



Rational Software Whitepaper

Achieving Capability Maturity Model[®] Integration (CMMI[®]) Maturity Level 2 Using IBM Rational[®] Software's Solutions

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This paper addresses how a company, organization, or project can leverage IBM Rational® Software's process and tool solutions as a viable means toward the achievement of a Capability Maturity Model® Integration (CMMI®) SE/SW Version 1.1 maturity level 2 appraisal rating.

For those organizations that have already adopted IBM Rational solutions, this paper offers valuable information on how to achieve a CMMI maturity level 2 rating. The paper identifies how the Rational Unified Process® (RUP®), Version 2002.05.00 and the application of IBM Rational tools and services, along with your organization's processes could meet many of the CMMI goals.

For organizations looking to engage in a process improvement initiative, this paper will show that by adopting RUP and IBM Rational integrated tools, they may achieve their goals more expeditiously, while establishing a solid foundation for a CMMI maturity level 3 effort.

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SECTION 1: OVERVIEW

As the first in a series of papers designed in a modular form, this paper provides a goal-level overview of the CMMI maturity level 2, and how IBM Rational solutions help satisfy the goals of ML 2. Additional modules will be available that address each CMMI process area (PA) in more detail by listing each practice, its description, the RUP role that might be responsible for satisfying the practice, what RUP process and procedure/template might help satisfy the practice, and any other observations that might be relevant. In situations where IBM Rational solutions do not fully address a practice, recommendations are made on how the organization might satisfy the practices to attain CMMI compliance. These additional modules can be found (as they become available) on the IBM Rational website at www.rational.com/solutions/industry/govt/cmmi.jsp.

Background of the CMMI

Over the past two decades, the Capability Maturity Model for Software (SW-CMM) has been the predominant tool for assessing and improving an organization's software development maturity. Following the success of the SW-CMM, various models were developed for other disciplines, including:

- Systems Engineering Capability Model (SECM) – EIA/IS-731
- Software Acquisition CMM
- Integrated Product Development CMM

Some large organizations even developed their own, customized CMMs such as the Federal Aviation Administration's integrated CMM (FAA-iCMM).

Ironically, the success of these CMMs also introduced many drawbacks. While the models were designed to guide organizations toward higher maturities, the underlying structures were different. Some, like the SW-CMM, advocated a "staged" approach that pre-defined process areas organizations should focus on as they reached "maturity levels". Others, like the SECM, implemented a "continuous" approach where organizations could choose to improve maturity within a process area independent of other process areas.

Significant overlap was also present between these models, particularly in the areas of project management, requirements, and process definition.¹

The results of these drawbacks were a higher cost of implementation due to additional training, certifications, expertise required, process engineering, assessments/appraisals, etc. Confusion was also introduced because of the models' differing representations, overlap, terminology, use within the organization, and so on.

As a remedy, the Software Engineering Institute (SEI) at Carnegie Mellon University (www.sei.cmu.edu/cmmi) launched the Capability Maturity Model Integration (CMMI) effort. The goals were to reduce the redundancy and complexity resulting from the use of separate, multiple capability maturity models, and to improve the efficiency of and the return on investment for process improvement. These goals would be met through the integration of several CMMs, and the creation of a product suite that provided frameworks for specified disciplines (or discipline combinations), training products, assessment materials, glossary terms, and tailoring requirements.¹

From the CMM to the CMMI: An Important Transition

The United States Department of Defense (DoD) originally commissioned the Capability Maturity Model for Software (SW-CMM) in response to the escalating costs and schedule overruns that were impacting projects and programs within the department. Software development results were no better in the commercial software industry. The Standish Group's landmark 1994 CHAOS Report showed that the average software project ran 189% over budget, and overshot its schedule by 222%.² The DoD needed a way to independently assess the software engineering capabilities of software suppliers, while simultaneously providing them roadmap for improvement.

¹ From the "Concept of Operations for the CMMI", www.sei.cmu.edu/cmmi/background/conops.html

² "The CHAOS Study", The Standish Group International, inc., Dennis, MA, 1994

The CMM offered the DoD that objective measuring stick. With five increasingly higher levels of software capability as a gauge, the CMM clearly demonstrated the benefits of increased software development maturity. Software organizations operating at SW-CMM Maturity Level 3 are 65% more productive than those at SW-CMM ML 1, reduce project costs and schedule by 20%, and deliver 80% less defects. CMM ML 3 organizations also deliver projects with better cost and schedule predictability.³

Additionally, organizations outsourcing software development projects are increasingly looking for increased software development maturity from their vendors via independent CMM-based assessments. Those suppliers that wish to deliver better results to their customers are engaging in CMM-based software process improvement efforts.

As the SEI transitions from the CMM to the CMMI, more and more organizations will adopt the new, integrated model. The SEI has stopped updating the SW-CMM and plans on discontinuing training for the SW-CMM by the end of 2003. SW-CMM Lead Assessors and Lead Evaluators will be given until the end of 2005 to transition to the new CMMI appraisal method.

The CMMI provides many benefits, and leading companies are making the transition to it in order to implement a standardized, integrated approach towards software and systems engineering in their organizations.

Initiating a Process Improvement Project

Generally, those organizations seeking to improve their engineering capabilities first conduct a CMMI-based, independent, informal appraisal. This appraisal is based on the Appraisal Requirements for CMMI v1.1 (ARC) Class B and C methods developed by the SEI, and it identifies strengths in the organization, as well as weaknesses, compared to the CMMI model. Class B and C methods of appraisals are less rigorous and far less costly than the more formal Standard CMMI Appraisal Method for Process Improvement (SCAMPI) Class A method which should be undertaken only when the organization is ready for and confident of achieving a Maturity Level.

Leading organizations simultaneously conduct a financial appraisal of the organization, such as the cognence, inc. “Cost of Quality Appraisal” (www.cognence.com/CostofQualityAppraisalOne-Sheet.pdf), which sets the baseline for the organization’s engineering financial performance. This appraisal provides the business case for an improvement effort, and allows improvement results to be measured from a dollars and cents perspective.

