Applying CMMI to Systems Acquisition

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Building on relevant best practices extracted from the Capability Maturity Model® Integration (CMMI®) Framework, the CMMI-Acquisition Module defines effective and efficient practices for government acquisition organizations. Acquisition best practices are focused inside the acquisition organization to ensure the acquisition is conducted effectively, and are focused outside the acquisition organization as it conducts project monitoring and supplier oversight. These best practices provide a foundation for acquisition process discipline and rigor that enables product and service development to be repeatedly executed with high levels of ultimate acquisition success.

The Capability Maturity Model® (CMM®) Integration (CMMI®) has been applied successfully to systems development and maintenance and has helped organizations improve their project management, engineering, and related processes. In the Software Engineering Institute’s (SEI) special report “Demonstrating the Impact and Benefits of CMMI: An Update and Preliminary Results [1],” the following benefits were reported:

- Boeing Australia experienced a 33 percent reduction in the average cost to fix a defect.
- General Motors experienced an 80 percent reduction in late deliveries.
- Lockheed Martin Integrated Systems and Solutions experienced a 30 percent gain in software productivity.

CMM-based process improvement has enabled these organizations to more consistently deliver products and services on time, at high quality, and for the predicted cost.

These gains are not the exception; they are the norm. System development organizations are making great strides in transferring evolutionary capability into their customers’ hands. Gains achieved by Department of Defense (DoD) contractors are transferred directly to the fighting men and women of our armed forces as they become more capable and utilize technology faster than ever before. In addition to satisfied customers and a well-equipped warfighter, the return on the investment these organizations have experienced from the implementation of CMMI is substantial. For example, Northrop Grumman [1] enjoyed a 13-to-1 return on investment.

The acquisition process plays a critical role in how the government transfers increased capabilities into operational use. Acquisition professionals must acquire complex systems and systems of systems in order to provide these enhanced capabilities. If using CMMI can help the developers of these systems, why not apply CMMI practices to help the acquirers as well?

CMMI Acquisition Module

In late 2003, a few colleagues familiar with both acquisition practices and CMMI were asked by Mark Schaeffer, principal deputy, Defense Systems, Office of the Under Secretary of Defense (OSD) for Acquisition, Technology, and Logistics (AT&L), to interpret CMMI for use in acquisition organizations. The goal was to publish a streamlined version of CMMI best practices that could easily be implemented through self-improvement and self-assessment activities to help establish effective acquisition practices within acquisition programs. The result was “CMMI-AM [Acquisition Module]” [2], a technical report published by the SEI. Acquisition professionals in government and industry can use this module to improve their processes.

The CMMI models and the CMMI modules are two different types of products. The CMMI models, which are part of the CMMI Product Suite, are the official documents that contain CMMI best practices, and can be used with a Standard CMMI Appraisal Method for Process Improvement (SCAMPI®) Class A appraisal to achieve a maturity level.

The CMMI modules, however, are documents that are excerpts from a CMMI model with possible trial additions and are available for piloting and use for process improvement. Modules that are deemed successful may at some time become part of a CMMI model. A module can be used to identify strengths, weaknesses, improvement opportunities, risks, and best practices during an informal gap analysis or as informative material during a benchmarking SCAMPI Class A appraisal using a CMMI model.

Although CMMI contains many best practices that can help an acquisition organization, CMMI-AM provides additional information designed to help acquisition organizations more easily apply CMMI best practices to their processes.

Acquisition Challenges

Systems acquisition is no easy task. If you think about how complex commercial products are, you are seeing just the tip of the iceberg. A family car is the result of a complex mix of subcomponents that are engineered into a system. Most DoD weapon and information systems are at least this complex.

Acquirers must not only understand the operational context and codify the desired capabilities or system requirements into something that can be implemented by a development team, but also they must continuously evaluate both the
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Managing Acquisition Risk

By improving acquisition processes, acquirers can take on higher-risk programs because they can balance program risk with their improved ability to manage that risk (see Figure 1). The CMMI best practices provide guidance for improving an organization’s processes and its ability to manage the development, acquisition, and maintenance of products and product components. The CMMI model and the CMMI-AM assemble best practices into a structure that helps organizations examine the effectiveness of their processes, establish priorities for their improvement, and implement needed improvement.

