CMMI Level 2 Within Six Months? No Way!

George Jackelen
Global Analytic Information Technology Services, Inc.

Global Analytic Information Technology Services, Inc. (GAITS) decided to receive a Software Engineering Institute (SEI) Capability Maturity Model Integration (CMMI) Level 2 rating within five months. The purpose of this article is to show that when an organization is already doing competent project management, the effort to benchmark that capability by using CMMI is almost straightforward, and it is possible to achieve a Level 2 CMMI appraised rating within six months. This means there must be management support, the right CMMI project personnel, selection of the right effort(s) to be evaluated, and a CMMI appraiser who understands the company's effort and provides positive feedback.

Even though there was no contractual requirement, the GAITS owners decided in November 2005 to initiate a project to achieve a SEI CMMI appraised Level 2 rating within five months for a GAITS program.

The first thing the owners did was designate a mature effort for CMMI evaluation, i.e., a five-year Federal Aviation Administration (FAA) Independent Verification and Validation (IV&V) program. The program was chosen due to its requirement to use an internationally accepted process, i.e., the Institute for Electronic and Electrical Engineering (IEEE) 1012, *Software Verification and Validation*; the program was already active for almost two years; and the program's receipt of outstanding ratings from the GAITS quarterly customer satisfaction surveys. As a result of IEEE 1012, there was a built-in requirement to have a project plan, i.e., our IV&V plan, which management believed would be the foundation to achieve its CMMI goal. Without performing an internal appraisal, the program had a GAITS assumed level of maturity that would satisfy most, if not all, of the CMMI Level 2 requirements. Even though this proved to be true, they had a lot of work ahead.

The owners then designated a CMMI required sponsor from the senior managers to work with the CMMI project personnel as a channel of communications to other senior managers, and to ensure GAITS obtained the required CMMI project training, resources, and guidance. Next, they assigned a CMMI project leader who had experience as a process developer and who was an active member of the selected program. Finally, the owners assigned a CMMI project technical leader who was experienced with the FAA program and who could provide the CMMI project with technical and administrative support.

With the assistance of the mentor, Electronic Data Systems Corporation (EDS), as part of the Department of Defense (DoD) Mentor Protégé Program, GAITS selected an SEI-approved appraisal company to perform the CMMI appraisal. GAITS then selected a lead appraiser.

The GAITS assumption that the IV&V program could quickly be appraised at CMMI Level 2 had to be tested. If this assumption were not true, then more time would be needed.

By attending an SEI CMMI course and by reading books, the GAITS CMMI team realized the IV&V program had many of the needed artifacts/evidence. The perceived main problems were to fill in the gaps, to verify the artifacts met the requirements, to map the artifacts to the requirements, and to accomplish all of this within five months.

Most of the gaps consisted of documenting how we already did business in terms of the CMMI Process Areas (PAs). For instance, the IV&V plan did not address the needed details for the CMMI described Configuration Management (CM) process or the Management Analysis (MA) process. In other situations, gaps were caused by the need to find the physical artifacts, e.g., meeting minutes and documents addressing more than one CMMI PA. This was accomplished over three months; the team was confident they had the needed information for a CMMI Level 2 rating. However, the work was just beginning.

To improve the chances for success, the IV&V Program Manager (PM) agreed to allocate time during his weekly staff meetings for the CMMI project personnel to introduce CMMI, the reason the GAITS owners were willing to spend the time and money to receive a Level 2 rating, and to train the staff on the CMMI process and what to expect from a CMMI appraisal.

Practice Implementation Indication Description (PIID)

One of the critical steps was to develop a CMMI PIID; see Table 1 (page 14) for an example. The PIID identified the CMMI Level 2 PAs (column 1) and related specific and generic goals and practices (column 2), direct and indirect artifacts (e.g., documents), direct artifact title and the indirect artifact title columns, action items (direct artifact recommendations and the indirect artifact recommendations columns), history of key CMMI project activities (direct artifact comments and the indirect artifact comments columns and the direct artifact weakness/artifact collection issue column), and who was responsible for each CMMI project activity (the last column). In essence, a PIID is a traceability matrix between CMMI processes (the first two PIID columns) and the location of the related artifacts. The PIID was also used to track CMMI project progress.