Weaknesses (gaps) identified in the Class B or C informal appraisal can then be translated into an action plan, and the organization can work to resolve the weaknesses. Weaknesses may range from not performing the required practices that support CMMI goals, to a general lack of institutionalization of behaviors in the organization, to a lack of documented plans and procedures.

Once the organization has addressed the appraisal action items, a formal SCAMPI appraisal may be conducted to verify that the organization has indeed resolved the weaknesses, and achieved the desired CMMI maturity level. A follow up Cost of Quality Appraisal can specifically show the financial benefits of process improvement by comparing the organization’s cost allocation prior to, and after the effort.

Accelerating CMMI Maturity with Tools and Best Practices from IBM Rational

IBM Rational is the leading provider of integrated solutions, combining market-leading tools, software engineering best practices, and services, which automate the software development process. For more than 20 years, IBM Rational has helped software teams overcome chronic development obstacles through a flexible and proven approach that results in higher-impact software, a more motivating work environment, and a greater return on software development investments. For more information on Rational, see www.rational.com.

The goal of the CMMI is to create better quality software by improving the processes that are used to create project deliverables. A process is a sequence of steps performed for a given purpose, and integrates people, methods and procedures, and tools (See Figure 1).⁴

³ “Measuring Software Process Improvement”, Capers Jones, Software Productivity Research, 2001

⁴ “The Capability Maturity Model”, Carnegie Mellon University, 1994

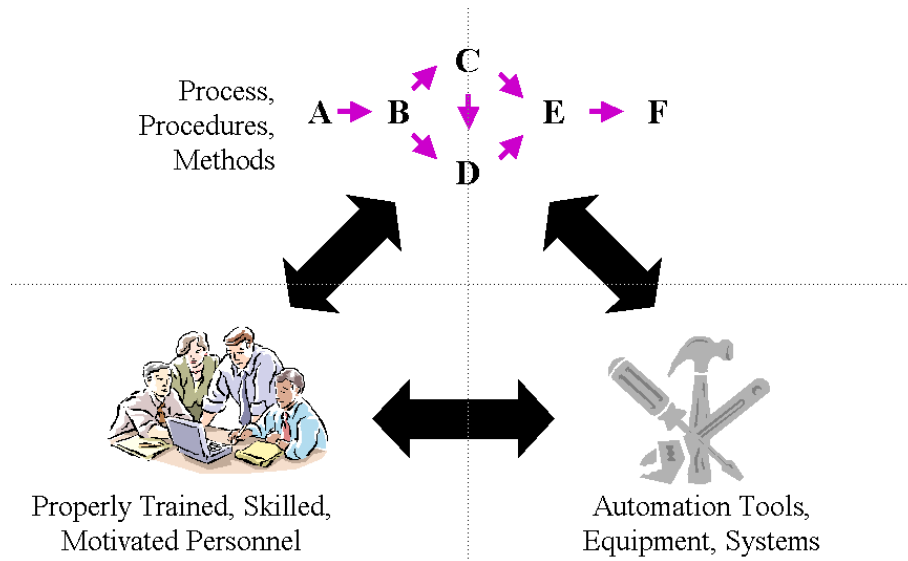


Figure 1
IBM Rational brings solutions to bear in all three process dimensions

The Rational Unified Process® integrates proven software engineering best practices to deliver a world-class software development process, methods, procedures, templates, and more through an easy-to-use, intuitive web interface. RUP provides a foundation that covers a large percentage of the requirements stated by the CMMI. This foundation can be used to address the CMMI across the project, not just the software portion of the project.

IBM Rational also provides an integrated suite of tools that automates many aspects of the software development process, including requirements management, configuration and change management, visual modeling, automated testing, and more. Tools from IBM Rational are integrated with RUP, and when used appropriately, provide a near seamless process to tool interface.

Rational University enables organizations to make the most effective use of RUP and IBM Rational tools through comprehensive process and product training course offerings. IBM Rational also provides professional services to get an implementation up and running so organizations can enjoy the benefits of higher software quality and improved productivity more quickly.

Through the proper implementation of IBM Rational integrated software engineering best practices and automation tools, an organization can accelerate the attainment of CMMI maturity level 2, and have a solid foundation for maturity level 3. While other organizations are defining and documenting processes and procedures, trying to integrate disparate tools, and internally creating custom training, Rational-enabled organizations are reaping the benefits higher process maturity provides.

Assumptions

The CMMI appraisal model essentially follows the “Say what you do, Do what you say, Prove it” concept. This means that organizations that wish to achieve a CMMI maturity level 2 rating must document various engineering methods and procedures (“Say what you do”), execute them as documented (“Do what you say”), and be able to prove they are following their methods and procedures via quality records and/or project artifacts (“Prove it”). During an appraisal, the appraisal team verifies compliance with the CMMI goals through examination of objective evidence in the form of direct artifacts, indirect artifacts, and affirmations. Direct artifacts are things directly produced by implementing the expected practice (e.g., a project plan, a configuration management plan), while indirect artifacts are things which show the practice was implemented but aren’t a direct result of the practice (e.g., meeting minutes showing something was reviewed). Affirmations are written or oral statements indicating that a certain practice was performed. SCAMPIS are verification-based appraisals and will also conduct interviews of selected project participants in order to corroborate the objective evidence.