Figure 1: National Depiction of a Program’s Ability to Balance Risk With Healthy Acquisition Practices

- Prescribe uniform guidance for implementation across the DoD.
- Assist the services and departments by the following:
  - Ensuring that source selection criteria includes past performance and the maturity of the software products offered by potential sources.
  - Serving as a clearinghouse for best practices in software development and acquisition in both the public and private sectors.

This summer, a team of acquisition professionals who are knowledgeable about both CMMI and CMMI-AM has begun a series of pilot appraisals using the module within select DoD programs. In these pilots, participants evaluate the effectiveness of the module in helping program offices establish process improvement programs compliant with Section 804 requirements. This piloting activity is sponsored by Dave Castellano, deputy director, Systems Engineering, Defense Systems, OSD for AT&L.

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CMMI models.
• The Software Acquisition Capability Maturity Model.
• The Federal Aviation Administration Integrated Capability Maturity Model.
• Section 804 of the National Defense Authorization Act.

The CMMI-AM is designed to be used with CMMI best practices as an acquisition lens for interpreting these practices in acquisition environments. Figure 3 illustrates the structure of the module.

Comparing the Module to the Model
If you compare Figures 2 and 3, you will see the difference between CMMI-SE/SW/IPPD/SS and CMMI-AM. Notice that the module does not include the Process Management process areas.

In CMMI-AM Project Management process areas, Supplier Agreement Management, Integrated Supplier Management, and Quantitative Project Management are not transferred from the model. The module adds Solicitation and Contract Monitoring as a new process area.

In the Engineering process areas of CMMI-AM, Technical Solution and Product Integration are not transferred from the model.

In the Support process areas of CMMI-AM, Causal Analysis and Resolution is not transferred from the model. The module adds Transition to Operations and Support as a new process area.

To provide a flavor of CMMI-AM’s content, the following includes a best practices’ example from one process area within each process area category covered in CMMI-AM.

Project Management

A few of the best practices included in the Solicitation and Contract Monitoring process area include the following:
• Designate a selection official.
• Establish cost and schedule estimates.
• Evaluate proposals.

Engineering
The Engineering process areas included in CMMI-AM are Requirements Management, Requirements Development, Verification, and Validation.

A few of the best practices included in the Requirements Development process area include the following:
• Establish product and product-component requirements.
• Establish operational concepts and scenarios.
• Analyze requirements to achieve balance.

Support
The Support process areas included in CMMI-AM are Configuration Management, Process and Product Quality Assurance, Measurement and Analysis, Decision Analysis and Resolution, Transition to Operations and Support, and Organizational Environment for Integration.

A few of the best practices included in the Transition to Operations and Support process area include the following:
• Establish product transition plans.
• Identify support responsibility.
• Evaluate product readiness.

IPPD Concepts
The fundamental concepts of IPPD incorporated in CMMI-AM include the effective use of cross-functional or multi-disciplinary teams, leadership commitment, appropriate allocation and delega-
The IDEAL Model

Generic Practices

Generic practices ensure that the improvements you make to your processes are effective, repeatable, and lasting. These practices must be considered when implementing the specific practices of the process areas.

Implementing CMMI-Based Process Improvement

To improve acquisition practices, practitioners, projects, and organizations must move from ad hoc acquisition practices to explicit acquisition practices. Using CMMI-AM and the Initiating, Diagnosing, Establishing, Acting, and Learning (IDEAL) model, a simple improvement process, organizations can do just that (see Figure 4).

Using the IDEAL model and CMMI-AM, a process improvement team would follow each phase in the loop to improve its organization’s acquisition practices. The IDEAL model is available at <www.sei.cmu.edu/ideal/ideal.html>.

