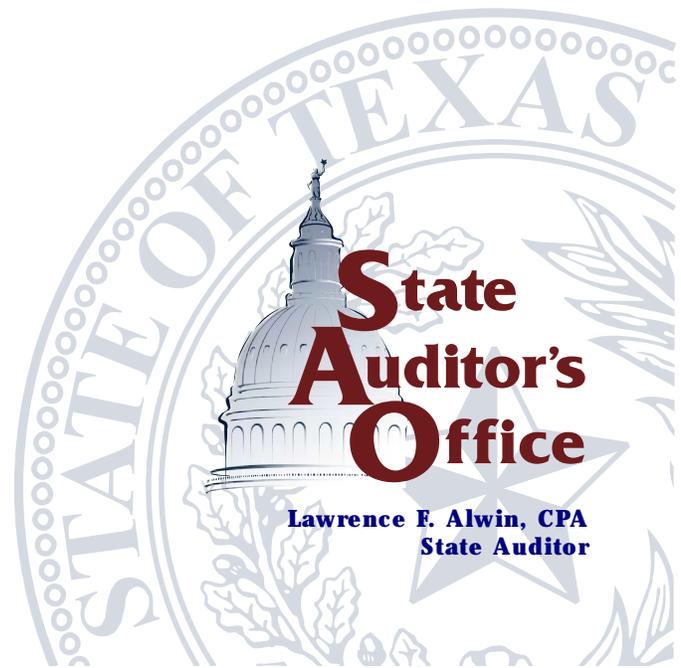


# Texas Can Benefit From Using a Standard Framework to Manage Software Development

A Pilot Study Using the  
Capability Maturity Model for Software

November 2001

Report No. 02-008



# Key Points of Report

## Texas Can Benefit From Using a Standard Framework to Manage Software Development

A Pilot Study Using the Capability Maturity Model for Software

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### Overall Conclusion

The State can expect significant savings from using a standard framework such as the Capability Maturity Model for Software (SW-CMM<sup>1</sup>) for managing and improving software development processes.

### Key Facts

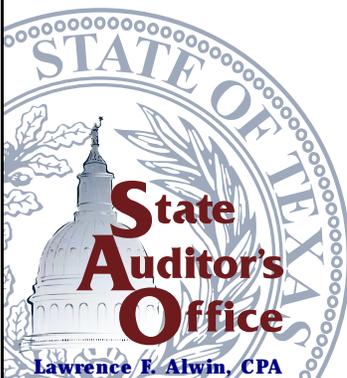
- The Comptroller of Public Accounts (Comptroller) estimates that it will achieve a 5 to 15 percent efficiency gain on projects by using the SW-CMM to standardize its software development processes.
- As of August 2001, the Quality Assurance Team (QAT) was monitoring 44 high-risk projects with life cycle costs of \$801 million. If these projects achieved a savings of 5 to 15 percent resulting from efficiency gains as estimated by the Comptroller, the State could save between \$40 to \$120 million over the life of the projects.
- Of the 44 high-risk projects, 70 percent experienced delays in product delivery ranging from 2 to 71 months.
- Following a standard framework to manage software development should result in information technology (IT) projects that are developed on time, on budget, and with agreed-to functionality.
- The SW-CMM provides a level-by-level approach to managing and improving software development processes:
  - The SW-CMM helps organizations identify what key processes should be in place when developing and maintaining software.
  - Using the SW-CMM reduces development and maintenance costs, improves understanding of product functionality, and produces products much closer to on time and within budget.

### Contact

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<sup>1</sup> SW-CMM<sup>®</sup> is registered with the U.S. Patent and Trademark Office.



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# Executive Summary

The State of Texas can save significant money and time by using a standard framework such as the Capability Maturity Model for Software (SW-CMM) to manage and improve its processes for developing and implementing software systems. The Comptroller of Public Accounts (Comptroller) estimates it will achieve a 5 to 15 percent efficiency gain on projects as a result of using the SW-CMM to standardize its software project management. The State spends approximately \$1.5 billion per year on information technology (IT) projects. As of August 2001, the Quality Assurance Team (QAT) was monitoring

44 high-risk IT projects with life cycle costs of \$801 million. If these 44 projects achieved efficiency gains similar to those estimated by the Comptroller, the resulting savings for the State could be between \$40 to \$120 million over the life of the projects. Furthermore, 70 percent of the high-risk IT projects experienced delays in product delivery ranging from 2 to 71 months, compounding the negative effects of software development inefficiencies.

In a pilot study managed by the State Auditor's Office, the Comptroller and the Department of Human Services (DHS) implemented the SW-CMM on software projects involving their core business operations. The Comptroller estimates efficiency gains of approximately 5 to 15 percent through the use of SW-CMM; DHS has yet to estimate the increases in its efficiency.

A major lesson learned during the pilot study was the importance of agency executive management support. The success of improving software development processes, regardless of methodology, requires continuous senior management involvement to create and maintain focus, staff buy-in, and process ownership.

Projects that directly affect an agency's core business operations provide the greatest incentives for adopting the SW-CMM because of the potential gains. As agencies become more adept in process

improvement, they will become better at forecasting budgets, meeting performance standards, and tracking performance. These improvements will lead to savings on software development projects and increased credibility with users and oversight agencies.

The Program Management Office, which was established by the passage of Senate Bill 1459 (77th Legislature), provides a statewide mechanism for implementing the SW-CMM and generating savings on software development projects. The QAT has already adopted the SW-CMM as a standard for assessing the management of software development projects that fall within its purview, further supporting the efforts of improving IT project management in Texas. Using the SW-CMM will help agencies develop useful software on time and on budget.

## What is the SW-CMM?

The SW-CMM is a standard framework for managing and improving software development processes. As an organization's ability to manage projects improves, its "capability" improves or "matures." The SW-CMM defines five levels of capability maturity and helps organizations identify the key processes needed to move from one level to the next. The SW-CMM was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University.

For more information on the SW-CMM, refer to Section 4 of this report.

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## Why should Texas implement the SW-CMM?

Based on the results of the pilot study, the State Auditor's Office recommends that state agencies with large information technology (IT) operations implement a standard framework for software development processes to achieve the elements of the Capability Maturity Model for Software's (SW-CMM) key process areas (see Appendix 2 on page 21). Participants in the pilot study, which was managed by the State Auditor's Office, implemented the SW-CMM on software projects involving their core business operations.

Texas agencies have a history of software development problems. The pilot study and industry results show that the State of Texas could save millions of dollars each year by following standard processes under the SW-CMM framework. The SW-CMM will allow agencies to focus on processes and management of those processes to achieve results, reduce costs, and increase productivity. It will provide project teams and internal audit departments with a proven method of preemptive checks and balances to ensure that a software project will produce expected results within given time and budget constraints.

As agencies reach a higher level of capability maturity, they will increase process repeatability, increase outcome predictability, increase product quality, and decrease rework. Using the SW-CMM reduces development and maintenance costs; improves understanding of product functionality; and produces a software product that more closely meets its (1) scheduled deadline, (2) original budget, and (3) agreed-to functionality. Agencies should also expect an increase in the credibility of up-front information such as timeframes and cost estimates.

Agencies can use the SW-CMM to assist in their evaluation of a software development contractor. Agencies can require contractors to prove they operate at a given SW-CMM level. One way to determine a contractor's SW-CMM level is for the contractor to be assessed by a team trained and led by a Software Engineering Institute (SEI)-authorized lead assessor. Contractors could provide documentation of appraisal results and the improvements made after appraisals.

Process improvement is a long-term, strategic effort. An organization should consider its improved capability for developing software processes as a "new technology" that must be adopted throughout the organization. It takes a lot of work and some up-front costs to instill the SW-CMM into an organization, but once there it offers the high-level of accountability required of software development and maintenance environments.

### **Texas Agencies Have a History of Cost Overruns and Delays in Software Development**

Most IT audits of state agencies in the 1980s and early 1990s revealed that agencies lacked formal methods and effective controls for developing software.

During reviews of the State's high-risk IT projects, the Quality Assurance Team (QAT) consistently found cost overruns, delays, and missing functionality. As of August 2001, the QAT was monitoring 44 high-risk IT projects with life cycle costs of \$801 million. Fifty-nine percent of the projects were over budget; 25 projects had cost overruns ranging from \$49,000 to \$62 million and 1 had a cost overrun of \$286 million. Twenty-seven percent had cost savings; 11 projects had savings ranging from \$165,000 to \$13 million and 1 had a savings of \$43 million. Fourteen percent (6 projects) were on budget. Taken in aggregate, the total cost overrun for these 44 projects was \$361 million. Furthermore, 70 percent of these projects (31 of 44) experienced delays in product delivery ranging from 2 to 71 months. Twenty-five percent (11 of 44) were on schedule, and 5 percent (two of them) were ahead of schedule by three months or less.

### **Pilot Agencies See Benefits From Implementing the SW-CMM**

The Comptroller and DHS have installed a complete process improvement infrastructure that includes process management governance bodies, process action teams, repositories for process documents, and sets of process management procedures. They now have a set of processes to support the management of IT projects and an IT infrastructure. Management information systems staff members have gained expertise on the SW-CMM principles by participating in training classes and on process action teams. Key individuals also gained expertise on the SW-CMM-based appraisal for internal process improvement (CBA-IPI) through training classes and participation on a CBA-IPI assessment.

#### **The CMM Pilot Study**

The CMM pilot study was used to establish baseline methodologies and incorporate the use of an industry standard that the State can use to manage software development projects. Improved management will increase the State's ability to reduce costs and provide timely, cost-effective, quality software products. The State Auditor's Office sponsored the pilot study; the Comptroller and DHS served as the pilot agencies. Each pilot agency chose one or more pilot projects on which to implement the CMM.

**Comptroller of Public Accounts.** The project manager for the Comptroller estimates time savings of 10 percent over the course of the Comptroller's pilot project as a result of SW-CMM implementation. The project manager expects efficiency gains of 5 to 15 percent as the agency's software development capabilities mature. The projected savings results from having processes in place to effectively manage, track, and monitor software development projects. Processes include the setting of requirements, the measuring of quality, and the monitoring of contractor performance. Furthermore, the Comptroller is continuing its process improvement effort even though the pilot study is finished. Having the agencies continue their efforts was one of the goals for the pilot study.

By following the principles of the SW-CMM on its Integrated Statewide Administrative System (ISAS) project, the Comptroller used documented processes to increase the consistency of operations and reduce the time to release. The development of release plans (which was performed at the beginning of the project) allowed the entire project team to meet, discuss issues, and define areas affected by the project. This helped the team complete Release 7.51 of ISAS 22 days early.