For an organization to effectively use this white paper, certain assumptions are implicit:

1. The organization has adopted the Rational Unified Process (RUP).
2. The organization is following RUP as documented, and has made appropriate changes to reflect how the project or organization performs tasks.
3. The organization is creating the artifacts as requested by the Rational Unified Process.
4. The organization has a plan on how to implement RUP as part of its process improvement activities.
5. The organization schedules a review by an independent appraisal team, in order to ensure appropriate implementation against the CMMI.
6. The CMMI uses terminology in a very specific manner that must be understood by the organization prior to use of the model.
7. The organization has chosen or is in the process of choosing whether they will use the CMMI's staged representation or the continuous representation.
8. This paper is not intended to describe the CMMI in detail. For complete CMMI information, see the SEI site.
9. This paper should not be considered training on either the staged or continuous representations of the CMMI.
10. This paper is not intended to be a complete description of how a project can satisfy the CMMI requirements. The CMMI is a model, and as such, the solutions to CMMI requirements a project identifies can be very different than those outlined here.
11. This paper does not provide training on any of the associated engineering or project management activities. For training there are numerous entities such as Rational University, SEI, IEEE, PMI, INCOSE, or formal University teachings that provide direction on courses, or courses themselves.
12. It is important to recognize that the compliance of any organization with maturity level requirements of the CMMI are based on the integration and institutionalization of the organization's processes. Tools can greatly aid in the implementation of and reduce effort associated with processes, but any tool in itself does not guarantee that all the requirements of the model are being met. The organization must implement processes that comply with the CMMI requirements first. The processes and templates provided by RUP will automate many of the required process steps and provide objective evidence in the form of plans, records, etc., however it is still the responsibility of the organization to ensure its overall process implementation meets all the requirements of the desired maturity level.
13. The Rational Unified Process evaluated in this whitepaper is version 2002.05.00.

CMMI OVERVIEW

This section provides an overview of the CMMI, and at a high-level, how IBM Rational solutions can satisfy CMMI goals in each maturity level 2 process area. This section is only intended to be an overview. Additional detailed information on the CMMI can be found at the SEI website at www.sei.cmu.edu/cmmi. An excellent resource describing the CMMI is the book “*CMMI Distilled*“, by Dennis M. Ahern, Aaron Clouse, and Richard Turner, ISBN 0-201-73500-8.

As they become available, more detailed information on how IBM Rational solutions satisfy CMMI maturity level 2 process areas will be accessible via CMMI Process Area Modules on The IBM Rational website at www.rational.com/solutions/industry/govt/cmmi.jsp.

The CMMI SE/SW V1.1 model consists of 22 process areas. A process area is a cluster of related practices that, when performed collectively, satisfy a set of goals considered important for making significant improvement in a given area. All CMMI process areas are common to both continuous and staged representations. In the staged representation, process areas are organized by maturity levels with each process area pre-defined to exist in only one maturity level.⁵ In the continuous representation a given process area’s maturity is called its capability level and each process area can exist at any of the six capability levels independent of any other process area. Thus the term maturity level refers to a predefined group of process areas that all exist at the same level of maturity, whereas the term capability level refers only to an individual process area.

Continuous vs. Staged Representation

The CMMI can be applied via the continuous representation, or via the staged representation. The continuous representation allows an organization to select the order of improvement that best meets the organization’s business objectives and mitigates the organization’s areas of risk. The staged representation provides a proven sequence of improvements, beginning with basic management practices and progressing through a predefined and proven path of successive levels, each serving as a foundation for the next.⁵ More detail regarding each representation is found later.

To fully satisfy a process area, both the generic goals and the specific goals must be satisfied. Specific goals apply to a process area and address the unique characteristics that describe what must be implemented to satisfy the process area. Specific goals are required model components and are used in appraisals to help determine whether a process area is satisfied. Specific goals are supported by specific practices, which are activities that are considered important in achieving the associated specific goal. The specific practices describe the activities expected to result in achievement of the specific goals of a process area. Specific practices are expected model components.⁵

Generic goals are called “generic” because the same goal statement appears in multiple process areas. In the staged representation, each process area has only one generic goal. Achievement of a generic goal in a process area signifies improved control in planning, implementing, and controlling the processes associated with that process area, thus indicating whether these processes are likely to be effective, repeatable, and lasting. Generic goals are required model components and are used in appraisals to determine whether a process area is satisfied. Generic goals are supported by generic practices that provide institutionalization to ensure that the processes associated with the process area will be effective, repeatable, and lasting. Generic practices are categorized by generic goals and common features and are expected components in CMMI models.⁵

Refer to Figure 2 for a pictorial view of CMMI’s staged representation structure.

⁵ From “*CMMI Integration, Version 1.1 – Staged Representation*” found at www.sei.cmu.edu/cmmi

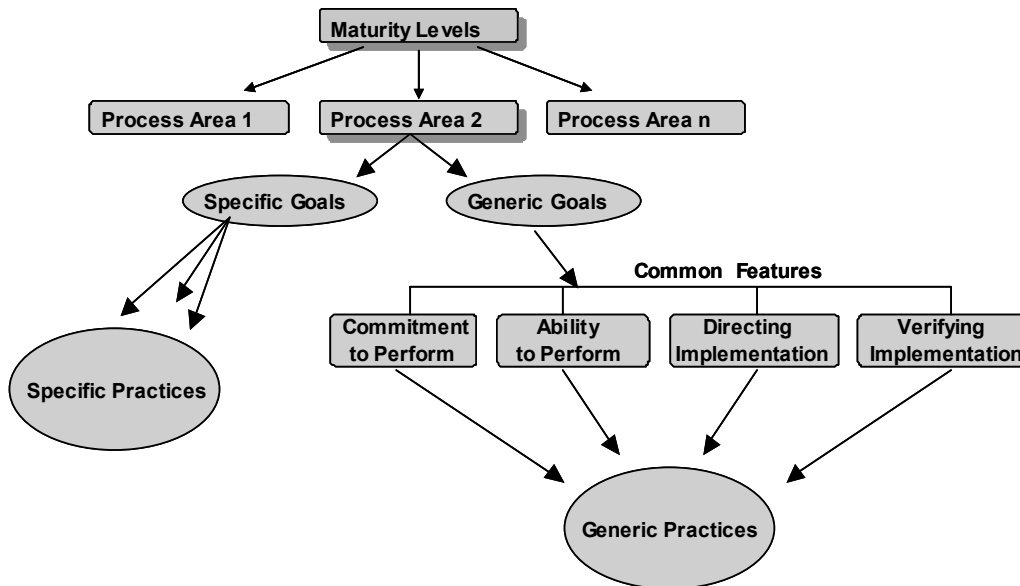


Figure 2
Pictorial view of CMMI's staged representation structure

While the next section of this paper describes the continuous representation, the general purpose of this paper is to explain how IBM Rational solutions help organizations achieve CMMI maturity level 2 using the staged representation. CMMI maturity level 2 focuses on implementing a management capability at the project level for all activities, with the goal of institutionalizing these capabilities so that in times of stress, they are not discarded. The result is an organization that can better estimate and deliver products on-time, on-budget, and with better quality.

