrated significant cost savings, and the following benefits are expected from the use of the CMMI models:

- reduced costs
- increased predictability of project costs and schedules
- higher quality and productivity
- shorter cycle time
- increased customer satisfaction
- higher employee morale