The Journey to CMM Level 5: A Time Line

Patrick W. Cosgriff
Ogden Air Logistics Center, Software Engineering Division

*The answer to the question, "How long does it take?" a brief time line of
our journey to Level 5, and a few tips that may help you get there sooner.*

As I discuss process improvement with people, I am often asked how long it takes to achieve Capability Maturity Model (CMM) Level 5. My mind usually drifts back to when we were Level 1 or 2, when I asked someone a similar question and was given a philosophical answer like, "Well, process improvement isn't really a destination—it's a journey. You shouldn't look at it as trying to get a level. …"

Forget philosophical answers, because I have an answer: It takes approximately 7.559 years to go from CMM Level 1 to Level 5. I know this because we formally began process improvement in 1991, and we achieved Level 5 July 23, 1998. Of course, this assumes you have good senior management sponsorship, you have many process improvement champions that happen to be in the right place at the right time, and you have customers who are supportive of process improvement efforts. This also assumes you think you are different and that the CMM does not apply to you, you have an abundance of skeptics at all levels of your organization, you think you are much too busy to do process improvement, and you think the legacy systems you are forced to use supposedly do not support CMM-type measurement. If 7.559 years is too long, you always have the option of stopping production so that you can work on your processes full time.

Using Appraisal Feedback to Guide Early Process Improvement

In 1991, TIS began its CMM-based process improvement initiative (see Figure 1). Some projects had been doing some process improvement in an ad hoc way, but this was the beginning of our structured organization-wide process improvement efforts. We formed a Software Engineering Process Group (SEPG) and began process definition at the project level.

In May 1992, we were formally assessed using the Software Process Assessment (SPA) method. We were rated an emerging Level 2, which was a gentle way to say we were Level 1. The main Level 2 weaknesses identified were in project planning, project tracking and oversight, and software quality assurance. The assessment team noted that some areas had already institutionalized some of the key practices required for the organization to attain a Level 3. Encouraged by these results, we developed an action plan based on the findings and began to implement it. The focus of the action plan was to implement and institutionalize the Level 2 and Level 3 key process areas (KPAs).

In September 1994, we were assessed as a solid Level 2 organization. We were close to being a Level 3, with weak-
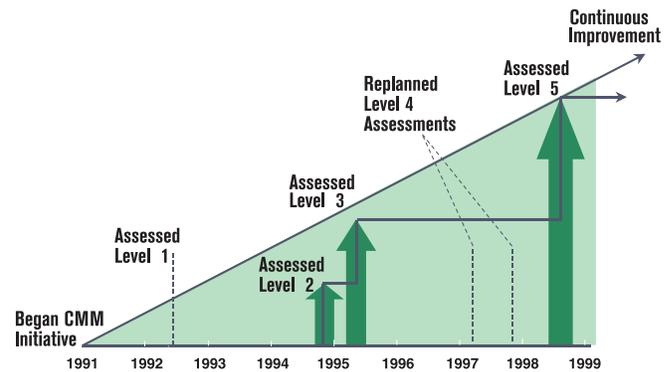

Figure 1. *TIS process improvement time line.*

nesses concentrated in the training, peer review, and integrated software management KPAs.

Because there were only a few Level 3 weaknesses found in the 1994 assessment and because they were concentrated in just three KPAs, TIS sought the support of the Software Engineering Institute (SEI) to hold a Delta Appraisal and focus on the three KPAs found to be deficient. SEI agreed, but the KPAs would be rated in their entirety, and the assessment had to be held within six months of the previous assessment.

In March 1995, a Delta Appraisal was conducted. All of the weaknesses from the 1994 assessment were sufficiently addressed, and we were rated as CMM Level 3.

On Our Own for Implementing Levels 4 and 5 Processes

At this point, we thought we could again develop an action plan based on the assessment findings and go to work. However, there were not many findings on which to work. Although we had always owned our own process improvement planning process, we had always based our action plans on recommendations from an assessment team. Because Levels 4 and 5 were not in the scope of the assessments to this point, Levels 4 and 5 findings and recommendations had never been developed for us by the assessment teams.