The material contained herein generically describes how IBM Rational solutions support the attainment of CMMI's maturity level 2 goals. Specific details (at the practice level) regarding each CMMI maturity level 2 process area are contained in additional modules available at www.rational.com/solutions/industry/govt/cmmi.jsp as they become available.

Description of the Continuous Representation

The continuous representation of the CMMI allows an organization to focus on its capability, and on the improvement, of a single process area, or on multiple specific process areas in ways that do not map into pre-defined stages. Each process area has its associated specific goals, similar to the staged representation. Each capability level from 1 through 5 has an associated generic goal and associated generic practices. The 22 process areas are consistent across both the continuous and staged representations. Note that in the staged representation there are no requirements for maturity level 1, whereas in the continuous representation there are specific and generic goals which are required to reach capability level 1. This increased granularity of capability (process maturity) allows organizations to show progress much sooner than might otherwise be possible. This can be important in organizations that are under senior management pressure to show immediate results.

For ease of thought and process improvement use, the 22 process areas (PAs) themselves are divided into four process categories:

- Process Management – 5 PAs
- Project Management – 6 PAs
- Engineering – 6 PAs
- Support – 5 PAs

By choosing one process area, or by choosing a single process category, an organization can concentrate its improvement efforts on those areas it has decided are most important to its business goals, imperatives, or problems.

Each of the 22 process areas can be individually characterized by the CMMI as being:

Capability Level 0 - Incomplete: An incomplete process is a process that is either not performed or partially performed. One or more of the specific goals of the process area are not satisfied.⁶

Capability Level 1 - Performed: A performed process is a process that satisfies the specific goals of the process area. It supports and enables the work needed to produce identified output work products using identified input work products. A critical distinction between an incomplete process and a performed process is that a performed process satisfies all of the specific goals of the process area.⁶ There is a single generic goal at capability level 1 which requires that the basic specific practices of the process area are implemented.

Capability Level 2 - Managed: A managed process is a performed (capability level 1) process that is also planned and executed in accordance with policy, employs skilled people having adequate resources to produce controlled outputs, involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description. The process may be instantiated by an individual project, group, or organizational function. Management of the process is concerned with the institutionalization of the process area and the achievement of other specific objectives established for the process, such as cost, schedule, and quality objectives.

A critical distinction between a performed process and a managed process is the extent to which the process is managed. A managed process is planned (the plan may be part of a more encompassing plan) and the performance of the process is managed against the plan. Corrective actions are taken when the actual results and performance deviate significantly from the plan. A managed process achieves the objectives of the plan and is institutionalized for consistent performance.⁶ There is a single generic goal at capability level 2 which requires that the process area be institutionalized as a managed process. This generic goal has ten generic practices which address the policy, plans, resources, training, management, and objective oversight provided over the process area.

Capability Level 3 - Defined: A defined process is a managed (capability level 2) process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines, and contributes work products, measures, and other process-improvement information to the organizational process assets.

A critical distinction between a managed process and a defined process is the scope of application of the process descriptions, standards, and procedures. For a managed process, the process descriptions, standards, and procedures are applicable to a particular project, group, or organizational function. As a result, the managed processes for two projects within the same organization may be very different. At the defined capability level, the organization is interested in deploying standard processes that are proven and that therefore take less time and money than continually writing and deploying new processes. Because the process descriptions, standards, and procedures are tailored from the organization's set of standard processes and related organizational process assets, defined processes are appropriately consistent across the organization. Another critical distinction is that a defined process is described in more detail and performed more rigorously than a managed process. This means that improvement information is easier to understand, analyze, and use. Finally, management of the defined process is based on the additional insight provided by an understanding of the interrelationships of the process activities and detailed measures of the process, its work products, and its services.⁶ There is a single generic goal at capability level 3 which requires that the process area be institutionalized as a defined process. It has two generic practices which address the establishment of the project's defined processes and collection of improvement information.

Capability Level 4 - Quantitatively Managed: A quantitatively managed process is a defined (capability level 3) process that is controlled using statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria in managing the process. The quality and process performance are understood in statistical terms and are managed throughout the life of the process.

A critical distinction between a defined process and a quantitatively managed process is the predictability of the process performance. The term "quantitatively managed" implies using appropriate statistical and other quantitative techniques to manage the performance of one or more critical subprocesses of a process so that the future performance of the process can be predicted. A defined process only provides qualitative predictability.⁶ There is a single generic goal at capability level 4 which requires that the process area be institutionalized as a quantitatively managed process. It has two generic practices which address the establishment of quantitative objectives for the

⁶ From "CMMI Integration, Version 1.1 – Continuous Representation" found at www.sei.cmu.edu/cmmi

process area and the stabilization of one or more subprocesses that are considered critical to achieving the quantitative objectives.

Capability Level 5 - Optimizing: An optimizing process is a quantitatively managed (capability level 4) process that is changed and adapted to meet relevant current and projected business objectives. An optimizing process focuses on continually improving the process performance through both incremental and innovative technological improvements. Process improvements that would address root causes of process variation and measurably improve the organization’s processes are identified, evaluated, and deployed as appropriate. These improvements are selected based on a quantitative understanding of their expected contribution to achieving the organization’s process-improvement objectives versus the cost and impact to the organization. The process performance of the organization’s processes is continually improved.