The PIID direct artifact comments column also identifies the evidence within the identified artifact showing the specific CMMI requirement was satisfactorily met, e.g., what paragraph within a progress report addressed the communications of Project Monitoring and Control (PMC) progress to our senior managers or customer.

The PIID indirect artifact comments column is similar to the PIID direct artifact comments column but identifies the evidence within the identified artifact, showing artifacts are available to satisfy a CMMI indirect requirement.

Selected Program

The selected program involved the IV&V of an FAA critical, complex program involving aircraft flights throughout the United States. The IV&V program's staff size varies from year-to-year due to the annual FAA task order changes. Currently, there is a staff of 19 full-time personnel.

Even though the CMMI project per-

sonnel indicated the ability to be CMMI Level 2 appraised within five months would be impossible, an internal evaluation of the selected program showed the program was more advanced for a CMMI Level 2 rating than the CMMI project personnel initially thought. The ability to quickly develop, review, and correct the PA plans also helped, especially since the lead appraiser was one of the reviewers and provided very useful comments from a CMMI perspective that were very helpful and encouraging. The purpose of the lead appraiser's review was to identify areas not meeting the CMMI Level 2 requirements. After about three months of work, the CMMI project leader and the lead appraiser notified the sponsor that sixth months was needed to finish the CMMI project. The company's owners agreed to a one-month extension.

Roles and Responsibilities

The following provides information about how the CMMI team (CMMI project personnel, sponsor, and lead appraiser) worked together on this CMMI project.

The GAITS sponsor, a required CMMI appraisal position, provided the leadership needed to keep the CMMI project focused on the objective and provided needed communications to CMMI project personnel, other senior managers, and the lead appraiser. He also scheduled training for the CMMI project personnel and assumed the role of the acting PM when the PM left the company. Based on CMMI, the sponsor made changes to how the PM reported to the senior managers.

The GAITS FAA IV&V PM ensured compliance with the program's contract, vision, and objectives (without this coordination, the CMMI project would have failed due to conflicts between the IV&V program and the CMMI project). This included identifying appropriate program and company related artifacts, providing comments on how the CMMI FAA IV&V PA plans disagreed with the way the program operated, and providing recommended changes. He also obtained concurrence from our FAA customer and government stakeholders to utilize the FAA program for the CMMI appraisal. A key FAA IV&V PM activity was to provide CMMI training time during the program's weekly staff meetings. To improve communications between the program personnel and the CMMI project, he appointed PA managers to review and implement the PA plans.

The CMMI project leader managed the CMMI project and developed each of the PA plans and related documents, e.g., procedures and forms. Based on our environment, this was the most efficient way to develop the plans and to ensure compatibility between the plans and the program. Based on the CMMI project leader's experience with the PAs, process improvements, knowledge of CMMI and the program, and his past development and implementation of process plans, there was minimal rework and it was easier for the lead appraiser to deal with one person rather than a separate person for each PA plan. To improve the overall CMMI project, the CMMI project leader also created the initial Process and Product Quality Assurance (PPQA) plan, checklists, and forms. When it was time to perform PPQA audits, the CMMI project leader was excluded, per the lead appraiser, from auditing the PAs since a conflict of interest existed, i.e., the CMMI project leader might not provide *objective evidence* of what was found during the audit of plans the CMMI project leader developed.