In addition, the project manager noted that before the implementation of the SW-CMM, the normal time for a new employee to become familiar with and

participate fully in agency operations was six to nine months. Since implementation of the SW-CMM, it takes one-and-a-half to two months. With the SW-CMM, the project manager is better able to identify weak areas in the project, justify requests for personnel, post accurate job descriptions, select qualified candidates, and define staff expectations.

Following the SW-CMM framework, the project manager and project team created a new method for evaluating and accepting deliverables from the contractor. This method improved the project team's ability to identify what to measure, especially as it related to the contractor. As a result of the project team's SW-CMM efforts, the contractor can more effectively perform self-evaluations. In addition, the project team is better able to track milestone dates, error rates of training materials, and the number of times it took the contractor to rework a "fix." Addressing these types of issues helped the project team identify and correct problems prior to product release, improve the overall quality of the product, and improve the overall management of the project. In addition, the ISAS project team members have experienced increased pride in the quality of their work since implementing the SW-CMM.

**Department of Human Services.** As of the writing of this report, DHS was in the middle of its implementation of the SW-CMM on two Federal Welfare Reform projects. Because the projects were in the implementation stage, the project manager had not yet identified potential savings in money or time. The project manager noted that DHS was still in the higher cost phase, referring to the initial learning curve associated with implementing a process improvement effort. DHS will not be able to quantify the extent of improvements until after the implementation is complete. DHS is continuing its process improvement effort even though the pilot study is finished. Having the agencies continue their efforts was one of the goals for the pilot study.

Although the projects are not complete, DHS has identified some benefits as a result of its SW-CMM implementation efforts. It has shifted toward a process-oriented culture at both management and staff levels. As a result, the agency has improved its working relationship with its information system customers.

As the process improvement effort continues, DHS expects these benefits to help improve the timeliness and quality of software projects, staff recruitment and retention, and its ability to cope with staff turnover and legislative mandates with short timeframes. DHS expects to be able to provide IT services at a lower cost and manage increasingly complex technical systems in the future.

## **Organizations Outside of State Government Have Benefited From the Use of the SW-CMM to Improve Software Development**

Many industry organizations such as Hewlett Packard, Boeing, Motorola, Citicorp, Texas Instruments, Raytheon, and Entergy have used the SW-CMM to improve the quality of software they develop, thereby realizing a tremendous competitive advantage. Organizations experience benefits such as an average return on investment of 5 to 1, increases in productivity and defect detection, and decreases in the number of defects delivered and the time to release a product. These are measurable gains that can be tracked and reported year after year. Organizations also experience benefits

such as improved morale, less overtime, lower turnover, and increased customer satisfaction.

For example, Raytheon was experiencing a 41 percent rework rate. After implementing the SW-CMM, the company reduced rework by \$15.8 million over a four-year period, test rework by half, and defects by a factor of 4.2. In addition,

Raytheon decreased its overtime and employee turnover. The company experienced increases in productivity of 190 percent over 8 years, bonus pay for early delivery, and the ability to take on more business.

**Executive Management Support is Critical to the Success of the SW-CMM Implementation**

The State Auditor's Office team visited the Department of Veterans Affairs (VA) at the beginning of the pilot study to collect information from the VA's SW-CMM process improvement efforts. Like the State Auditor's Office study, the VA found that executive management support is critical to the success of the SW-CMM implementation; training is required for those persons who will be involved in the improvement effort; and an organization needs to create a software engineering process group prior to implementing the SW-CMM. (Refer to Section 3 on page 8.)

The SEI studied 13 organizations that implemented the SW-CMM. It found that the organizations increased productivity a median of 35 percent, increased pre-release defect detection an average of 22 percent, reduced time to market an average of 19 percent, and reduced the number of defects delivered an average of 39 percent. Other industry information identifies savings in cost overruns and maintenance costs.

By implementing the SW-CMM, the Department of Veterans Affairs (VA) improved morale and increased teamwork and synergy. It noted that the first 12 to 18 months cost more due to the learning curve, but both cost and time requirements

decreased as the organizational culture became process-oriented. What took employees days now takes hours because the employees have processes to follow and can reuse work from previous projects. For example, it took 30 hours to create documents for one of the pilot projects and only 5 hours to produce the same set of documents on a subsequent project.

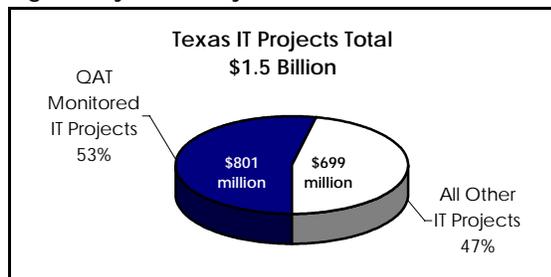
## What types of agencies should implement the SW-CMM?

The State should focus its software development process improvement efforts on projects that are housed in large IT departments. Large, high-risk and high-impact software projects have the potential for the highest return on investment for the State. The QAT identifies and monitors these types of projects. Other conditions also indicate a greater need for process improvement. These conditions include high employee turnover, a small workforce, and outsourced software development projects.

### Why were Comptroller and DHS projects appropriate for SW-CMM implementation?

As of August 2001, the QAT was monitoring 44 high-risk projects with life cycle costs of \$801 million, more than half the total for the State (see Figure 1). Some or all of these projects could benefit from the use of the SW-CMM.

Figure 1  
As of August 2001, fifty-three percent of the State's software development projects were considered high risk by the Quality Assurance Team.



Source: DIR data

The State Auditor's Office selected the Comptroller as a participant in the SW-CMM pilot study because its financial systems are critical to state operations. The Comptroller agreed to participate and chose ISAS as its pilot project because it recognized that improvements were needed in enhancing processes and documentation related to the project. These improvements were necessary because of limited state resources and high turnover associated with the ISAS project. The ISAS development team plays a critical role in customizing and maintaining the financial

system for the State of Texas and deploys it to all participating agencies. The improvements gained in the execution of the ISAS development and maintenance effort are widespread, benefiting all users of the software.

The State Auditor's Office chose DHS as a pilot agency for the SW-CMM pilot study in part due to its large IT department. DHS has a large IT influence on Texans. Its automated systems affect more than 20,000 users through 57 state and federal programs. DHS has 804 networked offices statewide. It makes payments of \$36 million daily and holds data on more than 6 million people. The agency's systems send, receive, and compare data among 150 internal systems and 77 other state, federal, and private organizations. Its IT department acts as a service bureau to 140 other state and private entities for systems, networks, and processing, and it is faced with increasing complexity, obsolescence of IT assets, and increasing costs of resources and service delivery.

## What elements are critical to successfully implementing the SW-CMM?

### **A Software Development Life Cycle**

The improvements that occur under the SW-CMM apply to the project management portion of a software development system. However, organizations still need to follow good software engineering practices. The SW-CMM is designed to support an agency's software development life cycle (SDLC) and assumes that a functioning SDLC exists. If an agency does not have its SDLC in place, it must establish one before implementing the SW-CMM. An organization's SDLC is in effect a picture of its software development processes. The SDLC is made up of the core engineering processes used to develop and maintain software.

### **Defined Project Requirements**

Defining requirements is critical to the success of a software development project. Although the SW-CMM framework is effective for determining the maturity of the processes used by software professionals, it does not address the process of defining requirements. It covers project management to meet requirements that have already been defined.

### **A Process Improvement Infrastructure**

Implementing the SW-CMM will result in a new process improvement infrastructure. This should be made clear prior to implementation. The management steering team (MST), software engineering process group (SEPG), and process action teams (PATs) for each process area are all pieces of this new infrastructure, and they are critical to successfully institutionalize the SW-CMM within the organization. (See Section 4 on page 13 for more information on the infrastructure.)

### **Support From Senior Management and the Internal Audit Department**

The success of process improvement is directly tied to support from senior management. Constant, visible executive support is critical to successful implementation of any cultural change, including the SW-CMM, because everyone's commitment is tested repeatedly throughout the change process. Senior management supports process improvement by checking its progress, maintaining focus, and devoting resources. For example, when personnel and groups identify things like lessons learned, the information should be used to assist them in improving processes, not to punish them for inadequate processes.

The executive management of one of the pilot agencies exhibited sustained support throughout the SW-CMM pilot study. This included realigning resources to support

the agency's pilot project. The executive management of the second agency in the pilot study initially exhibited this support and planned staff hours for each phase of the study. However, a temporary shift in management support created concerns about executive management's commitment and ability to implement the SW-CMM. Management support had to be reestablished within the organization. Ultimately, management provided a sustained support that has allowed the agency to continue implementing the SW-CMM.

In addition to senior management commitment, the pilot agencies' internal audit departments were supportive of the SW-CMM pilot study. In fact, one agency supplied an internal auditor to its initial assessment team and SEPG. This kept the internal audit department directly involved with the changes taking place within the agency and provided key expertise to the audit staff.

### **A Willingness to Pay Up-Front Costs for Future Savings**

It is essential for agencies to recognize that implementation of the SW-CMM has up-front costs and causes temporary decreases in productivity. Staff members need time to define the processes, train others to use the processes, and refine the processes. Additional costs include items such as training on SW-CMM concepts and process engineering and hiring SW-CMM experts to teach and develop personnel on how to create and maintain appropriate processes. However, the long-term benefits far surpass any short-term costs. For example, a U.S. Department of Defense organization invested \$462,000 but saved \$2.9 million (6.3 times its investment) during the course of its process improvement effort.

### **Projects That Involve the Agency's Core Business Operations**

The SW-CMM follows the concept that an organization should improve its most important processes first. This will provide the biggest return on investment. Agencies should identify software development projects that involve their core business operations and focus on them throughout the process improvement effort.

### **Staff Commitment**

Process improvement can be demanding on the employees and the organization. Implementing the SW-CMM is expensive in terms of time, and should only be implemented when the organization and its employees are committed to the effort. Maintaining buy-in and focus from staff throughout the improvement process is key to its success. Furthermore, it is necessary for contracted personnel to be committed to process improvement. Not attaining commitment from all parties will hinder the improvement effort.

Personnel from both agencies in the pilot study bought into the process improvement effort, becoming champions of the SW-CMM within their agencies. This buy-in of process improvement took some time due to the nature of organizational changes that took place during implementation. This change began with employees becoming

familiar with and understanding process improvement concepts. Once champions were identified and allowed to become a part of the improvement process, the excitement spread across the IT departments of the organizations. Eventually, the efforts involved employees who wanted to change the culture of their software development groups.

The process action teams (PATs) in the pilot study became the owners of the processes instead of simply the users or promoters. Personnel on the PATs facilitated orientation sessions for their fellow staff members. This transition of ownership was a key success element that needed to take place prior to the SW-CMM facilitator's departure to ensure that the improvement effort could continue effectively after the close of the pilot study. (See Section 4 on page 13 for more information on PATs.)

