



Applying the Software Acquisition Capability Maturity Model

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Using poor management processes to acquire software can hold back the best software development processes. The Software Acquisition Capability Maturity Model® (SA-CMM®) was developed to help improve software acquisition processes so that organizations are better able to achieve acquisition goals. This article describes principles that helped successfully apply the SA-CMM and shares some lessons learned from successful and less successful SA-CMM-based improvement programs.

Government and industry are recognizing the need to improve the maturity of their software acquisition management processes. Unstable acquisition processes can impact a supplier's software development processes and result in substandard products. The Software Acquisition Capability Maturity Model® (SA-CMM®) was developed to help improve the acquirer's ability to manage such acquisitions by providing a mechanism to discipline the acquirer's software acquisition processes [1].

Organizations have used the SA-CMM not only to instill discipline in their software acquisition processes, but also in their general acquisition processes. This is possible because of the flexibility and adaptability of the SA-CMM for each organization's unique business needs. In this paper, we explore the features of the SA-CMM that support this flexibility and provide some lessons learned in applying the model to several different organizations' process improvement efforts.

What Is the SA-CMM?

Capability maturity models are collections of features that reflect effective processes and practices for various disciplines. The first capability maturity model, the

Software Capability Maturity Model® (SW-CMM®), was created by the SEI to help organizations improve their software development processes [2]. The SA-CMM was created to help organizations improve their acquisition processes.

There are other capability maturity models for personnel management and for systems engineering. The ongoing Capability Maturity Model IntegrationSM (CMMISM) effort is an attempt to combine several of these disciplines under one framework [3]. The CMMI model variant that partially includes the acquisition discipline has a product development perspective with acquisition seen as supporting the development.

The SA-CMM has been and is focused on software acquisition and management of the acquisition rather than development. Once the CMMI fully embraces the concepts and principles of the SA-CMM, it would be expected that the SA-CMM would be retired three years after. For now, the SA-CMM provides the comprehensive software acquisition focus.

The SA-CMM focuses on how the acquisition organization manages its internal business, not on how the supplier (developer) manages his development project. From another perspective, the SW-

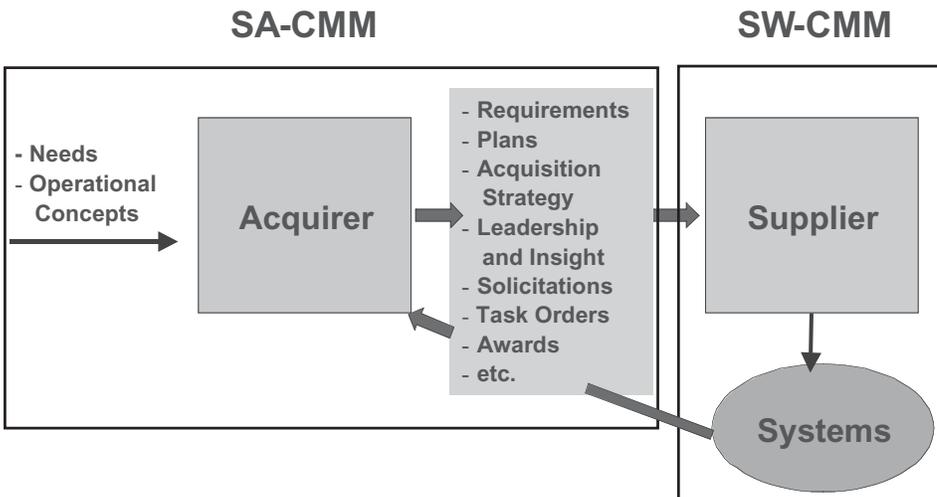
CMM describes the seller's (supplier's) role while the SA-CMM describes the buyer's (acquirer's) role in the acquisition process, as shown in Figure 1.

If applied correctly, the SA-CMM results in an introspective view of an organization's ability to accomplish its software acquisition mission. Typically, such introspection reveals areas for improvement that include the following: the organization lacks institutionalized acquisition processes, the processes are inefficient and sometimes ineffective, organizational overlaps exist, responsibilities are not well defined, and visibility into projects is poor. Application of SA-CMM helps an organization understand the existence of these conditions. This realization provides the basis for developing improvement plans.