The GAITS project technical leader provided backup to the CMMI project leader and kept the CMMI project leader informed of daily CMMI project activities. Whereas the CMMI project leader managed the CMMI project and developed the PA plans, the CMMI project technical leader's main role was to ensure the plans were implemented as described and to identify non-conformances. To accomplish this role, the CMMI project technical leader was assigned to perform the PPQA audits and to find and store the required artifacts. (NOTE: Since there would be a conflict of interest for the CMMI project technical leader to audit the PPQA PA, the FAA IV&V PM appointed another person to audit the PPQA PA.) The CMMI project technical leader also documented discrepancies discovered during the PPQA audits and followed through to ensure the identified corrective actions corrected the discrepancies. Since the PAs were being implemented based on documented plans, the CMMI project technical leader worked with the PA managers prior to and during the PPQA audits to modify the initial PA plans and audit checklists to correct errors or to improve the processes. The CMMI project technical leader also maintained the PIID by working with the lead appraiser and program personnel to document the location of artifacts and to resolve issues. This was a critical task and required many hours of work to ensure timeliness, consistency, and completeness, while working with others (e.g., PM, PA managers, and the lead appraiser) to ensure

Table 1: *Sample PIID*

CMMI Practice	Practice Statement	Direct Artifact Recommendations	Direct Artifact Weakness/Artifact Collection Issue	Direct Artifact Title	Direct Artifact Comments	Direct Artifact Path	Indirect Artifact Recommendations	Indirect Artifact Title	Indirect Artifact Comments	Indirect Artifact Path	Actions by Who and When Due
PMC Generic Practice 2.5	Train the people performing or supporting the project's monitoring and control process as needed.	None	Valid Artifacts	• FAA IV&V Training Tracker • PMP	• PMC 10/27 2005 and Management and Administration Training 11/4 • Section 5.10: Training	VSS – $/Projects/ FAA IV&V/4 Training/ Training Tracker.doc	Link in the meeting minutes and the training material.	Staff meeting minutes 11/11/05	New Business: First item is related to the Measurement and Analysis process area.	VSS ... FAA IV&V/9 FAA IV&V CM/IV&V Staff Meeting Minutes 11/11/05.doc	• PM • 12/5

everyone understood what was needed, when it was needed, and why it was needed. PIID updating was a daily task. As part of his PIID work, the CMMI project technical leader provided timely progress reports to the CMMI project team.

Prior to performing the official CMMI appraisal, the lead appraiser made several on-site visits to evaluate CMMI progress and to provide guidance. The theme of these visits was to determine if GAITS was ready for the appraisal and to identify our strengths and weaknesses. At first glance, this appeared to be a conflict of interest when it was not. The lead appraiser followed strict SEI rules, e.g., not developing artifacts. Instead, he performed informal appraisals to identify CMMI defects in what they were doing. Plus, when it was time to perform the official appraisal, a new SEI-trained appraiser came onboard to provide independent assessments. Since the formal appraisal results had to be a consensus of the appraisal team, the new appraiser could prevent an automatic approval based on just the lead appraiser's view or possible bias. At the same time, the lead appraiser and the group being appraised could be independently audited by the SEI if the SEI believed a possible conflict of interest existed or if the SEI appraisal rules were violated. In my experience, this is like the quality assurance and test groups stepping in to work as partners (not cops or watch dogs) with the development groups to ensure a quality product was being produced (e.g., to identify problems early), but still being able to objectively evaluate the products since these groups did not develop the products. In fact, having this early partnership results in better assessments and test cases, through a better understanding of what is being done, while minimizing the risk of failure late in a project. A partnership does not guarantee approval by an evaluating group. Instead, it improves communications and understanding. This is what the lead appraiser provided.

Some appraisers just identify defects without providing information to assist in resolving the defects. When identifying a deficiency or the need for a clarification, our lead appraiser provided recommended corrective action and positive advice. For us, the key was that the lead appraiser's information was enough for us to understand the problem and possible solution. The lead appraiser also asked questions so we would recognize a problem. At the same time, he reminded CMMI project personnel of items that were already discussed in other documents, thus eliminating duplications. An important function the lead appraiser performed was to identify items required and not required by CMMI Level 2. For example, some of the items in the process plans were for CMMI Level 5 and could not be supported by other process plans.