## **Organizational Awareness of the Implementation**

It is the responsibility of senior management and the SEPG to market the SW-CMM to the organization. It is not enough for only those people directly involved with the process improvement effort to be aware of its existence; it is important that the entire organization be aware. Implementing the SW-CMM will cause a cultural change, and it will affect everyone to some degree.

## **Training**

The SW-CMM is a process improvement framework that works in phases which logically build on one another. It is important that all those involved with the improvement effort be trained on its purpose, the phases, and the phase deliverables. For example, understanding the action plan and its work breakdown structure is critical for understanding what and why specific actions will be taken during the course of improvement.

All key personnel should be trained at the beginning of the improvement effort. As the improvement effort continues, key personnel should take part in training classes and workshops applicable to the work they perform. These people should be the organization's experts, from whom others can learn best practices. The earlier these experts are identified, the sooner the process improvement effort can be realized.

## **An Understanding That the SW-CMM is a Bottom-Up Approach**

The SW-CMM is a bottom-up approach in which pilot projects are used to develop baseline processes that eventually will be developed into organization-level processes. This allows for project-level implementation even though organization-level processes are not in place. In this approach, project members create the processes, allowing them to better understand the expectations of using the new processes. They use the processes throughout the project and document lessons learned. This is repeated on several projects, and lessons learned are evaluated to help define the organization-level processes.

Management does not create the processes and push them down; the projects create processes and push them up. This occurs through systematic integration, evaluation, and improvement of the baseline processes. The SEPG should be responsible for developing a plan and schedule to implement the chosen approach to process improvement. It is the management steering team's responsibility to review and approve the process improvement plan and schedule, provide resources to implement the plan, and actively review progress (at least monthly) of the process improvement program. (See Section 4 on page 13 for more information on management steering teams.)

On its pilot projects, one agency attempted to implement SW-CMM Level 3 before implementing Level 2. It attempted an organization-level implementation instead of a project-level implementation. Its concept was to define the organization-level processes, then push them down to the project level. This top-down approach yielded little process improvement because pilot project members were not part of the process development work, making new processes difficult to implement at the project level. The agency found that its approach was ineffective in creating the cultural change required to improve. Ultimately, beginning with an organization-level approach caused a four-month delay and added additional cost to the agency's improvement efforts.

## What is the SW-CMM?

| The Capability Maturity Model for Software (SW-CMM) is a level-by-level framework for managing and improving software development projects. As an organization's ability to manage projects improves, its "capability" improves or "matures." The SW-CMM defines five levels of capability maturity and helps organizations identify the key processes needed to move from one level to the next. The SW-CMM identifies what processes should be performed, but does not mandate how they should be implemented. Each organization implements its own processes in its own way. As organizations mature, they improve their ability to measure and track key business components, instill a continuous process improvement culture, and reduce costs.

**Capability Maturity Models (CMMs) Have Evolved**

The Capability Maturity Model for Software is one of several maturity models developed at the Software Engineering Institute (SEI) at Carnegie Mellon University.

The SEI has developed CMMs for software, people, software acquisition, and systems engineering.

In an effort to address the problem of organizations having to use multiple CMMs, the SEI recently combined three source models into one integrated model known as the Capability Maturity Model Integration (CMMI). The CMMI will replace the CMM for Software. The process of defining requirements is included in the CMMI.

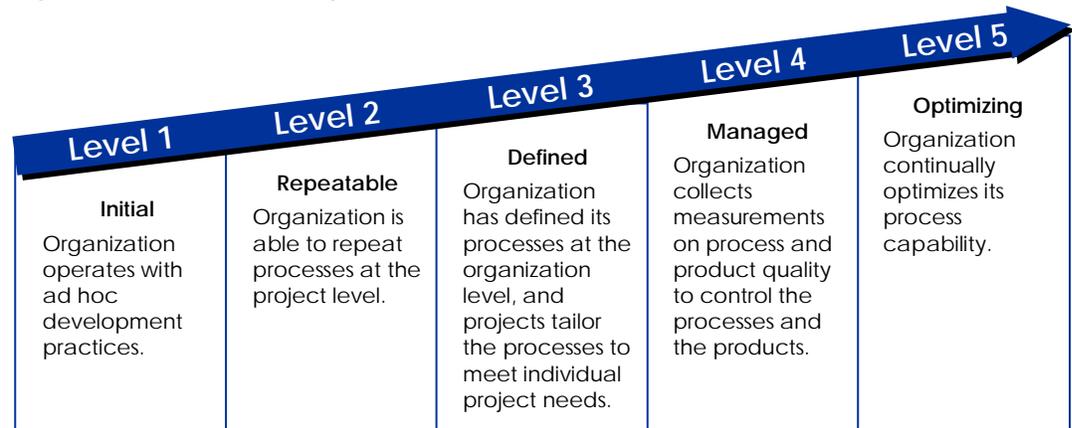
Further information on the various CMMs can be found on SEI's Web site at [www.sei.cmu.edu/sei-home.html](http://www.sei.cmu.edu/sei-home.html).

Incorporating the SW-CMM changes the culture of an organization. The organization begins to use an engineering discipline to formalize its processes

and document and control its work. Through many small, evolutionary steps, the organization shifts from crisis management using individual heroics to structured management using formal processes.

### Levels of Maturity

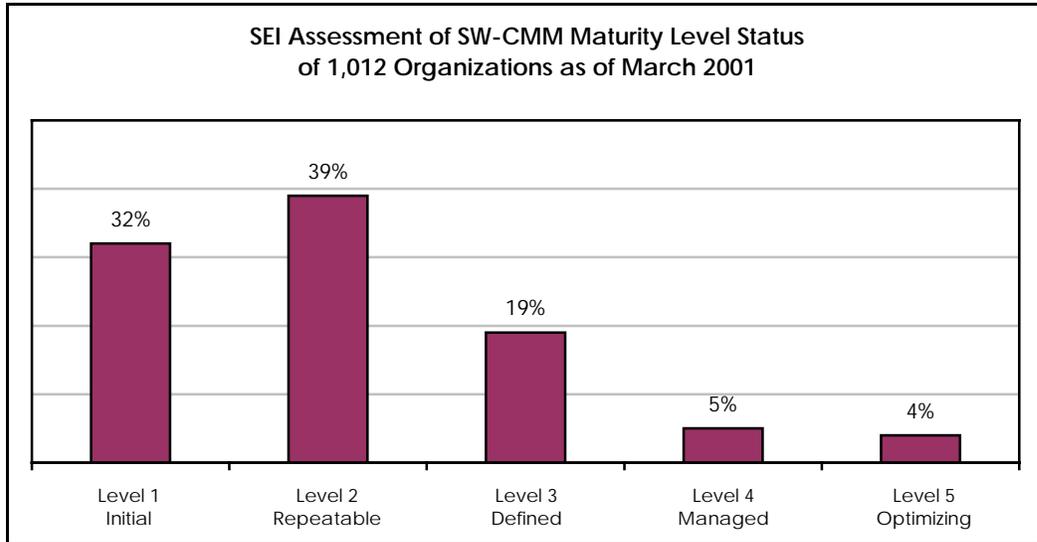
The SW-CMM has five levels of maturity that build on one another as the organization's processes improve. As lower levels are achieved and maintained, an organization can attain a higher level.



## SW-CMM Maturity Level Status

Prior to 1992, 130 organizations reported SW-CMM appraisal results to SEI; as of March 2001 this number had increased to over 1,300.

Figure 2



Source: SEI data based on an assessment of 1,012 organizations.

## Process Improvement Infrastructure

Implementing the SW-CMM will result in a new process improvement infrastructure. An organization must establish the following teams to implement the SW-CMM successfully.

- The management steering team (MST) consists of senior managers who have authority over budgeting, personnel, and operations within the organization. The MST provides appropriate support regarding financial, personnel, and workload issues. The MST reviews and accepts processes submitted by the software engineering process group (SEPG).
- The SEPG is a team of individuals from various IT areas who have expert knowledge of their particular work environment. The SEPG manages the development, review, and acceptance of organizational processes. The SEPG recommends processes for acceptance to the MST and communicates which processes are operational to the project teams.
- Process action teams (PATs) are composed of experts in the specific operations within which processes are defined and documented. Their expertise is captured and recorded in formal processes to become institutional knowledge that can be used by others within the organization. They provide the base work and design processes, then send them to the SEPG for review, acceptance, and recommendation for approval.

## Management Responses



### COMPTROLLER OF PUBLIC ACCOUNTS

P.O. BOX 13528  
AUSTIN, TX 78711-3528

September 6, 2001

Gary Leach  
State Auditor's Office  
1501 N. Congress, Suite 4.224  
Austin, Texas 78711

Dear Mr. Leach:

Here is my agency's response to your draft report entitled *Benefits to Texas' Software Development Capability Through Standard Project Management Frameworks*:

*The Comptroller of Public Accounts concurs with the SAO recommendation that the State of Texas use the Capability Maturity Model for process improvement when creating, developing and implementing software systems. The benefits of following CMM best practices on the ISAS project were clear in the areas of vendor accountability, improved documentation and streamlined development processes. In March 2001, CPA expanded their use of CMM to the area supporting the Integrated Tax System (ITS). By leveraging the work already done by the ISAS pilot CMM project, ITS will be ready for a CMM Level 2 assessment at the same time as the ISAS project. CPA plans to continue propagating the processes and practices throughout the application development area until all systems enjoy the same level of documentation, control and project management.*

*Since the QAT has already adopted the CMM as the standard for assessing the management of IT projects that fall within their purview and the SAO is recommending that large, high-risk, high-profile IT projects follow the CMM guidelines, it behooves all agencies that are the most likely to initiate these types of projects to start with a small pilot project and be trained and assessed using the CMM. Statewide CMM training should be made available to agencies by the SAO and/or DIR, and a state assessment team should be formed with certified assessors. SAO could be the lead assessor and other members could come from participating agencies. Developing this core competency could save the state thousands of dollars on the roll-out of CMM since a typical assessment costs approximately \$40,000. It would also strengthen CMM efforts in every participating agency to have a certified assessor on their staff to guide and direct their efforts and perform regular reviews.*

*Through the coordinated efforts of the SAO, DIR and the LBB, the state should form an information clearinghouse of best practices. One of the basic tenets of CMM is that reusable, repeatable processes increase productivity and insure consistency in service delivery. Making the policies and procedures of agencies that are institutionalizing CMM available to all agencies would give them the jumpstart that CPA's ITS project received from the ISAS pilot project.*

The Comptroller staff that worked with you expressed appreciation for your efforts during the pilot project. We believe that this project will benefit our continuing efforts to improve software development and maintenance. Thank you for all your hard work.