The SA-CMM architecture is structured into five levels of process maturity.¹ Maturity Levels 2 through 5 represent increasing organizational process maturity. Each maturity level (except Level 1) contains key process areas (KPAs), which are clusters of important, related practices. Table 1 depicts these levels and the key process areas at each level.

Note that the primary focus of Level 2 is basic project management within a single project. The Software Acquisition Planning and Solicitation KPAs provide the acquisition plans and requirements for the solicitation package and the resulting contract. Requirements for the solicitation and contract are developed under the Requirements Development and Management KPA. (These requirements are passed to the supplier through the solicitation package and contract.) Although the acquisition organization develops and manages the requirements from the beginning of the project, both the acquirer and the supplier have roles in managing requirement changes throughout the contract period of performance.

Figure 1: Areas of Focus for Acquirer and Supplier Models



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While project management occurs throughout the acquisition, it is during the contract performance period that the Project Management KPA uses the Contract Tracking and Oversight KPA and the Evaluation KPA to collect information about supplier performance. Throughout the contract performance period, the Evaluation KPA focuses on objective evidence of product compliance with the contractual requirements. The Transition to Support KPA supplies life cycle support requirements to both the supplier and to the eventual support organization.

Level 3 focuses on process standardization and a more proactive approach among projects within the acquisition organization. For example, the Process Definition and Maintenance KPA focuses on creating and maintaining process definitions for the entire acquisition organization. The Project Performance Management takes several of the project-oriented activities from the Level 2 KPAs, primarily the Project Management KPA, and adds practices to foster better planning, communication, and cooperation. At the same time, the Contract Performance Management KPA adds more proactive and cooperative emphasis to the Contract Tracking and Oversight and Evaluation KPAs. Level 3 also supports its proactive management emphasis through the Acquisition Risk Management KPA. This includes risk management in the project management, planning, and contract management activities.

The SA-CMM Level 3 training program is established as an organization-wide training program. This concept supports the Level 3 requirement of *required* training for individuals, projects, and the acquisition organization in the Training Program KPA.

Level 4 emphasizes quantitative management of the processes and projects. Here, the application of quantitative data extends the Project Performance Management and Contract Performance Management KPAs from Level 3 to their respective Level 4 counterparts: Quantitative Process Management KPA and Quantitative Acquisition Management. In other words, Level 4 requires that project management and contract oversight be based upon quantitative data.

Level 5 emphasizes continuous and proactive improvement of the acquisition processes. The Continuous Process Improvement KPA uses Level 4 quantitative measurements to improve the acquisition processes while the Acquisition Innovation Management KPA includes technologies that support this process improvement.

These maturity levels provide a high-level road map for the continuous improvement of an organization's software acquisition process. As an acquisition organization attempts to achieve each higher level of maturity, its management must increase its involvement, leadership, and discipline. A maturity level is achieved by mastering all of the KPAs at that level, i.e., by achieving specified process goals within each KPA. The higher maturity levels of the model build on the lower levels. Indeed, some of the key process areas of the higher levels represent an improvement in the capability of the KPAs at lower levels as noted earlier.

Interpreting and Applying the SA-CMM

The following principles, most excerpted from the SA-CMM, provide some guidance on how to interpret the SA-CMM for specific acquisitions. In addition, these principles support the *flexibility* of the SA-CMM when applying it to specific organizations and acquisitions. However, interpreting the SA-CMM for a particular organization must be performed with professional judgment based upon both the knowledge of the principles below and experience in managing software acquisitions. Organizations that have adhered to these principles have typically achieved their process improvement goals more rapidly.

Interpret the Model in Light of Business or Mission Needs

The SA-CMM should be interpreted in the context of the business or mission needs of the organization. Effective and efficient acquisition processes are critical to successful process improvement, but the quality of their output can only be determined in the

context of the organization's business needs. The SA-CMM should be tailored or adapted to fit the organization; the organization should not be restructured to reflect the SA-CMM.

Apply the Model in Terms of the Organizational Scope

The SA-CMM applies to the acquisition of all types of embedded and stand-alone software applications, including those where commercial-off-the-shelf (COTS) and non-developmental item software are being acquired, either as a part of a system or separately. Depending upon the mission of the organization, the SA-CMM may be used to improve acquisition processes for any type of product, not just software products.