Where to Go From Here

The CMMI-AM has been going through piloting, and an updated module will be available for use in early Fall 2004. However, there is nothing stopping you from using CMMI-AM now.

To get started, learn as much as you can about CMMI, CMMI-AM, and your organization’s acquisition practices. To learn more about CMMI models and CMMI-AM, see <www.sei.cmu.edu/cmmi/models/models.html>. To learn more about CMMI, see <www.sei.cmu.edu/cmmi/>.

Training is available to help you get started, including the Introduction to CMMI training course and CMMI-AM tutorial. There are two types of Introduction to CMMI training available: staged and continuous representations, allowing you to choose the course that is the best fit for your company. Regardless of which course you may take, your choice does not limit your ability to use either or both representations. See <www.sei.cmu.edu/cmmi/training/course-decision.html> for information about selecting an Introduction to CMMI course.

Introduction to CMMI training is available from the SEI or from members of the SEI Partner Network. For more information, refer to <www.sei.cmu.edu/collaborating/partners/partners-tech.html#ICMMAI-SE/IPPDS>. The CMMI-AM tutorial is a one-day introduction to the module designed for acquisition professionals who have attended Introduction to CMMI training and are interested in applying CMMI to acquisition. If you are interested in the CMMI-AM tutorial, contact SEI Customer Relations at <customer-relations@sei.cmu.edu> for more information.

Ensure that your process improvement program has senior management sponsorship and middle management support. Such sponsorship and support is critical to making the program’s success possible.

Determine the scope of your initial process improvement program. You can select one or more departments, divisions, programs, or projects. Or, you can select the entire organization. However, it is wise to begin with a smaller scope.

Map your organization’s processes to CMMI-AM and CMMI model. It is unlikely that the best practices will map one-to-one with your organization’s processes. However, by mapping the existing processes to the practices in CMMI-AM, you will identify where there are gaps. Consider using the IDEAL model to help you implement your process improvement program.

You can conduct an informal gap analysis using CMMI-AM or, if you want a maturity level or capability level rating, you can conduct a benchmarking SCAMPI Class A appraisal using CMMI-SE/IPPDS. If you choose to conduct a SCAMPI Class A appraisal, it will require an SEI-authorized SCAMPI Lead Appraiser. If you do not already have an authorized lead appraiser, there is a list of all currently authorized lead appraisers at <www.sei.cmu.edu/collaborating/partners/partners-tech.html#SCAMPI>. These lead appraisers also have the knowledge to conduct more informal gap analyses using CMMI-AM.

After your gap analysis or appraisal, you will know which processes enable the most useful improvement and the results will guide your process improvement efforts.

Use CMMI-AM as a place to start improving your acquisition processes. You will benefit from the previous experience of successful organizations and

“Since the quality of systems is governed largely by the processes used to create and maintain them, improving the processes used by both the acquirer and the supplier will improve the quality of systems.”

Figure 4: The IDEAL Model
develop a language that is common among organizations improving their processes — organizations that include the suppliers you work with every day.

References

Additional Reading

About the Authors
Brian P. Gallagher is the director of the Software Engineering Institute’s (SEI®) Acquisition Support Program. He is responsible for building teams from across the SEI’s disciplines to support the needs of the Department of Defense and other government agency acquisition programs.

Sandy Shrum is a senior writer/editor at the Software Engineering Institute (SEI®). Since 1998, she has been a member of the Capability Maturity Model® Integration (CMMI®) Product Team in roles such as author, reviewer, editor, and quality assurance process owner. Shrum also serves on the CMMI configuration control board and is the CMMI communications manager. She is co-author of the book “CMMI: Guidelines for Process Integration and Product Improvement.” Before joining the SEI, Shrum wrote documentation for mainframe- and Unix-based products for Legent Corporation. She has more than 16 years experience as a technical writer in the software industry. Shrum has a Master of Science in professional writing from Carnegie Mellon University and a Bachelor of Science in business administration from Gannon University.

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