Sincerely,

A handwritten signature in black ink, appearing to read "Billy Hamilton". The signature is fluid and cursive, with a large initial "B" and "H".

Billy Hamilton  
Deputy Comptroller



**TEXAS**  
Department of  
Human Services

COMMISSIONER  
James R. Hine

September 4, 2001

Mr. Gary L. Leach, Project Manager  
State Auditor's Office  
Robert E. Johnson Building  
1501 North Congress Avenue, Suite E 4.224  
Austin, Texas 78701

Dear Mr. Leach:

The Department of Human Services Management Information Systems (DHS/MIS) agrees that adopting the framework of the Capability Maturity Model (CMM) can yield benefits to an agency by increasing the discipline and quality of projects. The realization of those benefits increases over time. There is a significant initial investment of time and money required of any agency to develop and install CMM-compliant processes before such benefits can be fully realized.

DHS/MIS continues to be committed to the use of Software Engineering Institute's (SEI) CMM framework and will expand the process set and the number of projects using them each year.

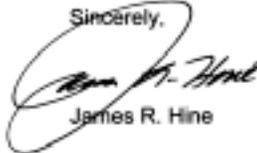
DHS/MIS has just completed a formal SEI CMM Based Appraisal for Internal Process Improvement (CBA-IP) follow-up appraisal to establish the progress made in the MIS pilot projects that were part of the State Auditor's Office (SAO)-sponsored project.

In Fiscal Year 2002 DHS/MIS will concentrate on two project-centric activities to further instantiate CMM:

- 1) expanding the use to all appropriate projects of the 3 "Level 2" key processes and the Software Development Life Cycle (SDLC) already documented and piloted during the SAO project; and
- 2) documenting and piloting the remaining "Level 2" key processes in selected projects.

In Fiscal Year 2002 DHS/MIS will also leverage its current success in installing "Level 3" key processes by maintaining support for the process infrastructure and organizational process capabilities already established.

Sincerely,



James R. Hine

JRH:cfl

**BOARD MEMBERS**

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Chair, Dallas  
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## Objectives, Scope, and Methodology

### Objectives

#### Strategic Objective

Make available a baseline set of standard processes for IT software project implementation management for Texas state agencies. (The baseline set of standard processes is limited to those created by the two pilot agencies. It is important to note that other agencies can use this baseline set as a starting point and then alter processes based on the agency's operations. This eliminates the need to completely re-create process documents for each agency.)

#### Pilot Study Objective

Determine the degree to which Carnegie Mellon University–SEI's SW-CMM framework can be used to improve state agencies' software development processes so that software projects will be cost-effective and successful and provide reliable systems developed on time, within budget, and with agreed-to functionality.

### Scope

The pilot study encompassed three participating agencies and an advisor agency. The participating agencies included the State Auditor's Office as the sponsor and the Comptroller and DHS as pilot agencies. The State Auditor's Office managed the pilot study and provided for a consultant. The Comptroller and DHS provided personnel, managed their respective pilot projects, and worked directly with the contractor to implement applicable SW-CMM level 2 key process areas on their projects. The Comptroller piloted its ISAS Release 7.51 and DHS piloted two Federal Welfare Reform projects. The Department of Information Resources (DIR) served as an advisor agency.

### Methodology

Representatives from each of the four agencies formed the SW-CMM Core Team. The Core Team managed cross-functional operations and provided necessary input to ensure the success of the study. It designed the request for offer, reviewed and evaluated each offer submitted, and chose the contractor to assist the pilot agencies with their process improvement efforts. The State Auditor's Office managed the pilot study and prepared the final report, the pilot agencies managed their respective pilot projects, and the Core Team managed interagency interactions, communications, and documentation. While on site at the pilot agencies, the contractor worked under the general direction of those agencies' respective site coordinators.

The pilot study consisted of five phases:

- Planning – During the planning phase, the contractor worked with the pilot agencies’ senior management groups to determine if they were ready to begin a process improvement effort. In doing so, the contractor ensured that the senior management groups fully supported and would continue to support efforts throughout the entire improvement process.
- Training and Assessment – During the training and assessment phase, the contractor trained the pilot agency employees on the concepts of process improvement and the design, expectations, and limitations of the SW-CMM. The contractor closed the training and assessment phase by performing initial assessments to identify the SW-CMM level of each pilot agency at the beginning of the process improvement effort. This was accomplished by performing a SW-CMM-based appraisal for internal process improvement (CBA-IPI) at each agency. In performing the CBA-IPI, the contractor led a team of people consisting of the contractor and people from the respective pilot agencies. Each team filled in a template consisting of a battery of questions that covered the SW-CMM level 2 criteria. From the results of the CBA-IPI, the contractor was able to determine at which SW-CMM level each agency was operating and identify the items each agency needed to work on during the improvement process.
- Action Plan Development – The results of the CBA-IPI fed directly into the third phase, action plan development. During this phase, the agencies identified the highest priority items and created an action plan to follow during the course of their process improvement work.
- Process Implementation – During the process implementation phase each agency formed an improvement team consisting of multiple process action teams (PATs), a software engineering process group (SEPG), and a management steering team (MST). The PATs developed the processes and sent them for approval through their SEPG. The SEPG reviewed the processes to ensure that they were compatible with other processes and agency policies. The SEPG sent the processes to the MST for final acceptance and approval.
- Interim Progress Evaluation – In the interim progress evaluation phase, the contractor assisted the agencies in their efforts to self-monitor and self-evaluate their improvement effort. The contractor guided the pilot projects through biweekly reviews to determine how well the agencies were performing. The agencies did this by reviewing the action plan and updating it based on the actions taken during the process improvement effort. This self-evaluation was the key to transitioning process ownership to the agencies.

Throughout the pilot study, the State Auditor’s Office kept abreast of the agencies’ pilot projects by holding regular update meetings with the contractor. During such meetings, the contractor passed along successes and lessons learned as the pilot study continued. The State Auditor’s Office also received updates on progress from the agencies’ points of view through regular Core Team meetings.

The State Auditor's Office's primary research included observation of activities performed by the contractor, evaluation teams, and pilot teams and anecdotal evidence from pilot project team leaders. Secondary research included reviews of process improvement related articles, SW-CMM related articles, industry results submitted to the SEI, information available online via the world wide web, and results generated by the pilot study contractor.

DIR participated in the pilot study as an advisor agency by providing project support and by providing a person for the pilot study's Core Team. DIR published guidelines for internal quality assurance on its Web site. The guidelines included information provided by the SW-CMM pilot study regarding items such as process definitions, templates, and checklists for some of the SW-CMM level 2 key process areas. The guidelines can be found on the DIR web site at [www.dir.state.tx.us/eod/qa](http://www.dir.state.tx.us/eod/qa). The information is for state agencies to access and use.

The State Auditor's Office used the results of the SW-CMM pilot study to assess the benefit of using the SW-CMM framework as an effective tool for improving the State's delivery of quality software products.

## **Other Information and Acknowledgements**

This assessment was conducted from September 1999 through August 2001. The assessment was not an audit, and thus was not subject to auditing standards.

The following members of the participating organizations performed the work on this pilot study:

### State Auditor's Office Pilot Study Team:

- Gary Leach, MBA, CQA (Supervising Auditor, Project Manager, Contract Manager)
- Ed Pier, CPA (Technical Specialist)
- Michael Dean (Team Member)
- Carlos Salinas (Team Member)
- Serra Tamur (Team Member)
- Pat Keith, MBA, CQA (Chief Information Officer)
- Leticia Flores (Legal Counsel)
- Charles P. Dunlap, Jr., CPA (Quality Control Reviewer)
- Mary Goehring (Audit Manager, Initial Project Manger)

### SW-CMM Core Team:

State Auditor's Office –

- Gary Leach, MBA, CQA (Supervising Auditor, Project Manager, Contract Manager) – Core Team Leader
- Ed Pier, CPA (Technical Specialist)
- Mary Goehring (Audit Manager, Initial Project Manger)

Comptroller of Public Accounts –

- Dianne Thompson (ISAS Project Manager, CPA Site Coordinator)
- Paul Underwood (Assistant ISAS Project Manager, Assistant CPA Site Coordinator)
- Lisa Kaselak (Systems Analyst, Initial CPA Site Coordinator)

Department of Human Services –

- Linda Parker (Quality Management, DHS Site Coordinator)
- Sue Anderson (Process Improvement Manager)
- Terry Booth (Procurement Specialist)

Department of Information Resources –

- Debbie Estes (Systems Analyst, Liaison)
- Jennifer Walden (Systems Analyst, Initial Liaison)

## SW-CMM Terminology

### **SW-CMM-Based Appraisal for Internal Process Improvement (CBA-IPI)**

A CBA-IPI is a formal assessment that is managed by an SEI Lead Assessor to determine the SW-CMM level of an organization. The Lead Assessor is the liaison between the organization and the SEI when the organization becomes recognized by the SEI as performing at a particular SW-CMM level.

### **Infrastructure**

The underlying framework of an organization or system including organizational structures, policies, standards, training, facilities, and tools that supports its ongoing performance (from glossary, *The Capability Maturity Model*, Carnegie Mellon University, 1995, p. 358).

### **Institutionalization**

The building of infrastructure and culture that supports methods, practices, and procedures so that they are the ongoing way of doing business, even after those who originally defined them are gone (from glossary, *The Capability Maturity Model*, Carnegie Mellon University, 1995, p. 358).

### **Key Process Area**

A cluster of related activities that, when performed collectively, achieve a set of goals considered to be important for establishing process capability. The key process areas have been defined to reside at a single maturity level. They are the areas identified by the SEI to be the principal building blocks to help determine the software process capability of an organization and understand the improvements needed to advance to higher maturity levels (from glossary, *The Capability Maturity Model*, Carnegie Mellon University, 1995, p. 358).

### **Process Capability**

The range of expected results that can be achieved by following a process (from glossary, *The Capability Maturity Model*, Carnegie Mellon University, 1995, p. 361).

