

Capability Maturity Model

George Albright

The Capability Maturity Model (CMM) is a precise, verifiable representation of an organization or project that is highly effective in producing software. The CMM is an ongoing project of the Software Engineering Institute (SEI) a federally funded research and development center at Carnegie Mellon University.

Like ISO 9000, Certified CMM conformance is often cited as a contractual requirement and is becoming widely recognized and accepted as a standard of excellence. However, achieving a maturity level takes time, organizational commitment, sustained effort, budget and culture building.

George Albright, the Headquarters program executive for Hubble Space Telescope flight science operations and on-orbit servicing since 1993, brings his 30 years of experience at Grumman to explain CMM to the NASA community. “Software technology has outpaced NASA’s management capability for software,” he notes. “Many program and project managers lack the technical background for exercising an equivalent degree of management insight on software as they do in hardware.”

Nevertheless, with CMM, software professionals can develop and improve their ability to identify, adopt and use sound management and technical practices

Level 5 “OPTIMIZING”	<ul style="list-style-type: none"> • Defect Prevention • Technology Change Management • Process Change Management 	Organization executes continuous and measurable software process improvement.	<1%
Level 4 “MANAGED”	<ul style="list-style-type: none"> • Quantitative Process Management • Software Quality Management 	Organization has a quantitative understanding of both the software process and the software products being built.	<1%
Level 3 “DEFINED”	<ul style="list-style-type: none"> • Organization Process Focus • Organization Process Definition • Training Program • Integrated Software Management • Software Product Engineering • Intergroup Coordination • Peer Reviews 	Organization establishes an infrastructure that institutionalizes effective S/W engineering and management processes across all projects.	~ 3%
Level 2 “REPEATABLE”	<ul style="list-style-type: none"> • Requirements Management • Software Project Planning • Software Project Tracking and Oversight • Software Subcontract Management • Software Quality Assurance • Software Configuration Management 	Organization has tools by which individual projects can establish basic project management controls.	~ 6%
Level 1 “INITIAL”	No Key Practices Defined	Random successes achieved via heroics in an environment of chaos.	~ 90%

Figure 17. The Key Process Areas

for delivering quality software that will meet requirements on schedule and within budget. Through CMM, an organization can determine the maturity or richness of their software and identify the most critical issues for improving software quality and process.

Basically, there are five maturity levels in the CMM. (See Figure 17, Key Process Areas.) Level 1 is the “Initial” or immature organization where projects operate in varying degrees of chaos. Here, there is low confidence in the organization’s ability to repeat a successful project. It may take two years for such a group to achieve Level 2.

The second CMM level is “Repeatable” because individual projects can establish basic management controls in the planning, tracking and oversight of software. Moving on to Level 3, “Defined,” may take a year or two as the infrastructure is built to institutionalize effective software engineering and management processes across all projects. Training activities are also provided to develop skills and knowledge needed to perform software management.

About a year later, Level 4, “Managed,” can be achieved when an organization has a quantitative grasp of software products and processes. The project’s software activities are planned and controlled quantitatively, and measurable goals for quality are defined.

Level 5, “Optimizing,” is quite difficult to achieve, and not enough data is available to predict how long it would take to arrive from Level 4. Nevertheless, Level 5 is characterized by continuous software process improvement. Common causes of defects are prioritized and systematically eliminated. New technologies are transformed into normal practice across the organization.

For more information, Albright recommends *The Capability Maturity Model, Guidelines For Improving the Software Process* by the Software Engineering Institute, published by Addison Wesley. He also suggests that the Enterprise Offices encourages Software Capability Evaluation (SCE) certification from SEI, and that the Office of Safety and Mission Assurance establish formal NASA requirements for software training and certification, along the lines of that already offered for ISO 9000. Finally he suggests that PPMI expand offerings in Systems Engineering and Software Acquisition Management to include formal SCE and CMM certification courses.

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