A critical distinction between a quantitatively managed process and an optimizing process is that the optimizing process is continuously improved by addressing common causes of process variation and providing statistical predictability for the results. Though a level 4 process may produce predictable results, the results may be insufficient to achieve the established objectives. In a process that is optimized, common causes of process variation are addressed by changing that process in a manner that will lead to a shift in the mean or a decrease in variation when it is brought back to stability. These changes are intended to improve process performance and achieve the organization’s established process-improvement objectives.⁶ There is a single generic goal at capability level 5 which requires that the process area be institutionalized as an optimizing process. It has two generic practices that ensure continuous process improvement and identifying/correcting root causes of problems.

Organizations utilizing the continuous representation can find themselves at differing capability levels in various process areas, as illustrated by Figure 3.

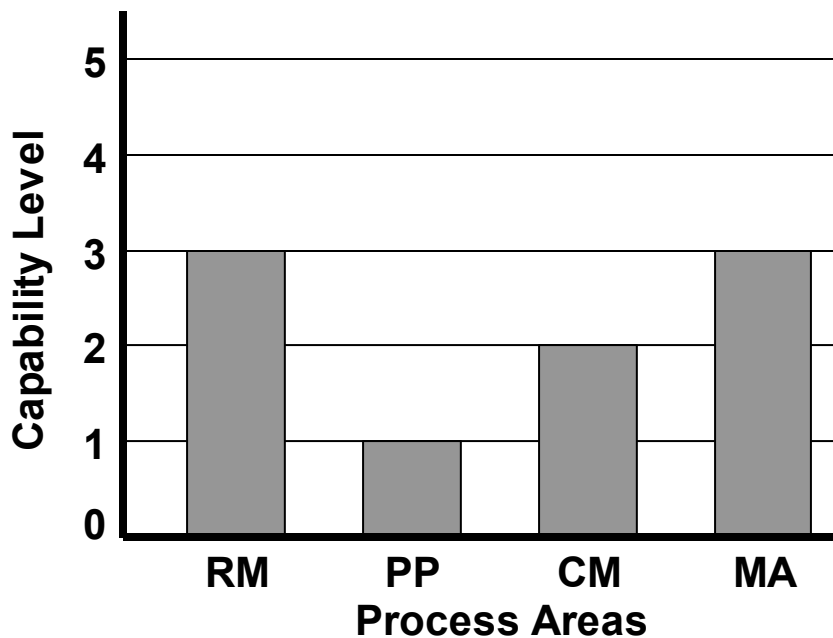


Figure 3

Description of the Staged Representation

The staged representation of the CMMI focuses on organizational maturity. The staged representation consists of 22 process areas, each of which is assigned to one of 5 maturity levels (ML). Each process area consists of one or more specific goals, and one or more generic goals. Each goal has an associated set of defined practices. The practices of the generic goals can be identified as belonging to the common features of Commitment to Perform, Ability to Perform, Directing Implementation, and Verifying Implementation. The staged representation forces an organization to concentrate on a predefined set of process areas to attain each maturity level. An appraisal against the model allows an organization to be appraised at a given maturity level 1 through 5. The five levels and their definitions include:

Maturity Level 1 – Initial: At ML 1, processes are usually ad hoc and chaotic. The organization usually does not provide a stable environment. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes. In spite of this ad hoc, chaotic environment, maturity level 1 organizations often produce products and services that work; however, they frequently exceed the budget and schedule of their projects. ML 1 organizations are characterized by a tendency to over commit, abandon processes in the time of crisis, and not be able to repeat their past successes.⁵

Maturity Level 2 – Managed: At ML 2, an organization has achieved all the specific and generic goals of the ML 2 process areas. In other words, the projects of the organization have ensured that requirements are managed and that processes are planned, performed, measured, and controlled. The process discipline reflected by ML 2 helps to ensure that existing practices are retained during times of stress. When these practices are in place, projects are performed and managed according to their documented plans.⁵

Maturity Level 3 – Defined: At ML 3, an organization has achieved all the specific and generic goals of the process areas assigned to MLs 2 and 3. At ML 3, processes are well characterized and understood, and are described in standards, procedures, tools, and methods. The organization's set of standard processes, which is the basis for ML 3, is established and improved over time. These standard processes are used to establish consistency across the organization. Projects establish their defined processes by tailoring the organization's set of standard processes according to tailoring guidelines.

A critical distinction between ML 2 and ML 3 is the scope of standards, process descriptions, and procedures. At maturity level 2, the standards, process descriptions, and procedures may be quite different in each specific instance of the process (for example, on a particular project). At ML 3, the standards, process descriptions, and procedures for a project are tailored from the organization's set of standard processes to suit a particular project or organizational unit. The organization's set of standard processes includes the processes addressed at ML 2 and ML 3. As a result, the processes that are performed across the organization are consistent except for the differences allowed by the tailoring guidelines.⁵

Maturity Level 4 - Quantitatively Managed: At ML 4, an organization has achieved all the specific goals of the process areas assigned to MLs 2, 3, and 4 and the generic goals assigned to MLs 2 and 3. Subprocesses are selected that significantly contribute to overall process performance. These selected subprocesses are controlled using statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria in managing processes. Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers. Quality and process performance are understood in statistical terms and are managed throughout the life of the processes.⁵

Maturity Level 5 – Optimizing: At ML 5, an organization has achieved all the specific goals of the process areas assigned to MLs 2, 3, 4, and 5 and the generic goals assigned to MLs 2 and 3. Processes are continually improved based on a quantitative understanding of the common causes of variation inherent in processes. ML 5 focuses on continually improving process performance through both incremental and innovative technological improvements. Quantitative process-improvement objectives for the organization are established, continually revised to reflect changing business objectives, and used as criteria in managing process improvement. The effects of deployed process improvements are measured and evaluated against the quantitative process-improvement objectives. Both the defined processes and the organization's set of standard processes are targets of measurable improvement activities.⁵