### **Subcontractor**

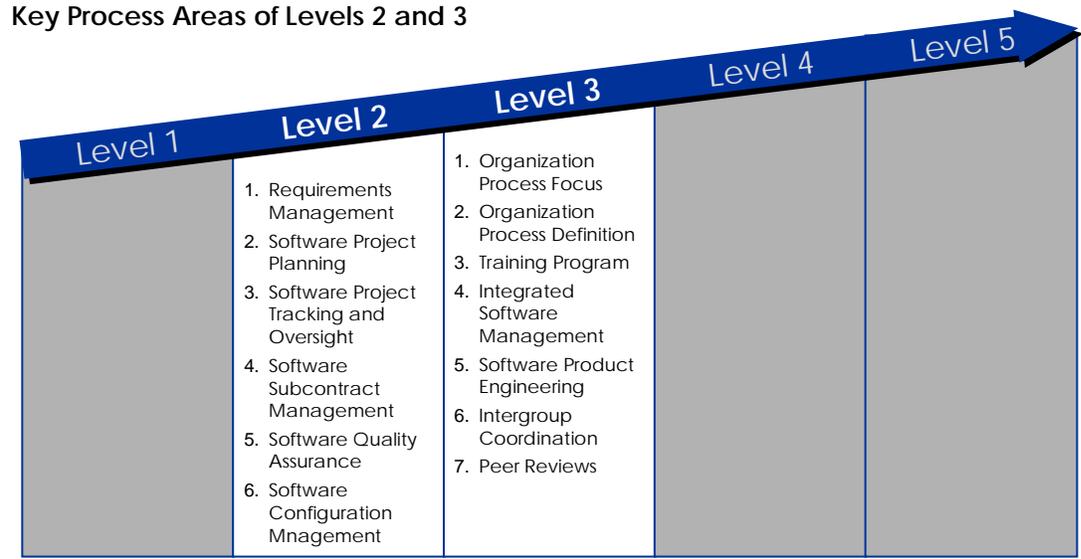
An individual, partnership, corporation, or association that contracts with an organization (i.e., the prime contractor) to design, develop, and/or manufacture one or more products (from glossary, *The Capability Maturity Model*, Carnegie Mellon University, 1995, p. 367). Subcontractors use their own processes to produce and deliver a product. Organizations must determine how they will manage processes that are owned and performed by their subcontractor. They do this via Software Quality Assurance (SQA) teams. An organization's SQA should regularly communicate and interact with the subcontractor's SQA.

## Levels 2 and 3 of the SW-CMM

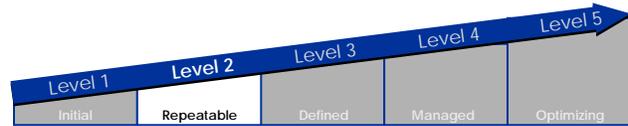
This appendix includes lists of the SW-CMM levels 2 and 3 criteria as documented in *The Capability Maturity Model: Guidelines for Improving the Software Process*<sup>1</sup> from SEI. These are the criteria against which an organization is assessed when receiving a SW-CMM-based appraisal for internal process improvement (CBA-IPI).

To be assessed at a particular level, the organization must show that it meets all the key process area (KPA) criteria for that level. For example, an organization desiring to become assessed at level 2 must meet all six KPAs for level 2. Within each KPA, the organization must show that it meets the goals and key practices. The key practices are composed of activities, commitment to perform, ability to perform, measurement and analysis, and verifying implementation. Commitment to perform, ability to perform, measurement and analysis, and verifying implementation must be institutionalized within the organization. This can be shown by recurrence over time.

### Key Process Areas of Levels 2 and 3



<sup>1</sup> Carnegie Mellon University, Software Engineering Institute (Principal Contributors and Editors: Mark C. Paulk, Charles V. Weber, Bill Curtis, and Mary Beth Chrissis), *The Capability Maturity Model: Guidelines for Improving the Software Process*, ISBN 0-201-54664-7, Addison-Wesley Publishing Company, Reading, MA, 1995.



## SW-CMM Level 2

### Requirements Management

**Purpose:** To establish a common understanding between the customer and the software project of the customer's requirements that will be addressed by the software project.

**Involves:** Establishing and maintaining an agreement with the customer on the requirements for the software project.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1	1	1, 2, 3, 4	1	1, 2, 3
2	2, 3	1	3, 4	1	1, 2, 3

#### Goals

- Goal 1: System requirements allocated to software are controlled to establish a baseline for software engineering and management use.
- Goal 2: Software plans, products, and activities are kept consistent with the system requirements allocated to software.

#### Activities

- Ac 1: The software engineering group reviews the allocated requirements before they are incorporated into the software project.
- Ac 2: The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities.
- Ac 3: Changes to the allocated requirements are reviewed and incorporated into the software project.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for managing the system requirements allocated to software.

#### Ability to perform

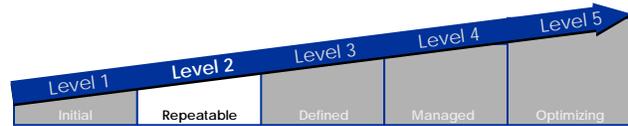
- Ab 1: For each project, responsibility is established for analyzing the system requirements and allocating them to hardware, software and other system components.
- Ab 2: The allocated requirements are documented.
- Ab 3: Adequate resources and funding are provided for managing the allocated requirements.
- Ab 4: Members of the software engineering group and other software-related groups are trained to perform their requirements management activities.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the activities for managing the allocated requirements.

#### Verifying Implementation

- Ve 1: The activities for managing the allocated requirements are reviewed with senior management on a periodic basis.
- Ve 2: The activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for managing the allocated requirements and reports the results.



## SW-CMM Level 2

### Software Project Planning

**Purpose:** To establish reasonable plans for performing the software engineering and for managing the software project.

**Involves:** Developing estimates for the work to be performed, establishing the necessary commitments, and defining the plan to perform the work.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	9, 10, 11, 12, 15	1, 2	1, 3, 4	1	1, 2, 3
2	2, 5, 6, 7, 8, 13, 14	1, 2	1, 2, 3, 4	1	1, 2, 3
3	1, 3, 4	1, 2	1, 3, 4	1	1, 2, 3

#### Goals

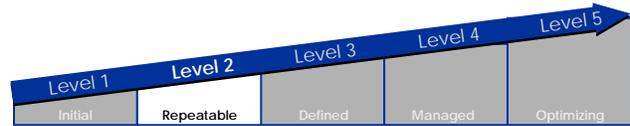
- Goal 1: Software estimates are documented for use in planning and tracking the software project.
- Goal 2: Software project activities and commitments are planned and documented.
- Goal 3: Affected groups and individuals agree to their commitments related to the software project.

#### Activities

- Ac 1: The software engineering group participates on the project proposal team.
- Ac 2: Software project planning is initiated in the early stages of, and in parallel with, the overall project planning.
- Ac 3: The software engineering group participates with other affected groups in the overall project planning throughout the project's life.
- Ac 4: Software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.
- Ac 5: A software life cycle with predefined stages of manageable size is identified or defined.
- Ac 6: The project's software development plan is developed according to a documented procedure.
- Ac 7: The plan for the software project is documented.
- Ac 8: Software work products that are needed to establish and maintain control of the software project are identified.
- Ac 9: Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.
- Ac 10: Estimates for the software project's effort and costs are derived according to a documented procedure.
- Ac 11: Estimates for the project's critical computer resources are derived according to a documented procedure.
- Ac 12: The project's software schedule is derived according to a documented procedure.
- Ac 13: The software risks associated with the cost, resource, schedule, and technical aspects of the project risks are identified, assessed, and documented.
- Ac 14: Plans for the project's software engineering facilities and support tools are prepared.
- Ac 15: Software planning data are recorded.

#### Commitment to perform

- Co 1: A project software manager is designated to be responsible for negotiating commitments and developing the project's software development plan.
- Co 2: The project follows a written organizational policy for planning a software project.



## SW-CMM Level 2

### Software Project Planning (continued)

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#### Ability to perform

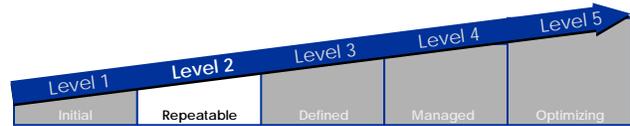
- Ab 1: A documented and approved statement of work exists for the software project.
- Ab 2: Responsibilities for developing the software development plan are assigned.
- Ab 3: Adequate resources and funding are provided for planning the software project.
- Ab 4: The software managers, software engineers, and other individuals involved in the software project planning are trained in the software estimating and planning procedures applicable to their areas of responsibility.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the software planning activities.

#### Verifying Implementation

- Ve 1: The activities for software project planning are reviewed with senior management on a periodic basis.
- Ve 2: The activities for software project planning are reviewed with project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for software project planning and reports the results.



## SW-CMM Level 2

### Software Project Tracking and Oversight

**Purpose:** To provide adequate visibility into actual progress so that management can take effective actions when the software project's performance deviates significantly from the software plans.

**Involves:** Tracking and reviewing the software accomplishments and results against documented estimates, commitments, and plans, and adjusting these plans based on the actual accomplishments and results.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2	1, 2, 3, 4, 5	1	1, 2, 3
2	2, 5, 6, 7, 8, 9, 11	1, 2	1, 2, 3, 4, 5	1	1, 2, 3
3	3, 4	1, 2	1, 2, 3, 4, 5	1	1, 2, 3

#### Goals

- Goal 1: Actual results and performances are tracked against the software plans.
- Goal 2: Corrective actions are taken and managed to closure when actual results and performance deviate significantly from the software plans.
- Goal 3: Changes to software commitments are agreed to by the affected groups and individuals.

#### Activities

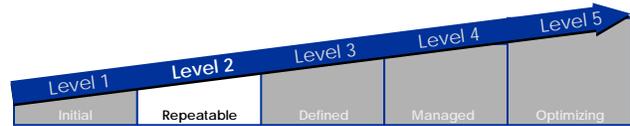
- Ac 1: A documented software development plan is used for tracking the software activities and communicating status.
- Ac 2: The project's software development plan is revised according to a documented procedure.
- Ac 3: Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.
- Ac 4: Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups.
- Ac 5: The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary.
- Ac 6: The project's software effort and costs are tracked, and corrective actions are taken as necessary.
- Ac 7: The project's critical computer resources are tracked, and corrective actions are taken as necessary.
- Ac 8: The project's software schedule is tracked, and corrective actions are taken as necessary.
- Ac 9: Software engineering technical activities are tracked, and corrective actions are taken as necessary.
- Ac 10: The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.
- Ac 11: Actual measurement data and replanning data for the software project are recorded.
- Ac 12: The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.
- Ac 13: Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.

#### Commitment to perform

- Co 1: A project software manager is designated to be responsible for the project's software activities and results.
- Co 2: The project follows a written organizational policy for managing the software project.

#### Ability to perform

- Ab 1: A software development plan for the software project is documented and approved.
- Ab 2: The project software manager explicitly assigns responsibility for software work products and activities.
- Ab 3: Adequate resources and funding are provided for tracking the software project.
- Ab 4: The software managers are trained in managing the technical and personnel aspects of the software project.
- Ab 5: First-line software managers receive orientation in the technical aspects of the software project.