He also ensured the PA plans were developed for a service support program rather than a system or software development program. The difficulty here was that the CMMI model was oriented toward system or software development rather than service support programs, e.g., quality assurance, quality control, IV&V, and CM. As a result, some of the CMMI principles and artifact contents did not apply or had to be re-defined so we could implement the intent of the CMMI principles and artifacts from a service support perspective.

To provide continuity, the lead appraiser remained involved with the CMMI project from the beginning until the conclusion of the Standard CMMI Appraisal Method for Process Improvement (SCAMPI[SM]) for final appraisal evaluation.

Issues

The FAA IV&V program was finishing its second year when the CMMI project started. As a result, an item the lead appraiser initially had an issue with was that GAITS did not have a CMMI project-planning plan. To resolve this, the CMMI project developed a CMMI IV&V project management plan (PMP) that used the existing, official deliverable (the FAA IV&V plan) and added the necessary CMMI items. To make maintenance easier (since the contract is renegotiated each year to identify annual tasks, resource needs, and funding), the existing plan was made an attachment to the CMMI IV&V PMP. As a result, the FAA IV&V CMMI PMP referenced the FAA IV&V plan as much as possible and specifically addressed items not addressed by the FAA IV&V plan. Thus, the CMMI portion of the FAA IV&V CMMI PMP should remain static throughout the contract while only modifying the official FAA IV&V plan attachment to list negotiated tasking, resourcing, and funding for the upcoming year. All of this was still compatible with the IEEE 1012 IV&V plan template.

For the CMMI project personnel, the hardest concept to understand was the difference between the following (NOTE: these are my definitions):

- **A direct artifact:** An output artifact used to show a process was performed and completed as described.
- **An indirect artifact:** An artifact supporting a process, e.g., a process input. This is used to show a process was initiated. Thus, a direct artifact of one process could be an indirect artifact for another process.

Another issue was that the FAA IV&V program's products do not require pre-delivery coordination with other groups; especially since the IV&V products are normally reports documenting IV&V evaluations of products from the FAA and their development contractor. Therefore the IV&V program does not require a Configuration/Change Control Board (CCB). Instead, from the start, the program established a peer-review process to ensure program products (excluding proprietary products, e.g., products with pricing information) satisfied contractual requirements. As a result, the stated internal review process will document the peer-review results, followed by a final PM review just prior to delivery. This system has worked well for the program and was acceptable to the lead appraiser, especially since the only customer comments occur during the annual IV&V plan update when the contract is re-negotiated and new tasks are identified. The main point is that they have a very successful review/approval process that does not use a normal development approval group (i.e., CCB). The lead appraiser had to keep reminding himself that for a service support program, this was not a violation of CMMI principles.

For those wondering about the issue of making sure the changes are lasting, CMMI has a requirement that there be an appraisal within three years of the passing of an appraisal. Thus, a group can lose its CMMI status if the group does not continually maintain the correct artifacts.

Lessons Learned

Before starting an official CMMI appraisal project, an organization needs to perform an honest self-evaluation (or hire an outside, honest broker). One of the key outputs is a PIID. Using the PIID format, the CMMI deficiencies can be clearly listed and addressed. In GAITS' situation, they had most of the needed artifacts, but they were not organized to provide easy, documented, and logical access. For instance, some of the artifacts were on the hard drive of individual laptops. As a result, these artifacts were moved to a more central location. Some of the data and information was placed under restricted access since some of this data and information was proprietary (such as billable information and they had subcontractors with access to the database). Another issue with the individual laptop storage was the inconsistency of the file names within an

individual's database folder. As part of the CMMI CM PA, the CM manager developed a CMMI required standardized program repository and a standardized naming convention.

A major benefit of our CMMI appraisal effort was to clearly identify where information and data were to be stored. With the CM manager's development of a repository infrastructure, finding and retrieving program information and data greatly improved. This was also a great help for the new PM to quickly come up-to-speed about the program. At the same time, our people are better able to share information and data.

Conclusions

With the cooperation of organizational personnel and the lead appraiser, a CMMI Level 2 rating can be accomplished in less then 18 months without compromising how an organization operates. This does not mean every attempt to be Level 2 can occur within 18 months. As described earlier, there are many things that must fall into place.