Fortunately, our Level 3 processes had now put us in a much better position to assess ourselves and to map out appropriate strategies. The planning started with our senior management developing a new strategic plan outlining the goals for our organization for the next two to five years, including achieving Level 4 by 1997. From this and the assessment findings, the SEPG developed an action plan to further institutionalize Levels 2 and 3 practices and to implement Level 4 practices.
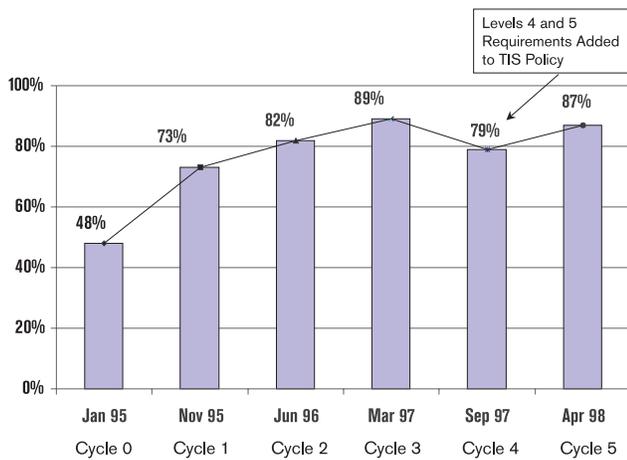
Figure 2. *TIS policy compliance.*

The Power of QuEST Feedback

We also were armed with a powerful new tool that proved invaluable for implementing consistent organizational process improvement: The Software Quality Assurance group, called the Quality Engineering and Support Team (QuEST). (For a detailed description of QuEST duties, see "Software Quality Assurance in a CMM Level 5 Organization," page 11 of this issue).

QuEST members report directly to the division chief—an independence from the projects that has proved invaluable. QuEST audited the projects in the organization against an extensive set of requirements taken directly from organizational policy (see Figure 2). The audits were objective and quantitative; they included detailed descriptions of the findings and recommendations for addressing non-compliance issues.

As an organization, we could analyze the QuEST data on a question-by-question basis to expose bad or unclear policy statements. The organization's willingness to update the organizational policy based on feedback fostered buy-in from all levels of the organization. People felt as though we were improving and listening to their concerns, which made them more willing to contribute.

Empowered with QuEST data, we were able to closely monitor our Level 4 implementation efforts and react quickly to unreasonable or poorly conceived plans—and we certainly had some. After all, we were in uncharted waters; there was not much practical, proven experience available on how to implement Level 4 practices.

We replanned our efforts twice, based on QuEST data and on our increasing understanding of the Levels 4 and 5 activities. We originally had planned to be reassessed in the spring of 1997. As we approached this milestone, our QuEST data indicated we would not achieve Level 4 by this date, so we replanned to assess in November 1997. As the SEPG analyzed the activities in Level 5, it was clear to us that if we could achieve Level 4 we could achieve Level 5. During the summer of 1997, the TIS management team discussed the advantages and disadvantages of delaying the assessment and going for

Level 5. Our process action teams had already developed the processes for the Level 5 KPAs while working on the Level 4 KPAs, which left only the task of implementing and institutionalizing the processes.

In September 1997, at the end of our fifth QuEST cycle, our data indicated we would not successfully achieve CMM Level 5 by November 1997. We were struggling with measurement, data gathering, and data consistency issues—not with what to do with valid data. We replanned again, postponing the assessment until the summer of 1998. Instead of performing a formal assessment in November 1997, we contracted with two Software Technology Support Center assessors to perform a Snapshot assessment (a much less rigorous and less expensive assessment) of our organization to determine our weaknesses from the perspective of an outside assessor. We then used this input and our QuEST data to develop a new action plan for the final nine months. This plan addressed Levels 4 and 5 implementation issues as well as assessment preparation activities.

In July 1998, we were assessed again. We were rated a CMM Level 5 by a highly experienced assessment team.

Lessons Learned

To gauge how long it will take your organization to implement Level 5 practices, look at your unique circumstances. It will largely depend on the culture of your organization, the senior management sponsorship, your motivation, your expectations, and the resources available to apply to improvement. And the bottom line is, you need good people; processes do not improve processes—people improve processes.

Can the dramatic changes be done in significantly less time than we took? I cannot answer that, but I know from experience that it takes time to change the culture of an entire organization. However, I believe others can achieve Level 5 maturity with less pain than we experienced. There is much more training available now, more conference presentations on the higher maturity practices, and more off-the-shelf tools available. Most important, more and more organizations are now reaching the higher maturity levels. This provides an experience base from which to draw practical proven practices. We were helped tremendously by listening to the lessons learned at Boeing and IBM.

