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Abstract

In late November 1996, AA Company (AAC) formed a 'methodology team' that began looking at ways to improve the company's development environment. Currently (circa February 2000), AAC is following a plan for improvement based on the Capability Maturity Model (CMM). AAC's initial effort to use CMM as a software process improvement (SPI) framework was somewhat flawed and, as a result, AAC has invested more than three years on the process; they still have a long way to go. This paper chronicles the route taken by AAC in their quest to improve software development and highlights some of the triumphs and traps along the way.

Introduction

Since 1986, the Capability Maturity Model (CMM) has been used as a framework for improving the software development process within organizations. Many companies have successfully adopted the CMM and have enjoyed the resulting benefits, such as higher productivity, higher quality products, and higher employee morale, among others (Herbsleb, et al., 1994).

AA Company, much like many other companies, needed to improve their software development practices. Facing rapid growth of the IT staff and an increasing need for new and improved information systems, AAC began to look for improvement in their development processes. Beginning with a November 1996 initiative, AAC pursued a strategy of continuous software process improvement, framed by the CMM. Currently, AAC is still struggling to get from Level-1 CMM to Level-2.

This paper chronicles AAC's efforts to improve their development environment. Their goal, as suggested by the CMM, is to move from an environment where software processes are generally improvised by practitioners and their management during the course of the project, to an environment characterized by solid project commitment and control processes based on experience with similar projects and previous releases (Paulk, et al., 1993a). The chronology highlights the successes and failures of AAC in their attempt to reach this lofty and important goal.

Background

Capability Maturity Model

The CMM for Software is a framework that describes the key elements of an effective software process by identifying five levels of maturity that lay successive foundations for process improvement. The five Maturity Levels measure the maturity of an organization's software development capability and each level is a well-defined evolutionary plateau on the path toward becoming an exceptional software organization. The CMM is not a "how-to" guide for creating systems. Rather, it is a framework that includes practices for planning, engineering, and managing software development and maintenance. These practices, when followed, enhance an organization's ability to reduce cost, improve quality, adhere to schedules, and meet functional requirements (Paulk, et al., 1993b).

AA Company Background

AA Company is a $2.3 billion publicly held service organization (largest in its industry) with about 12,000 employees nationwide. IS development is conducted internally with company employees (some contract labor is used, but sparingly). The majority of the approximately 185 developers are located in one location.

Improving Software Development at AAC

The Software Process Improvement Initiative

The SPI initiative at AAC began in November 1996 and continues today. The best way to illustrate this program is with a chronology of events from inception through present.

November 1996: Top management initiated a program to improve the systems development environment. This initiative did not grow out of a negative assessment of the current development environment, but rather as a proactive approach to improving the existing situation. A "Methodology Team", composed of team leaders, was formed to lead this effort. Their task was to look at ways to improve the development environment and make recommendations to upper management.

November 1996 - February 1997: During this period, the Methodology Team looked at ways of improving the development environment. Their focus was on technology only. In fact, the Team degenerated to only looking at tools that could assist developers. Subsequently, they recommended the purchase of several development tools.

February 1997: Based on the recommendation of the Methodology Team, several tools were purchased. The major purchases involved project tracking software and modeling tools. Thinking their job complete, the Methodology Team stopped meeting on a regular basis.

March 1997: The next phase of improvement was initiated by a member of IS Quality Assurance and one of the members of the Methodology Team. Together, they created a document entitled “Strategy for Process Improvement” which was submitted to upper management. The document suggested the following broad phases: (1) establish measurements and metrics; (2) perform baseline assessment; (3) define approach (methodology); (4) implement approach; (5) measure results; and (6) review and refine improvement process. Although upper management took no immediate action, the effort moved forward informally.

May 1997: Working from the March 1997 proposal, AAC performed a CMM self-assessment. To AAC, the results were shocking. The self-assessment placed them clearly at Level-1. At this time, the Methodology Team was officially disbanded and a new team, composed of mid-level managers, was formed to look at software process improvement.

May - August 1997: The new software process improvement team (hereinafter SPI Team) first examined the existing environment by taking an inventory of tools used in development across several different divisions and platforms within IS. The result was a matrix illustrating a widely disparate use of tools ranging from "Big Chief" notepads (used by one group to gather requirements) to the sophisticated set of automated tools purchased in February 1997. The use of tools was inconsistent across the IS organization. Although this effort provided insight into the current use of tools, it did little else. This matrix would subsequently be put aside for several months.