Refer to Figure 4 for a pictorial representation of the CMMI staged representation.⁷

⁷ From "CMMI v1.1 Tutorial" by Mike Phillips

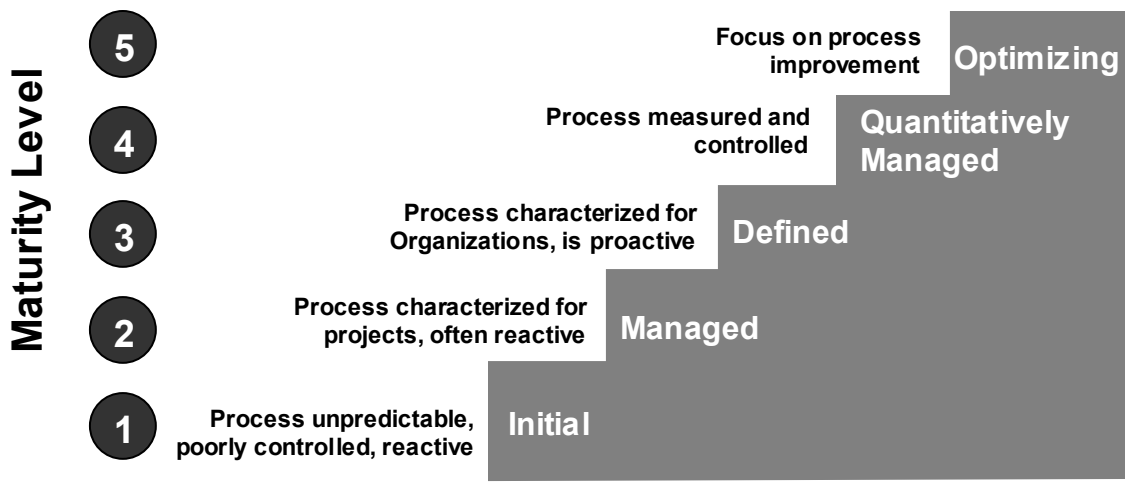


Figure 4

In the CMMI’s staged representation, there are seven process areas present at maturity level 2, and are discussed in more detail later in the paper. The PAs are:

1. Requirements Management (REQM)
2. Project Planning (PP)
3. Project Monitoring and Control (PMC)
4. Supplier Agreement Management (SAM)
5. Measurement and Analysis (MA)
6. Process and Product Quality Assurance (PPQA)
7. Configuration Management (CM)

Description of CMMI Maturity Level 2 Generic Goals and Practices

The CMMI’s maturity level 2 has a single generic goal stated as:

Generic Goal 2 (GG 2) – The process is institutionalized as a managed process

This generic goal must be satisfied for each of the maturity level 2 process areas. The intent of this goal is that a project puts in place, follows, and sustains a set of processes. Satisfying this generic goal shows that an organization has institutionalized the processes for all the maturity level 2 process areas.

The generic practices that map to the generic goal includes practices for the project to:

- Follow a policy,
- Plan its process and its work,
- Provide resources and assigns responsibility to perform the process and project work,
- Train its personnel on the process, tools, and additional required knowledge for each process area,
- That the project manages and controls work products and processes,
- Evaluate how well it adheres to the identified process, and
- Review project status with project management and senior management.

Again, the generic goal and its generic practices apply to each of the maturity level 2 process areas. In the staged representation maturity level 2, the 10 generic practices that map to the generic goal are categorized by common features.

Commitment to Perform

Generic Practice 2.1 (CO 1) – Establish and maintain an organizational policy for planning and performing process

The purpose of this common feature is for senior management to become involved and to provide guidance to the organization. This communication and support needs to be visible to all personnel and should include guiding principles, direction, and high-level expectations. This common feature is used to ensure the projects, and the project personnel understand what tasks they must perform to ensure they operate in the best interest of the organization while they perform activities for each of the process areas.

For each PA, the CMMI requires that a written organizational policy be in place and followed by the organization via the Commitment to Perform common feature. RUP does not specifically address the need for policies (or a single, overarching policy), although the Software Engineering Process Authority (SEPA) described in RUP would be the appropriate entity to help develop the policies.

Ability to Perform

Generic Practice 2.2 (AB 1) – Establish and maintain the requirements and objectives, and plan for performing the process

Generic Practice 2.3 (AB 2) – Provide adequate resources for performing the process, developing the work products, and providing the services of the process

Generic Practice 2.4 (AB 3) – Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process

Generic Practice 2.5 (AB 4) – Train the people performing or supporting the process as needed

The purpose of this collection of four practices under this common feature is to ensure that:

- Project personnel understand the reasons for performing a process, and have collected and documented those requirements
- Each project documents and controls their requirements in a manner that all project personnel have appropriate access to the requirements
- Project management plans and schedules the work consistent with the requirements
- Each task and deliverable is assigned to project personnel
- Project personnel are trained to perform their job duties as they relate to each process area
- Accountability and responsibility for performing the process on each project is specifically assigned to an individual

Resources and funding are required by the CMMI's Ability to Perform common feature. Organizations can map the required CMMI resources to RUP roles, keeping in mind the CMMI activities those roles are responsible for have to be performed, even if RUP does not address them. Of course, funding must be provided for the roles to be able to effectively perform their responsibilities. The RUP activity Project Management->Develop Software Development Plan->Define Project Organization & Staffing is the appropriate place to define and plan for the necessary roles.

The CMMI's Ability to Perform common features also require various roles and groups in the organization to be trained or oriented in their specific job function. Informal training/orientation can be provided by the RUP itself. It is web-based and can be available to all project team members via a web browser. Rational University provides many classes and workshops where formal engineering process and tool training can be acquired. Finally, a large number of books have been published that focus on RUP and the various best practices it advocates. Note however, that the CMMI suggests more comprehensive training in job functions than may be received if training is only concerned with RUP or the IBM Rational tool suite.