Following are a few suggestions that might speed up your journey.
- Understand the practices one level above the implementation level you are currently striving to obtain. Give some thought to how the practices interrelate and build off each other. This may save some rework in the long-run.
- Enforcement and implementation are basically the same, especially in large organizations. In other words, enforcement is the most effective implementation strategy. In my experience, objective audits done by capable, well-trained people and a clear set of audit requirements is the most effective enforcement and implementation strategy.

Coming Events

The 21st International Conference on Software Engineering: Preparing for the Software Century
Dates: May 16-22, 1999
Location: Los Angeles Airport Marriott Hotel, Los Angeles, Calif. Collocated with SSR '99 (Symposium on Software Reusability).
Host: The Los Angeles chapters of the Association for Computing Machinery Special Interest Groups on Software Engineering, Programming Languages, and Ada.
Theme: "Software Engineering Challenges for the Global Electronic Community"
Contact: Ashley Queen, registration manager
Voice: 919-419-8242 ext. 17
E-mail: ashleyqueen@mindspring.com
Internet: http://sunset.usc.edu/r8/icse99

SSR '99: Symposium on Software Reusability
Dates: May 21-23, 1999
Location: Los Angeles Airport Marriott Hotel, Los Angeles, Calif. Collocated with The 21st International Council on Software Engineering.
Internet: http://csalpha.unomaha.edu/~ssr99

12th International Quality Week '99 (QW '99)
Dates: May 24-28, 1999
Location: San Jose, Calif.
Theme: Facing the Future
Sponsors: Software Assurance Technology Center at NASA, Bay Area Quality Assurance Association, Center for National Software Studies, Santa Clara Software Quality Association, and Software Research, Inc.
Contact: Rita Bral, conference director
E-mail: bral@soft.com
Internet: http://www.soft.com/QualWeek/QW99

PSQT '99: The International Conference on Practical Software Quality Techniques
Dates and Locations: June 7-10, 1999, San Antonio, Texas; Oct. 4-7, 1999, St. Paul, Minn.
Sponsor: The San Antonio Software Process Improvement Network
Featuring: Watts Humphrey, James Bach, Karl Wiegers, and Bob Glass.
Conference Chairman: Magdy S. Hanna, 8476 Bechtel Avenue, Inver Grove Heights, MN 55076
Voice: 651-552-0716
Fax: 651-552-0791
E-mail: mhanna@softdim.com
Internet: http://www.softdim.com

- If your organization is large and diverse, you may want to coordinate the development of project processes with the development of your organizational processes from the start. Again, this may reduce rework associated with fundamental style and design differences between different product lines.
- Emphasize performance of project planning activities—not creation of documents that gather dust.
- Do not ignore intergroup coordination. It is hard to get your hands on it, but it is critical. Think of coordination as a characteristic you want integrated into all your activities, not a discrete set of activities unto themselves.
- Consider the data requirements of the software quality management KPA when implementing peer reviews. It is not difficult to gather the extra data needed to support software quality management and defect prevention. Having historical data on defects will give you a big jump on implementing these higher maturity practices.
- Levels 4 and 5 KPAs can be implemented together—in fact, defect prevention is the logical extension of software quality management, and process change management is the logical extension of quantitative process management.

I have finally realized that person was right all those years ago: Process improvement is a journey. The levels are good because, like any journey, you need recognizable milestones along the way to keep you from feeling lost or discouraged. However, the blind desire to achieve the next level will usually send you down the wrong road. The desire to improve will keep you on the right track. ◆

About the Author

Patrick W. Cosgriff is an SEPG member in the Technology and Industrial Support Directorate, Software Engineering Division at the Ogden Air Logistics Center at Hill Air Force Base, Utah. Before entering the SEPG, he was the lead of the Quality Engineering Support Team. His operational background is in automatic test equipment doing test program set development and maintenance. He has a bachelor's degree in electrical engineering from South Dakota State University.

OO-ALC/TIS-3
7278 Fourth Street
Hill AFB, UT 84056-5205
Voice: 801-777-3799 DSN 777-3799
Fax: 801-775-4444
E-mail: cosgrifp@software.hill.af.mil