August - December 1997: After finding little value from the tool matrix, the SPI Team changed their approach. Using the CMM as their framework, they informally mapped what they believed to be current work processes to the CMM. In effect, they were trying to indicate which of the key practices of Level-2 CMM were currently being practiced at AAC. The result was a matrix (called the "Process Matrix") illustrating the different key process areas (KPAs), their respective key practices, and an indication of whether or not the key practice was followed at AAC. To AAC, this showed areas of strength (i.e., the key practice was followed) and weakness (i.e., the key practice was not followed).

January 1998: The SPI Team used the Process Matrix to prioritize weaknesses to work on. Each area of weakness (i.e., a key practice not followed) was given a priority ranking of high (requires process definition), medium (task has process definition, but needs training), and low (items pertaining to audit only). Next, workgroups were formed for each KPA to address the items. The KPA Groups were headed by one or more of the managers from the SPI Team and staffed with various levels of developers (group sizes ranged from 3 to 7). The goal for these teams: reach Level-2 CMM "compliance" by October 1998.

February - March 1998: During this two-month period, KPA Groups began work on assigned items (based on the December 1997 Process Matrix). The first task of each team was to document existing processes corresponding to key practices (recall that the SPI Team "determined" if a key practice was followed, they did not formally document them). Teams then focused on items based on established priorities (i.e., work on high priority first, medium priority second, and low priority last). Each KPA group was given a different timeline based on the number of items. For example, the RM (Requirements Management) group deadlines were as follows: (1) document existing processes - 4/10/98; (2) address high priority items - 7/24/98; (3) address medium priority items - 10/15/98; and (4) address low priority items - 10/30/98. In all cases, the deadline for documenting current processes was April 1998 and the deadline for addressing all items was the end of October 1998.

April 1998: This was the deadline for all KPA Groups to document current processes. Recall that the original determination of strengths (i.e., we already do these things) and weaknesses (i.e., we don't do these things) was made in December 1997 by the SPI Team. At this point, the KPA Groups were supposed to have all of the "strengths" formally documented. Although all groups made the deadline, the quality of the outputs varied. Groups discovered (1) key practices were not followed as originally thought; (2) key practices were followed in some areas of the company, but not all; or (3) the way in which key practices were followed varied across different areas of the company, thus making it difficult to document the “current process.” In many cases, although a key practice was followed, no formal documentation existed and the effort to document existing processes turned out to be daunting. The result was, mainly, woefully inadequate documentation of existing processes. Their overall response was dismay at the amount of work yet to do to “reach Level-2 by October.”

Early May 1998: AAC conducted another self-assessment to gauge improvement since May 1997 (the first self-assessment). Results indicated relatively little improvement. Dismayed at the results and having no clear consensus from management on how to continue, an outside advisor (one of the authors) was asked to join the process to provide a fresh, neutral, perspective. A meeting was called of all mid and upper level managers (approximately 15 total managers) to discuss the current state of the SPI initiative. Top management was surprised and disappointed that improvements were not made during the year. Also, they were somewhat skeptical of the self-assessment results because, in their opinion, sound processes (in the form of a systems development methodology) were in place and followed by developers. The advisor suggested an audit of several projects to determine adherence to the methodology. Management agreed and an audit of 12 projects, completed within the past six months, was conducted by IS Quality Assurance.

Mid May 1998: The audit indicated only three projects followed the methodology properly. A few other projects utilized some parts of the methodology; but the majority did not use the methodology at all or only used a very small portion. Overall, the methodology (i.e., procedures) thought to be followed, really was not followed. The advisor was then asked to conduct a survey to gauge awareness and use of the methodology by developers (reason for this: some distrusted the randomness of the project audits and suggested the results were an anomaly).

Mid May 1998 - Mid June 1998: A survey of developers was conducted to determine awareness and use of methodology. Results of the survey were consistent with the earlier project audit. Also during this time, a close inspection of the methodology revealed that the methodology was little more than a collection of templates and tools. Few processes and procedures were formally specified for the methodology.

Based on the newest information, upper management set a new course and new deadlines. The four-step process and respective deadlines were:

Phase	Activity	Deadline
1	Assess and document current software processes	June 30, 1998
2	Create a new methodology from documents created in Phase 1	August 1, 1998
3	Develop an improvement action plan based on results of Phases 1 and 2	September 1, 1998
4	Implement action plan and begin pilot projects	October 1, 1998

Phase 1 was already partially completed because of the prior work in documenting key practices. The new deadline of June 30, 1998 asked that all key practices be documented. For key practices not followed, KPA Groups were asked to propose a procedure. Phase 2 was to take all the information from Phase 1 (which followed the form of the CMM) and put it into a methodology format. In Phase 3, managers were to evaluate the methodology (and make necessary modifications) and develop a plan to implement the new methodology. The action plan would begin and the new methodology would be pilot tested in Phase 4 (to begin October 1, 1998). Recall the original deadline set in January 1998: be Level-2 "compliant" by October 1998. Although the activities changed, management was trying to stick to their original deadline.