One approach is to use the SA-CMM to identify and subsequently generalize acquisition processes for the products and services an organization wants to buy and then ensure the software aspects in the SA-CMM are included in these processes as appropriate. In this way, there is no need to tailor the SA-CMM. Inclusion of software under the general acquisition processes would satisfy the KPA goals of the model during an assessment. To illustrate this point, consider the Project Management KPA. The SA-CMM activities here focus on planning, staffing, and generally managing and controlling the acquisition project. These activities can be applied usefully regardless of the type of product or service being acquired.

The SA-CMM is designed to be sufficiently generic for use by any government or industry organization. When applying the SA-CMM to a particular organization, translations may be required (in addition to tailoring or adaptation of the model to fit a specific acquisition). Translation involves

Table 1: SA-CMM Architecture

Level	Focus	Key Process Areas	
5 Optimizing	Continuous process improvement	Acquisition Innovation Management (AIM) Continuous Process Improvement (CPI)	Higher Quality Productivity Lower Risk
4 Quantitative	Quantitative management	Quantitative Acquisition Management (QAM) Quantitative Process Management (QPM)	
3 Defined	Process standardization	Training Program (TP) Acquisition Risk Management (ARM) Contract Performance Management (CPM) Project Performance Management (PPM) Process Definition and Maintenance (PDM)	
2 Repeatable	Basic project management	Transition to Support (T2S) Evaluation (EVAL) Contract Tracking and Oversight (CTO) Project Management (PM) Requirements Development and Mgt. (RDM) Solicitation (SOL) Software Acquisition Planning (SAP)	Higher Risk Rework
1 Initial	Competent people and heroics		

mapping from the model's generic organization, language, and intent to how the acquisition organization does business. Also, the generic model terminology must be mapped onto the local situation; some examples are *contracting official*, *affected groups*, and *domain*.

The SA-CMM is not limited to formal contract acquisitions. It can be used to obtain software products from *in-house* groups. For this usage, the term *supplier* refers to the organization performing the required development effort. The term *project team* refers to the individuals within the acquiring organization who have an assigned acquisition responsibility, and the term *contract* refers to the agreement between the organizations.

Lessons Learned in Applying the SA-CMM

Because it is relatively new, the SA-CMM has not enjoyed the widespread awareness and acceptance as has the older SW-CMM. Thus, there is not a large amount of data to demonstrate proven return on investment. Evidence of a SA-CMM benefit is often anecdotal and typically relates to problems avoided, which are possibly more meaningful than return on investment for an acquirer.

Nevertheless, many organizations are applying the SA-CMM in their specific context because it makes good business sense to improve their acquisition processes. These applications vary considerably among organizations, ranging from awareness of the model, primarily through training, to full-scale process improvement, including assessments. Some organizations applying the model include U.S. Army, PM Abrams, Computer Sciences Corporation, the IRS Business Modernization Office, U.S. Customs, the Department of Housing and Urban Development, and the General Accounting Office. All have had both good and bad experiences. We document here the following lessons that have been identified from applying the model. Many stem from not following the principles noted above or misinterpretations of the SA-CMM or process improvement in general.

Not a Silver Bullet for Troubled Projects

The SA-CMM is *not* a model for helping troubled projects. Some acquisition managers have heard of capability maturity models but do not have the requisite background to understand their intended uses. Instead, many of these managers are looking for the silver bullet that will retrieve

their acquisitions projects from their death spiral.

The use of capability maturity models for process improvement is not a short-term effort. It is unrealistic to expect an immediate benefit of process improvement when a project is failing. Imposition of a process improvement effort may in fact have a negative effect on an already beleaguered acquisition. However, even in such projects, the SA-CMM may be employed as a diagnostic tool to understand where the project is going wrong. This would possibly allow a focused effort to correct the problems.

Prematurely Mandating a CMM Level Leads to Failure

Some acquisition managers have little knowledge of capability maturity models and their use in process improvement activities. Many have no problem imposing SW-CMM levels on their contractors. However, they have no knowledge about imposition of capability maturity model

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levels on their internal efforts, i.e., how long it takes, what it takes, needed cultural changes, and resources required. Instead, managers may draw a line in the sand and announce their organization will achieve SA-CMM Level 2 or 3 in six months. Artificial imposition of a capability maturity model timeline encourages organizational shortcuts in process documentation and implementation, thereby undermining the intended purpose of the capability maturity models.