Having a program with well-established processes can only speed up the appraisal process, especially if the program processes are similar to what the CMMI is looking for. This also helps speed up the process to develop PA plans. A major effort was for the CMMI project leader to document what those processes were and to compare the results with their requirements.

Having a person who is knowledgeable with the program/organization(s) being evaluated and very experienced with writing plans, procedures, and checklists can not only minimize issues discovered by a lead appraiser, but can also ensure these documents are quickly developed or existing documentation is corrected.

Having an almost full-time person (i.e., our CMMI project technical leader) being the PIID point-of-contact, creating and maintaining the PIID, and performing the initial PPQA audits also speeds up the process. This person should work directly with the lead appraiser and others and should also provide the sponsor and lead appraiser with status reports – weekly at first, but daily as the date of the SCAMPI approaches.

Ensure that the lead appraiser will work with your organization to understand your environment and to provide help rather than just provide a list of needed corrective actions. If the lead appraiser has pre-conceived notions about how an organization must operate, the CMMI project sponsor and leader must ensure these notions are corrected or a compromise can be reached. With the cooperation of the lead appraiser, the sponsor and the CMMI project personnel can help ensure success.

Acquiring a CMMI Level 2 rating is not cheap and cannot occur haphazardly. The main costs are organization personnel (in our situation, two almost full-time people and several part-time people) and paying for the lead appraiser and CMMI training. However, GAITS estimated the results, especially when the organization follows through to maintain at least the Level 2 rating, should pay for the CMMI investment within two years. Being organized and having artifacts to show defined processes are being followed helps organizations enhance competitiveness and reduce cost. For example, portions of the PA plans can be used within proposals.

The lead appraiser informed us that based on SEI rules, since the CMMI evaluated program represented over 67 percent of the IV&V division's work, the IV&V division was CMMI Level 2 rated. Thus, our rating was at a higher organizational level than we had planned.

As mentioned before, SEI requires that we will be re-evaluated at a later date to ensure we are maintaining at least a CMMI Level 2 rating. To help non-developmental system and software efforts, SEI has completed a CMMI supplement to address services rather than development efforts. This should greatly assist service organizations – like IV&V – that desire CMMI appraisal.◆

About the Author

George Jackelen works at GAITS, Inc. as a senior systems engineer on the referenced FAA IV&V program as CMMI project leader. He has been directly involved with IV&V for more than 10 years and quality assurance for more than 18 years. Jackelen spent 20 years in the United States Air Force on various information technology projects and more than 20 years with private industry doing work for federal and state agencies.

85 South Bragg ST 4th FL
Alexandria, VA 22312
Phone: (703) 866-2400
Fax: (703) 866-2423
E-mail: gjackelen@gaits.com

More Online from CrossTalk

CrossTalk is pleased to bring you this additional article with full text at <www.stsc.hill.af.mil/crosstalk/2007/02/index.html>.

Connecting Software Industry Standards and Best Practices: Lean Six Sigma and CMMI

Gary A. Gack and Karl D. Williams
Six Sigma Advantage, Inc.

Integration of Six Sigma and the Capability Maturity Model Integration (CMMI) is becoming fairly widespread, yet confusion remains about their relationship. Part One of this article includes several case studies that answer some of the more common questions. Part Two describes the relationship of Lean Six Sigma and Six Sigma's approach to improvement of existing products and processes (Define, Measure, Analyze, Improve, Control [DMAIC]), and Part Three examines the relationship between Design for Lean Six Sigma (used to develop new products and processes or major enhancements) and the CMMI Engineering Process Areas.

Software professionals, especially those working in the Department of Defense environment, face a somewhat bewildering array of relevant standards and best practices. As awareness and penetration of Lean Six Sigma in this environment have increased significantly over the last several years, we find many organizations struggling to understand and leverage the relationships between Lean Six Sigma and several other approaches to software process improvement, including CMMI.