July 1998: Although slightly behind schedule, Phase 1 was completed. The teams completed their assessment of the current processes and new processes were proposed where necessary.

Mid September 1998: The first draft of the new methodology was completed (original deadline: August 1, 1998).

Mid September 1998 - Mid November 1998: Before rolling out the new methodology to all IS employees, managers evaluated and suggested modifications. Also, a methodology rollout plan was developed. After many iterations, the methodology was ready to be pilot tested. The project was more than two months behind the timeline established in June 1998.

Mid November 1998 - Late November 1998: A series of training sessions were conducted to introduce and teach the methodology to developers.

December 1998 - February 1999: In December 1998, AAC began pilot testing the methodology using 14 projects of various sizes and stages of completion (i.e., Phase 4 of the June 1998 plan; about two months behind schedule).

March 1999 - May 1999: The pilot tests revealed numerous problems with the methodology. From March 1999 until May 1999, a team of IS managers and the QA team worked to improve the methodology (i.e., correct problems, eliminate oversights, etc.).

June 1999 - mid July 1999: The updated methodology (version 2) was rolled-out to the developers. During this six-week period, all developers were instructed to use the methodology on all projects. For in-progress projects, developers were to start using the methodology at the current project stage. Also during this period, the advisor audited 10 randomly chosen projects per week to ensure compliance with the methodology.

Mid July 1999 - August 1999: At this point, developers had been using version 2 of the methodology for six weeks. Each Friday for the next six weeks, the QA team and the advisor met with developers (in groups of 20 to 30, for about 1 hour) to discuss their use of the methodology; these sessions were designed to get feedback from developers as they were using the methodology. Action items were created from these meetings. Small action items were handled immediately; others were queued. By the end of August, 91 action items had been generated. After six weeks of meetings, a survey was conducted to gather perceptions of the methodology (ease of use, usefulness, effectiveness, etc.).

September 1999-February 2000: Four teams were created to address 91 action items. The goal was to complete the necessary modifications to the methodology and rollout the updated methodology (version 3) by the middle of November 1999. Currently, the four teams are working on the update and have yet to rollout an updated methodology. They are expecting a March 2000 release date.

Discussion / Lessons Learned

For more than three years, AAC has worked on improving their software development environment. What started out as a seemingly simple journey has evolved into a division-wide crusade for improvement. AAC has had its share of failures along the way, but they have also enjoyed some successes.

Failures

The SPI effort has taken longer than originally expected and longer than the SEI reported average of 25.5 months for moving from CMM Level-1 to Level-2 (SEI, 1999). Why? First, original expectations were unrealistic. Once management made up their mind to follow CMM, they set a 10-month deadline for becoming CMM Level-2 compliant. Given the state of the IS division of AAC, 10 months was unrealistic. Second, because the CMM was not consulted at the beginning, several attempts at understanding the current development environment and subsequent changes were unsuccessful and resulted in wasted time. Third, much of the focus in 1999 was toward Y2K problems. Thus, software process improvement initiatives generally were given lower priority.

AAC initially approached the use of the CMM framework incorrectly. Rather than approaching it as “continuous improvement,” they viewed the achievement of Level-2 as a “compliance”; in other words, they viewed it as the end result of a one-time effort. It took several months before management bought into the philosophy of continuous improvement.

Successes

Along the way, AAC discovered many things about themselves. They realized that most of their software development efforts were based on the performance of individual software developers and not the processes guiding their actions. They also uncovered many inconsistent processes spread throughout the organization. Both discoveries prompted the formalization of many well-established, but informal, processes. They have also created many processes to fill the discovered voids. Formalizing the processes is already paying dividends in the form of shorter training/transition times for new hires.

The methodology created as a result of the initiative is very important to the future of the IS division of AAC. It represents a formal development approach, yet is flexible enough to be used across many different platforms. Employees have bought-in to the methodology thanks to top management’s commitment to garner employee involvement throughout the entire process. New employees are indoctrinated with the methodology; existing employees are increasingly adopting. The culture of the organization is slowly changing to one of formalized development practices as the norm, rather than the exception. The methodology will help AAC achieve Level-2 and position them to move quickly to Level-3.

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