The CMMI requires that various plans and procedures be documented and available to the organization. RUP provides many IEEE-based templates including the software development plan, software configuration management plan, and software quality assurance plan. Since these templates provide instructions on how to complete the templates, they are considered to be procedures by the CMMI. If completed fully and correctly, the resulting plans could be used to document other procedures required by the CMMI that are not specifically addressed by RUP itself. To accomplish this each organization should review and modify/expand the templates as necessary to ensure that other CMMI process area goal requirements or other specific organization requirements are accommodated.

Directing Implementation

Generic Practice 2.6 (DI 1) – Place designated work products of the process under appropriate levels of configuration management

Generic Practice 2.7 (DI 2) – Identify and involve the relevant stakeholders as planned

Generic Practice 2.8 (DI 3) – Monitor and control the process against the plan and take appropriate corrective action

The purpose of this collection of three practices under this common feature is to ensure that:

- Configuration control is maintained for managing the project documents, plans, specifications, and deliverables
- Stakeholders are communicated with according to plan
- The project plan and schedule is monitored to ensure the tasks and deliverables are being completed, but more importantly, to provide management indicators of when the project is not advancing according to the plan. This oversight gives decision makers an opportunity to identify and take actions to correct the project direction.

Generic practice 2.6 can be satisfied by following RUP's Configuration Management discipline, ensuring that the various work products created and maintained by the project are identified, their level of configuration control documented, and that they are managed and controlled as documented.

The process can be monitored, and stakeholders can be involved as identified and planned through various RUP-required project reviews found in the Monitor Project Status activity of RUP. The RUP calls out various reviews including:

1. Project Approval Review
2. Project Planning Review
3. Iteration Plan Review
4. PRA Project Review
5. Iteration Criteria Evaluation Review
6. Iteration Acceptance Review
7. Lifecycle Milestone Review
8. Project Acceptance Review

It is important during these reviews to focus not only on product progress, but also on the process creating the products.

If identified project stakeholders attend the appropriate meetings, the process is monitored, controlled, and action taken when required, and review records are kept, generic practices 2.7 and 2.8 can easily be satisfied. However care should be taken to recognize that the stakeholders referred to in this generic practice 2.6 includes representatives from non-project related organizations such as, but not limited to, the organization's engineering process group, organizational configuration management and quality groups, and senior managers interested in process improvement throughout the organization. Who these relevant stakeholders are varies widely across organizations and proactively identifying them is one purpose of generic practice 2.7.

Verifying Implementation

Generic Practice 2.9 (VE 1) – Objectively evaluate adherence of the process and work products and services of the process to the applicable requirements, objectives, and standards, and address noncompliance

Generic Practice 2.10 (VE 2) – Review the activities, status, and results of the process with higher-level management and resolve issues

The purpose of these two practices under this common feature is to ensure that

1. Checks are in place to evaluate the project activities for each process area and the work products created.
2. Project activities and deliverables map to the project plan, schedule, and process.
3. The results of these evaluations can then be reviewed with both project and senior management for decision-making purposes and to ensure that higher levels of management are both interested in and kept aware of the state of process related activities within the organization

Two levels of reviews are required by the CMMI's Verifying Implementation common feature: senior management, and quality assurance. The RUP calls out various reviews including:

1. Project Approval Review
2. Project Planning Review
3. Iteration Plan Review
4. PRA Project Review
5. Iteration Criteria Evaluation Review
6. Iteration Acceptance Review
7. Lifecycle Milestone Review
8. Project Acceptance Review

Senior management reviews can be accommodated by the RUP's PRA project review. This review requires that the project's senior management review the project's process activities and milestones. An outcome of this review is the Review Record. Appraisal teams will look to the Review Record for objective evidence that higher level management reviewed not only the projects activities and status, but also the status of the process area's activities compared to the plan.

Objective evidence of compliance with CMMI-required objective evaluations can be easily satisfied by having the individual or organizational entity performing the objective evaluation represented at the project reviews noted above and documenting in the Review Record their activities and status reports. Although the CMMI does not specifically require it, most organizations satisfy this portion of the CMMI through involvement of a Quality Assurance or equivalent functional group.

Description of CMMI Maturity Level 2 Process Areas and Specific Goals Requirements Management (RM)

The purpose of the Requirements Management Process Area is to manage the requirements of the project's products and product components and to identify inconsistencies between those requirements and the project's plans and work products

Only one specific goal is required to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Requirements are managed and inconsistencies with project plans and work products are identified

Project personnel need to have a consistent understanding of what is included in the scope of work of the project. Most projects experience some level of requirements change or churn over the life of the project. On a small project with few people and few requirements, this may not appear to be significant. As projects become larger it becomes more difficult to communicate these changes to all personnel. Thus the work products tend to drift from what the client has specified and agreed to. The intent of this process area is to ensure project plans, schedules, work products and deliverables stay consistent with the requirements.

The initial elicitation, analysis, and allocation of requirements to hardware, software, and other system components is handled within Requirements Development, a staged maturity level 3 process area. It is after the requirements have been identified that the Requirements Management process area becomes involved. Compliance with this process area is aided by good configuration management of the requirements and the associated process that ensures all relevant stakeholders are considered in the change process. RUP and the Rational tool suite describe many of these processes and provide the means to automate configuration management of the requirements and other work products. CM provides the basis for the organization to review the impacts of any changes to the requirements on the project plans and other related items.