## SW-CMM Level 2

### Software Project Tracking and Oversight (continued)

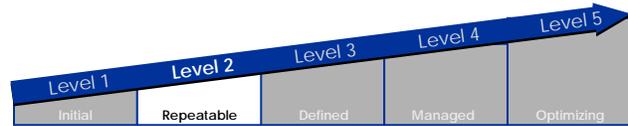
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#### Measurement and Analysis

Me 1: Measurements are made and used to determine the status of the software tracking and oversight activities.

#### Verifying Implementation

- Ve 1: The activities for software project tracking and oversight are reviewed with senior management on a periodic basis.
- Ve 2: The activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for software project tracking and oversight and reports the results.



## SW-CMM Level 2

### Software Subcontract Management

**Purpose:** To select qualified software subcontractors and manage them effectively.

**Involves:** Selecting a software subcontractor, establishing commitments with the subcontractor, and tracking and reviewing the subcontractor's performance and results.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2	1, 2	1, 2	1	2, 3
2	3, 4, 6	1, 2	1, 2, 3	1	1, 2, 3
3	7, 8, 9, 13	1, 2	1, 2, 3	1	2, 3
4	3, 5, 7, 9, 10, 11, 12, 13	1, 2	1, 2, 3	1	1, 2, 3

#### Goals

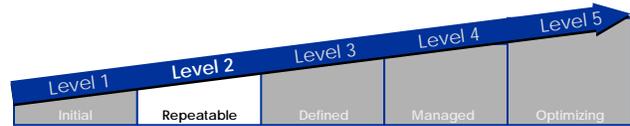
- Goal 1: The prime contractor selects qualified software subcontractors.
- Goal 2: The prime contractor and the software subcontractor agree to their commitments to each other.
- Goal 3: The prime contractor and the software subcontractor maintain ongoing communications.
- Goal 4: The prime contractor tracks the software subcontractor's actual results and performance against its commitments

#### Activities

- Ac 1: The work to be subcontracted is defined and planned according to a documented procedure.
- Ac 2: The software subcontractor is selected based on an evaluation of the subcontract bidders' ability to perform the work, according to a documented procedure.
- Ac 3: The contractual agreement between the prime contractor and the software subcontractor is used as the basis for managing the subcontract.
- Ac 4: A documented subcontractor's software development plan is reviewed and approved by the prime contractor.
- Ac 5: A documented and approved subcontractor's software development plan is used for tracking the software activities and communicating status.
- Ac 6: Changes to the software subcontractor's statement of work, terms and conditions, and other commitments are resolved according to a documented procedure.
- Ac 7: The prime contractor's management conducts periodic status/coordination reviews with the software subcontractor's management.
- Ac 8: Periodic technical reviews and interchanges are held with the software subcontractor.
- Ac 9: Formal reviews to address the subcontractor's software engineering accomplishments and results are conducted at selected milestones according to a documented procedure.
- Ac 10: The prime contractor's software quality assurance group monitors the subcontractor's software quality assurance activities according to a documented procedure.
- Ac 11: The prime contractor's software configuration management group monitors the subcontractor's activities for software configuration management according to a documented procedure.
- Ac 12: The prime contractor conducts acceptance testing as part of the delivery of the subcontractor's software products according to a documented procedure.
- Ac 13: The software subcontractor's performance is evaluated on a periodic basis, and the evaluation is reviewed with the subcontractor.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for managing the software subcontract.
- Co 2: A subcontract manager is designated to be responsible for establishing and managing the software subcontract.



## SW-CMM Level 2

### Software Subcontract Management (continued)

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#### Ability to perform

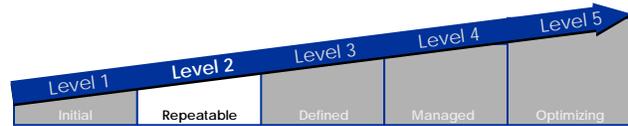
- Ab 1: Adequate resources and funding are provided for selecting the software subcontractor and managing the subcontract.
- Ab 2: Software managers and other individuals who are involved in establishing and managing the software subcontract are trained to perform these activities.
- Ab 3: Software managers and other individuals who are involved in managing the software subcontract receive orientation in the technical aspects of the subcontract.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the activities for managing the software subcontract.

#### Verifying Implementation

- Ve 1: The activities for managing the software subcontract are reviewed with senior management on a periodic basis.
- Ve 2: The activities for managing the software subcontract are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for managing the software subcontract and reports the results.



## SW-CMM Level 2

### Software Quality Assurance

**Purpose:** To provide management with appropriate visibility into the process being used by the software project and of the products being built.

**Involves:** Reviewing and auditing the software products and activities to verify that they comply with the applicable procedures and standards and providing the software project and other appropriate managers with the results of these reviews and audits.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2	1	1, 2, 3	1	2, 3
2	2, 3, 4, 5	1	1, 2, 3, 4	1	2, 3
3	6, 7, 8	1	1, 2, 3, 4	1	1, 2, 3
4	7	1	1, 2, 3, 4	1	1, 2, 3

#### Goals

- Goal 1: Software quality assurance activities are planned.
- Goal 2: Adherence of software products and activities to the applicable standards, procedures, and requirements is verified objectively.
- Goal 3: Affected groups and individuals are informed of software quality assurance activities and results.
- Goal 4: Non-compliance issues that cannot be resolved within the software project are addressed by senior management.

#### Activities

- Ac 1: A SQA plan is prepared for the software project according to a documented procedure.
- Ac 2: The SQA group's activities are performed in accordance with the SQA plan.
- Ac 3: The SQA group participates in the preparation and review of the project's software development plan, standards, and procedures.
- Ac 4: The SQA group reviews the software engineering activities to verify compliance.
- Ac 5: The SQA group audits designated software work products to verify compliance.
- Ac 6: The SQA group periodically reports the results of its activities to the software engineering group.
- Ac 7: Deviations identified in the software activities and software work products are documented and handled according to a documented procedure.
- Ac 8: The SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for implementing software quality assurance (SQA).

#### Ability to perform

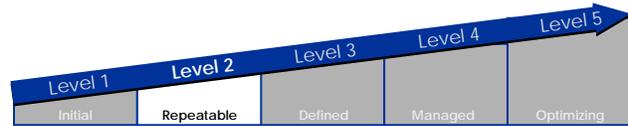
- Ab 1: A group that is responsible for coordinating and implementing SQA for the project (i.e., the SQA group) exists.
- Ab 2: Adequate resources and funding are provided for performing the SQA activities.
- Ab 3: Members of the SQA group are trained to perform their SQA activities.
- Ab 4: The members of the software project receive orientation on the role, responsibilities, authority, and value of the SQA group.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the cost and schedule status of the SQA activities.

#### Verifying Implementation

- Ve 1: The SQA activities are reviewed with senior management on a periodic basis.
- Ve 2: The SQA activities are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: Experts independent of the SQA group periodically review the activities and software work products of the project's SQA group.



## SW-CMM Level 2

### Software Configuration Management

**Purpose:** To establish and maintain the integrity of the products of the software project throughout the project's software life cycle.

**Involves:** Identifying the configuration of the software (i.e., selected software work products and their descriptions) at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the software life cycle.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2	1	2, 3, 4	1	2, 4
2	2, 3, 4, 7	1	1, 2, 3, 4, 5	1	4
3	5, 6	1	1, 2, 3, 4, 5	1	4
4	8, 9, 10	1	2, 3, 4, 5	1	1, 2, 3, 4

#### Goals

- Goal 1: Software configuration management activities are planned.
- Goal 2: Selected software work products are identified, controlled, and available.
- Goal 3: Changes to identified software work products are controlled.
- Goal 4: Affected groups and individuals are informed of the status and content of software baselines.

#### Activities

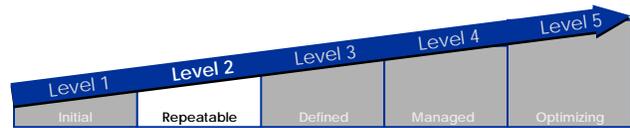
- Ac 1: A SCM plan is prepared for each software project according to a documented procedure.
- Ac 2: A documented and approved SCM plan is used as the basis for performing the SCM activities.
- Ac 3: A configuration management library system is established as a repository for the software baselines.
- Ac 4: The software work products to be placed under configuration management are identified.
- Ac 5: Change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a documented procedure.
- Ac 6: Changes to baselines are controlled according to a documented procedure.
- Ac 7: Products from the software baseline library are created and their release is controlled according to a documented procedure.
- Ac 8: The status of configuration items/units is recorded according to a documented procedure.
- Ac 9: Standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.
- Ac 10: Software baseline audits are conducted according to a documented procedure.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for implementing software configuration management (SCM).

#### Ability to perform

- Ab 1: A board having the authority for managing the project's software baselines (i.e., a software configuration control board – SCCB) exists or is established.
- Ab 2: A group that is responsible for coordinating and implementing SCM for the project (i.e., the SCM group) exists.
- Ab 3: Adequate resources and funding are provided for performing the SCM activities.
- Ab 4: Members of the SCM group are trained in the objectives, procedures, and methods for performing their SCM activities.
- Ab 5: Members of the software engineering group and other software-related groups are trained to perform their SCM activities.



## SW-CMM Level 2

### Software Configuration Management (continued)

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#### Measurement and Analysis

Me 1: Measurements are made and used to determine the status of the SCM activities.

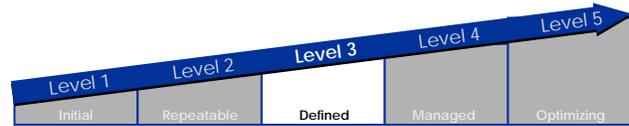
#### Verifying Implementation

Ve 1: The SCM activities are reviewed with senior management on a periodic basis.

Ve 2: The SCM activities are reviewed with the project manager on both a periodic and event-driven basis.

Ve 3: The SCM group periodically audits software baselines to verify that they conform to the documentation that defines them.

Ve 4: The software quality assurance group reviews and/or audits the activities and work products for SCM and reports the results.



## SW-CMM Level 3

### Organization Process Focus

<b>Purpose:</b>	To establish the organizational responsibility for software process activities that improve the organization's overall software process capability.
<b>Involves:</b>	Developing and maintaining an understanding of the organization's and projects' software processes and coordinating the activities to assess, develop, maintain, and improve these processes.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	3, 4, 5, 6, 7	1, 2, 3	1, 2, 3, 4	1	1
2	1	1, 2, 3	1, 2, 3, 4	1	1
3	2	1, 2, 3	1, 2, 3, 4	1	1

#### Goals

- Goal 1: Software process development and improvement activities are coordinated across the organization.
- Goal 2: The strengths and weaknesses of the software processes used are identified relative to a process standard.
- Goal 3: Organization-level process development and improvement activities are planned.