Managers must understand the SA-CMM and what it takes in resources and time to achieve a certain maturity level. Understanding what their suppliers have gone through to achieve certain SW-CMM maturity levels might shed some light on what it takes. Data are certainly available. Also, realize that capability maturity models were developed with the original intent to improve processes, not achieve maturity levels.

Another indication of a similar misunderstanding is using the model only to

achieve a maturity level rating, rather than instilling discipline into the process. This attitude may reflect a quest for status rather than a legitimate attempt to examine business needs and install process discipline to support these needs. The SA-CMM should be a means to an end, not an end itself.

Stabilize the Environment Before Attempting Process Improvement

Process improvement, whether using capability maturity models or not, is best done within the context of a stable environment. Some organizations do not understand their acquisition mission, do not have an organizational structure or skills to support this mission, or are evolving their acquisition processes as they learn how to accomplish mission requirements. For example, organizations that treat acquisition as simply managing the contractor significantly underestimate the challenges of program acquisition.

Before contemplating a process improvement effort, these areas of the environment should be sufficiently stabilized in order to facilitate success.

Treat Process Improvement as a Project

Process improvement experts agree – treat the process improvement effort as a well-run project. As a project, implement the following: develop reasonable plans with achievable goals based on business needs, do not try to improve everything at once, obtain long-term sponsorship and commitments, devote sufficient resources to the effort, and remember to plan deployment of process improvement efforts to the users.

Conduct Detailed Planning of the Acquisition

Some organizations believe that their acquisition projects do not have to be thoroughly planned. In other cases, there is an attitude that all planning resides with contractors, and the acquisition project simply follows the contractor's plans. It is clear that some acquisition projects do not understand what goes into a project plan, how to write a plan, and how to use a plan. There have been cases where project managers rely on planning templates without adapting the templates to their particular acquisition project. This results in devoting considerable resources to the development of plans that are not used. In such cases, organizational frustration may grow and resistance to process improvement may solidify.

The SA-CMM is based on the expectation that a mature organization and its

projects will do a thorough job of planning an acquisition. The resulting project planning documentation need not be any more extensive than that of any well-managed project.

Employ Demonstrated Expertise

In many cases, the acquisition organization has little knowledge or experience with SA-CMM and process improvement in general. This means it may have to contract externally for acquisition process improvement services.

If this is the acquisition organization's approach, it needs to obtain expertise in SA-CMM-based process improvement that can be verified and demonstrated. This expertise is especially critical in interpreting the SA-CMM in the context of the acquisition organization's environment and business paradigm.

Use the SA-CMM as a Starting Point

Acquisition organizations that buy software-intensive systems tend to believe the SA-CMM is not applicable to their acquisition processes since they buy systems, not software. One reason the SA-CMM was developed, as noted earlier, was to ensure these acquiring organizations realize the criticality of software in their acquisition.

However, organizations have used the SA-CMM as a foundation for process improvement in more general system acquisition processes, such as for systems

and services. Such organizations have stabilized processes and have corrected or resolved long-standing control issues.

Moreover, if software is properly included within the context of these general acquisition processes and these processes include the practices or features of the SA-CMM, then assessments using the SA-CMM as a reference model can be successful. Of course, success depends on the rigor the organization uses when implementing its process improvements.

Summary

The SA-CMM was created for the discipline of software acquisition, i.e., to help organizations improve their software acquisition processes. The SA-CMM focuses on how the acquisition organization manages its internal business, not on how the supplier (contractor) does its business. The model was developed to be flexible enough in its application to be adaptive to a variety of organizations and their differing acquisition processes. Many of the principles documented in the model itself support this flexibility.

Currently, the SA-CMM is being used by organizations to improve acquisition processes. The exact usage ranges from simply learning about the model and its implications to extensive process improvement projects. We have found that some of these organizations have interpreted and applied the model incorrectly without following the principles discussed here. Such

endeavors typically result in delays or cancellation of its process improvement efforts.

In general, we have found that the SA-CMM can be successfully applied to most acquisition organizations and their unique processes. When applied properly, the SA-CMM ensures that the acquisition organization is better poised to acquire the software product and services to meet the goals of the end users. ♦

References

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Note

1. In CMMI terms, the SA-CMM is a staged model.

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