#### Activities

- Ac 1: The software process is assessed periodically, and action plans are developed to address the assessment findings.
- Ac 2: The organization develops and maintains a plan for its software process development and improvement activities.
- Ac 3: The organization's and projects' activities for developing and improving their software processes are coordinated at the organization level.
- Ac 4: The use of the organization's software process database is coordinated at the organizational level.
- Ac 5: New processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization.
- Ac 6: Training for the organization's and projects' software processes is coordinated across the organization.
- Ac 7: The groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement.

#### Commitment to perform

- Co 1: The organization follows a written organizational policy for coordinating software process development and improvement activities across the organization.
- Co 2: Senior management sponsors the organization's activities for software process development and improvement.
- Co 3: Senior management oversees the organization's activities for software process development and improvement.

#### Ability to perform

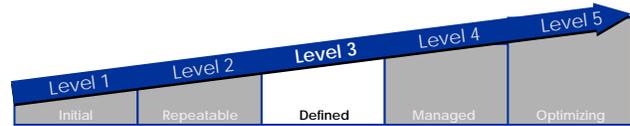
- Ab 1: A group that is responsible for the organization's software process activities exists.
- Ab 2: Adequate resources and funding are provided for the organization's software process activities.
- Ab 3: Members of the group responsible for the organization's software process activities receive required training to perform these activities.
- Ab 4: Members of the software engineering group and other software-related groups receive orientation on the organization's software process activities and their roles in those activities.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the organization's process development and Improvement activities.

#### Verifying Implementation

- Ve 1: The activities for software process development and improvement are reviewed with senior management on a periodic basis.



## SW-CMM Level 3

### Organization Process Definition

**Purpose:** To develop and maintain a usable set of software process assets that improve process performance across the projects and provide a basis for cumulative, long-term benefits to the organization.

**Involves:** Developing and maintaining the organization's standard software process, along with related process assets, such as descriptions of software life cycles, process tailoring guidelines and criteria, the organization's software process database, and a library of software process-related documentation.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2, 3, 4	1	1, 2	1	1
2	5, 6	1	1, 2	1	1

#### Goals

- Goal 1: A standard software process for the organization is developed and maintained.
- Goal 2: Information related to the use of the organization's standard software process by the software projects is collected, reviewed, and made available.

#### Activities

- Ac 1: The organization's standard software process is developed and maintained according to a documented procedure.
- Ac 2: The organization's standard software process is documented according to established organization standards.
- Ac 3: Descriptions of software life cycles that are approved for use by the projects are documented and maintained.
- Ac 4: Guidelines and criteria for the projects' tailoring of the organization's standard software process are developed and maintained.
- Ac 5: The organization's software process database is established and maintained.
- Ac 6: A library of software process-related documentation is established and maintained.

#### Commitment to perform

- Co 1: The organization follows a written policy for developing and maintaining a standard software process and related process assets.

#### Ability to perform

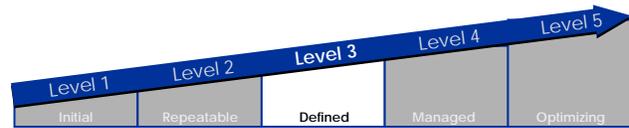
- Ab 1: Adequate resources and funding are provided for developing and maintaining the organization's standard software process and related process assets.
- Ab 2: The individuals who develop and maintain the organization's standard software process and related process assets receive required training to perform these activities.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the organization's process definition activities.

#### Verifying Implementation

- Ve 1: The software quality assurance group reviews and/or audits the organization's activities and work products for developing and maintaining the organization's standard software process and related process assets and reports the results.



## SW-CMM Level 3

### Training Program

**Purpose:** To develop the skills and knowledge of individuals so they can perform their roles effectively and efficiently.

**Involves:** First identifying the training needed by the organization, projects, and individuals, then developing or procuring training to address the identified needs.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2, 3	1	1, 2, 3, 4	1	1, 3
2	3, 4	1	1, 2, 3, 4	1, 2	1, 2, 3
3	5, 6	1	1, 2, 3, 4	1, 2	2, 3

#### Goals

- Goal 1: Training activities are planned.
- Goal 2: Training for developing the skills and knowledge needed to perform software management and technical roles is provided.
- Goal 3: Individuals in the software engineering group and software-related groups receive the training necessary to perform their roles.

#### Activities

- Ac 1: Each software project develops and maintains a training plan that specifies its training needs.
- Ac 2: The organization's training plan is developed and revised according to a documented procedure.
- Ac 3: The training for the organization is performed in accordance with the organization's training plan.
- Ac 4: Training courses prepared at the organization level are developed and maintained according to organization standards.
- Ac 5: A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform in their designated roles.
- Ac 6: Records of training are maintained.

#### Commitment to perform

- Co 1: The organization follows a written policy for meeting its training needs.

#### Ability to perform

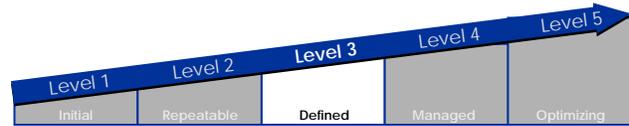
- Ab 1: A group responsible for fulfilling the training needs of the organization exists.
- Ab 2: Adequate resources and funding are provided for implementing the training program.
- Ab 3: Members of the training group have the necessary skills and knowledge to perform their training activities.
- Ab 4: Software managers receive orientation on the training program.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the training program activities.
- Me 2: Measurements are made and used to determine the quality of the training program.

#### Verifying Implementation

- Ve 1: The training program activities are reviewed with senior management on a periodic basis.
- Ve 2: The training program is independently evaluated on a periodic basis for consistency with, and relevance to, the organization's needs.
- Ve 3: The training program activities and work products are reviewed and/or audited and the results are reported.



## SW-CMM Level 3

### Integrated Software Management

<b>Purpose:</b>	To integrate the software engineering and management activities into a coherent, defined software process that is tailored from the organization's standard software process and related process assets, which are described in Organization Process Definition.
<b>Involves:</b>	Developing the project's defined software process and managing the software project using this defined software process. The project's defined software process is tailored from the organization's standard software process to address the specific characteristics of the project.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2, 3	1	1, 2	1	2, 3
2	3, 4, 5, 6, 7, 8, 9, 10, 11	1	1, 3	1	1, 2, 3

#### Goals

- Goal 1: The project's defined software process is a tailored version of the organization's standard software process.
- Goal 2: The project is planned and managed according to the project's defined software process.

#### Activities

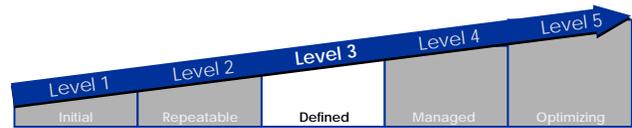
- Ac 1: The project's defined software process is developed by tailoring the organization's standard software process according to a documented procedure.
- Ac 2: Each project's defined software process is revised according to a documented procedure.
- Ac 3: The project's software development plan, which describes the use of the project's defined software process, is developed and revised according to a documented procedure.
- Ac 4: The software project is managed in accordance with the project's defined software process.
- Ac 5: The organization's software process database is used for software planning and estimating.
- Ac 6: The software size of the software work products (or size of changes to the software work products) is managed according to a documented procedure.
- Ac 7: The project's software effort and costs are managed according to a documented procedure.
- Ac 8: The project's critical computer resources are managed according to a documented procedure.
- Ac 9: The critical dependencies and critical paths of the project's software schedule are managed according to a documented procedure.
- Ac 10: The project's software risks are identified, assessed, documented, and managed according to a documented procedure.
- Ac 11: Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate.

#### Commitment to perform

- Co 1: The project follows a written organizational policy requiring that the software project be planned and managed using the organization's standard software process and related process assets.

#### Ability to perform

- Ab 1: Adequate resources and funding are provided for managing the software project using the project's defined software process.
- Ab 2: The individuals responsible for developing the project's defined software process receive required training in how to tailor the organization's standard software process and use the related process assets.
- Ab 3: The software managers receive required training in managing the technical, administrative, and personnel aspects of the software project based on the project's defined software process.



## SW-CMM Level 3

### Integrated Software Management (continued)

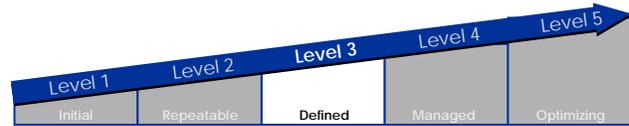
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#### Measurement and Analysis

Me 1: Measurements are made and used to determine the effectiveness of the integrated software management activities.

#### Verifying Implementation

- Ve 1: The activities for managing the software project are reviewed with senior management on a periodic basis.
- Ve 2: The activities for managing the software project are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for managing the software project and reports the results.



## SW-CMM Level 3

### Software Product Engineering

**Purpose:** To consistently perform a well-defined engineering process that integrates all the software engineering activities to produce correct, consistent software products effectively and efficiently.

**Involves:** Performing the engineering tasks to build and maintain the software using the project's defined software process (which is described in the Integrated Software Management key process area) and appropriate methods and tools.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1, 2, 3, 4, 5, 6, 7, 8, 9	1	1, 2, 3, 4	1, 2	1, 2, 3
2	10	1	1, 2, 3, 4	1, 2	1, 2, 3

#### Goals

- Goal 1: The software engineering tasks are defined, integrated, and consistently performed to produce the software.
- Goal 2: Software work products are kept consistent with each other.

#### Activities

- Ac 1: Appropriate software engineering methods and tools are integrated into the project's defined software process.
- Ac 2: The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process.
- Ac 3: The software design is developed, maintained, documented, and verified, according to the project's defined software process, to accommodate the software requirements and to form the framework for coding.
- Ac 4: The software code is developed, maintained, documented, and verified, according to the project's defined software process, to implement the software requirements and software design.
- Ac 5: Software testing is performed according to the project's defined software process.
- Ac 6: Integration testing of the software is planned and performed according to the project's defined software process.
- Ac 7: System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
- Ac 8: The system documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process.
- Ac 9: Data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process.
- Ac 10: Consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures.

#### Commitment to perform

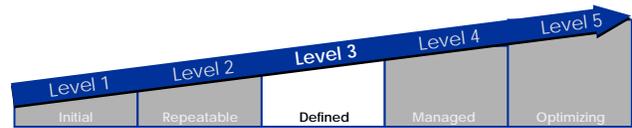
- Co 1: The project follows a written organizational policy for performing the software engineering activities.

#### Ability to perform

- Ab 1: Adequate resources and funding are provided for performing the software engineering tasks.
- Ab 2: Members of the software engineering technical staff receive required training to perform their technical assignments.
- Ab 3: Members of the software engineering technical staff receive orientation in related software engineering disciplines.
- Ab 4: The project manager and all software managers receive orientation in the technical aspects of the software project.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the functionality and quality of the software products.
- Me 2: Measurements are made and used to determine the status of the software product engineering activities.



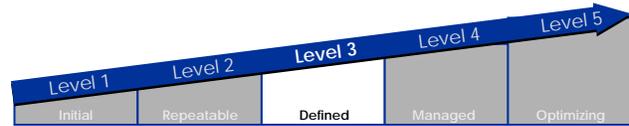
## SW-CMM Level 3

### Software Product Engineering (continued)

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#### Verifying Implementation

- Ve 1: The activities for software product engineering are reviewed with senior management on a periodic basis.
- Ve 2: The activities for software product engineering are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for software product engineering and reports the results.



## SW-CMM Level 3

### Intergroup Coordination

<b>Purpose:</b>	To establish a means for the software engineering group to participate actively with the other engineering groups so the project is better able to satisfy the customer's needs effectively and efficiently.
<b>Involves:</b>	The software engineering group's participation with other project engineering groups to address system-level requirements, objectives, and issues. Representatives of the project's engineering groups participate in establishing the system-level requirements, objectives, and plans by working with the customer and end users, as appropriate. These requirements, objectives, and plans become the basis for all engineering activities.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1	1	1, 2, 3, 4, 5	1	2, 3
2	3, 4, 5	1	1, 2, 3, 4, 5	1	2, 3
3	2, 6, 7	1	1, 2, 3, 4, 5	1	1, 2, 3

#### Goals

- Goal 1: The customer's requirements are agreed to by all affected groups.
- Goal 2: The commitments between the engineering groups are agreed to by the affected groups.
- Goal 3: The engineering groups identify, track, and resolve intergroup issues.

#### Activities

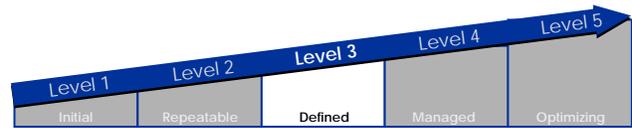
- Ac 1: The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements.
- Ac 2: Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues.
- Ac 3: A documented plan is used to communicate intergroup commitments and to coordinate and track the work performed.
- Ac 4: Critical dependencies between engineering groups are identified, negotiated, and tracked according to a documented procedure.
- Ac 5: Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs.
- Ac 6: Intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure.
- Ac 7: Representatives of the project engineering groups conduct periodic technical reviews and interchanges.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for establishing interdisciplinary engineering teams.

#### Ability to perform

- Ab 1: Adequate resources and funding are provided for coordinating the software engineering activities with other engineering groups.
- Ab 2: The support tools used by the different engineering groups are compatible to enable effective communication and coordination.
- Ab 3: All managers in the organization receive required training in teamwork.
- Ab 4: All task leaders in each engineering group receive orientation in the processes, methods, and standards used by the other engineering groups.
- Ab 5: The members of the engineering groups receive orientation in working as a team.



## SW-CMM Level 3

### Intergroup Coordination (continued)

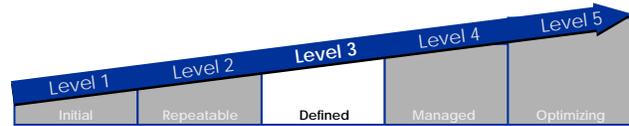
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#### Measurement and Analysis

Me 1: Measurements are made and used to determine the status of the intergroup coordination activities.

#### Verifying Implementation

- Ve 1: The activities for intergroup coordination are reviewed with senior management on a periodic basis.
- Ve 2: The activities for intergroup coordination are reviewed with the project manager on both a periodic and event-driven basis.
- Ve 3: The software quality assurance group reviews and/or audits the activities and work products for intergroup coordination and reports the results.



## SW-CMM Level 3

### Peer Reviews

**Purpose:** To remove defects from the software work products early and efficiently.

**Involves:** A methodical examination of software work products by the producers' peers to identify defects and areas where changes are needed. The specific products that will undergo a peer review are identified in the project's defined software process and scheduled as part of the software project planning activities, as described in Integrated Software Management.

#### Map of Key Practices to Goals

Goal	Activities	Commitment to Perform	Ability to Perform	Measurement and Analysis	Verifying Implementation
1	1	1	1, 2	1	1
2	2, 3	1	1, 2, 3	1	1

#### Goals

- Goal 1: Peer review activities are planned.
- Goal 2: Defects in the software work products are identified and removed.

#### Activities

- Ac 1: Peer reviews are planned, and the plans are documented.
- Ac 2: Peer reviews are performed according to a documented procedure.
- Ac 3: Data on the conduct and results of the peer reviews are recorded.

#### Commitment to perform

- Co 1: The project follows a written organizational policy for performing peer reviews.

#### Ability to perform

- Ab 1: Adequate resources and funding are provided for performing peer reviews on each software work product to be reviewed.
- Ab 2: Peer review leaders receive required training in how to lead peer reviews.
- Ab 3: Reviewers who participate in peer reviews receive required training in the objectives, principles, and methods of peer reviews.

#### Measurement and Analysis

- Me 1: Measurements are made and used to determine the status of the peer review activities.

#### Verifying Implementation

- Ve 1: The software quality assurance group reviews and/or audits the activities and work products for peer reviews and reports the results.

## Assessment Readiness Survey

The first thing an agency must do to allow for process improvement is be ready for the organizational change. The Assessment Readiness Survey is a survey that lead assessors used to determine if the pilot agencies were ready to accept the challenges associated with process improvement.

### NOTES:

- The following text is taken directly from the survey used during the project. It is provided so agencies can have the information an assessor uses to determine organizational readiness.
- There are four possible ratings for each of the following questions. They are:
  - 1 – Hardly at all
  - 2 – To a mild extent
  - 3 – To a moderate extent
  - 4 – To a great extent

Following each category, there is space for the assessor to total the score and make notes.

- The same questions were provided to senior management, middle management, team leaders, and experts. The results were then compared and evaluated.

**Work Aid Assessment Readiness Survey**

Organization:

Date:

**Directions:** Complete this questionnaire for each organization you plan to assess before you commit to the assessment. The answers to the questions will provide you a general indication of the areas that will need attention before the assessment and after the assessment to facilitate process improvement activities. Keep in mind that this instrument is designed to provide a global indication and does not represent all the details of the issues you will face in your process improvement work.

For each question below, circle the appropriate number to rate the extent to which the statement is true. If you don't know the answer to a question, leave it blank.

	Hardly at all	To a mild extent	To a moderate extent	To a great extent
<b>Sponsorship</b>				
The sponsor (the senior manager who has the position and clout to initiate and sustain the assessment and process improvement activities) is dissatisfied with the current state.	1	2	3	4
The sponsor is able and willing to demonstrate the type of public support necessary to convey strong organizational commitment to the assessment.	1	2	3	4
The sponsor is willing to commit resources to do the assessment and the follow-up improvement activities.	1	2	3	4
The sponsor has the power and resources to support improvement plans.	1	2	3	4
The sponsor is willing to assure that progress and problems will be tracked during follow-up improvement.	1	2	3	4
The sponsor is aware of the personal, organizational and political cost of the change coming from assessments.	1	2	3	4
<b>Sponsorship Total:</b>				

Part 4      Work Aids  
 Work Aid    Assessment Readiness Survey

<b>Culture</b>	Hardly at all	To a mild extent	To a moderate extent	To a great extent
There is consistency between our organization's view of teamwork (how much people are encouraged to communicate and cooperate with each other) and that established during a process assessment (e.g., collaboration, consensus decisions, etc.).	1	2	3	4
There is consistency between the way goals, tasks, and role assignments are currently defined and the way they're expected to be defined when beginning a process improvement effort.	1	2	3	4
<b>Culture Total:</b>				

Part 4 Work Aids  
 Work Aid Assessment Readiness Survey

	Hardly at all	To a mild extent	To a moderate extent	To a great extent
<b>Resistance</b>				
Practitioners see a need for process improvement.	1	2	3	4
Managers see a need for process improvement.	1	2	3	4
The communication between management and practitioners is clear and direct, with little confusion.	1	2	3	4
The cost of process improvement in time and personnel is seen by management as reasonable.	1	2	3	4
Practitioners are confident that management will provide organizational support (time, money, personnel) to help improve the software process.	1	2	3	4
The anticipated impact on budgets and schedules is seen by management as a reasonable cost of process improvements.	1	2	3	4
The organization has a history of success in making changes.	1	2	3	4
The person sponsoring the assessment inspires confidence in his or her subordinates.	1	2	3	4
The assessment team members are widely trusted and viewed as effective in their work.	1	2	3	4
Past performance in software improvement is viewed by sponsors and managers as a springboard to improvement.	1	2	3	4
Practitioners and project managers believe that the sources for information gathered in the assessment will remain confidential.	1	2	3	4
<b>Resistance Total:</b>				

Part 4      Work Aids  
 Work Aid    Assessment Readiness Survey

	Hardly at all	To a mild extent	To a moderate extent	To a great extent
<b>Synergy</b>				
Groups in the organization communicate with each other directly and with few misunderstandings.	1	2	3	4
Managers tend to create an open atmosphere where differences in opinion can be surfaced and dealt with directly.	1	2	3	4
Task groups generate creative ways to merge their diverse perspectives into alternatives everyone supports.	1	2	3	4
<b>Synergy Total:</b>				

Part 4      Work Aids  
 Work Aid    Assessment Readiness Survey

	Hardly at all	To a mild extent	To a moderate extent	To a great extent
<b>Organizational Issues</b>				
The stress from our day-to-day workload is low enough for us to manage the changes that come as a result of the process assessment.	1	2	3	4
Our organization has clear lines of responsibility and authority which create a tendency to get results rather than protect turf.	1	2	3	4
Our organization provides our employees the latitude to make mistakes, which encourages a risk-taking environment.	1	2	3	4
When changes are introduced, there are negative consequences for failing to support the changes.	1	2	3	4
When changes are introduced, employees are rewarded for supporting the changes.	1	2	3	4
When management announces a strategic directive, the organization always acts on it no matter how many other projects or problems compete for resources.	1	2	3	4
Decision-making for a major change effort involves obtaining true consensus from the people involved, rather than just the appearance of consensus.	1	2	3	4
Managers don't resist making changes when turf or control is at stake, because the corporate goal always has priority over the goals of individual groups.	1	2	3	4
<b>Organizational Issues Total:</b>				

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