Project Planning (PP)

The purpose of the Project Planning Process Area is to establish and maintain plans that define project activities

There are three specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Estimates of project planning parameters are established and maintained

Specific Goal 2 (SG 2) – A project plan is established and maintained as the basis for managing the project

Specific Goal 3 (SG 3) – Commitments to the project plan are established and maintained

Once requirements have been collected, the project tasks and deliverables can be planned and scheduled. The plan is a written document typically containing the schedule and additional project information. Completion time for each task and deliverable must to be estimated, and the estimates along with the basis of the estimates must to be captured for future project and organizational use. Project tasks and deliverables can then be scheduled (typically using a scheduling tool), with durations and resources assigned. Prior to finalization, the plan and schedule need to be agreed upon by both internal and external stakeholders. The plan and schedule must to be controlled just as every project work product for the duration of the project. This helps to ensure the project personnel are working to the same plan, schedule, and therefore requirements.

RUP's Project Management discipline satisfies the majority of the Project Planning PA's goals, including the development of a project plan, and obtaining commitment to the plan.

Although RUP does require estimates to be prepared, it does not specify any one particular estimation method. Thus, the organization or project must select and document the specific procedures used to identify and estimate values for the product attributes that will be used to estimate task durations and costs.. Similarly, a procedure is required detailing how the project creates and updates its schedule.

RUP does contain links to the COCOMO II method of estimation. This may be a good starting point for organizations to look into when investigating appropriate estimation methods, however the COCOMO family of models only applies to software development while the CMMI applies to hardware, software, and other project components. It may be necessary to document and use a number of estimating methods.

Documentation of project risks, assessment, and mitigation strategies can be automated using the Rational ClearQuest product.

Project Monitoring and Control (PMC)

The purpose of the Project Monitoring and Control Process Area is to provide an understanding into the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan

There are two specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Actual performance and progress of the project is monitored against the project plan

Specific Goal 2 (SG 2) – Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan

On every project, plans and schedules will change. To keep up with what is really occurring, the project management team needs to track the tasks and deliverables against the plan and schedule. Each project team member must be able to use the plan and schedule to ensure they are performing the correct tasks at the correct time, to keep their deliverables on schedule. If a problem is encountered, the plan and schedule may need to be changed to provide ongoing insight into the project activities. These changes are inserted into the plan and schedule, which, once updated, should be redistributed to all the stakeholders. Only by tracking to the latest project knowledge can the project manager really understand the risks to timely delivery of the technical content required of the project within the established cost and schedule budgets. By using Rational ProjectConsole, project managers can obtain up-to-the-minute status on each of their projects.

Similar to the Project Planning PA, RUP's Project Management discipline satisfies the majority of the Project Monitoring and Control PA's goals, particularly in the ongoing tracking of the development effort through the Monitor Project Status activity.

The main aspect of PMC to keep in mind is the ongoing tracking of project risks, work product sizes, effort and costs, resources, etc. While tracking, if any actual data deviates significantly from the initial estimates, corrective action must be taken via the Handle Exceptions & Problems RUP activity.

Project risk tracking can be easily automated using Rational ClearQuest.

Supplier Agreement Management (SAM)

The purpose of the Supplier Agreement Management Process Area is to manage the acquisition of products and services from suppliers external to the project for which there exists a formal agreement

There are two specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Agreements with the suppliers are established and maintained

Specific Goal 2 (SG 2) – Agreements with the suppliers are satisfied by both the project and the suppliers

Just as the project personnel need to understand their requirements, schedule, budget, and other pertinent project information and constraints, so do suppliers to the project. If a product or service is specified for purchase, and will be required by the project, both the project and the supplier need to understand what should be delivered and what is included in the contract.

RUP is intended to be used by an organization that typically develops software products or systems directly for a client organization. The CMMI takes into account the fact that often times there are multiple collaborating organizations working on pieces or tasks of a total system development effort. The CMMI assumes that one of these organizations is the "prime contractor", and the others are "suppliers". Suppliers typically use their own development processes, procedures, and tools to build or perform their respective parts of the system. Thus, many of the practices required by the CMMI in the Supplier Agreement Management PA are not specifically addressed by RUP.

However, an organization can become compliant in this PA by using the IEEE Std 1062 Recommended Practice for Software Acquisition. This standard outlines the recommended steps an organization should follow when undergoing a software acquisition effort. If the standard is utilized correctly, many of the SAM procedures asked for by the CMMI would be produced. Placing these agreements or other artifacts under CM control using the Rational tool suite would provide partial objective evidence of the “established and maintained” portions of the requirements from this process area.

Of course, a prime contractor using RUP might consider encouraging suppliers to follow RUP as well.

Measurement and Analysis (MA)

The purpose of the Measurement and Analysis Process Area is to develop and sustain a measurement capability that is used to support management information needs

There are two specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Measurement objectives and practices are aligned with identified information needs and objectives

Specific Goal 2 (SG 2) – Measurement results that address identified information needs and objectives are provided

The CMMI’s Measurement and Analysis process area require the organization to identify, collect, and use measurements that allow the organization to assess and improve their processes and work product quality. Measurements include project, product, and process data. Project data includes schedule, budget, and status of tasks and deliverables. Product data may include lines of code, numbers of defects, numbers of requirements, or measures of other product attributes. Process data may include effectiveness, timeliness, or measures of other process attributes of how the project processes are working. Each of these three areas must be considered to provide decision makers appropriate insight into the project activities. The measures collected can then be used to make decisions on this and other projects.

RUP recommends that a measurement plan be completed to specify the measurements that must be made and used. Then, these measurements can be reviewed and analyzed during the Project Review Authority (PRA) project reviews, or during the SEPA’s periodic meetings. Many IBM Rational integrated tools, such as Rational ClearCase, ClearQuest, RequisitePro, and ProjectConsole provide more than adequate measurement gathering simply by automating the engineering process with them. However to show compliance with this process area will require additional work and documentation to show how the measures collected are aligned with the organization’s business objectives. This process area also requires significant effort in precisely defining the measures that will be collected, how they will be collected, where they will be stored, how they will be analyzed, etc., and the organization must make sure that this detail is included in the measurement plan.

Process and Product Quality Assurance (PPQA)

The purpose of the Process and Product Quality Assurance Process Area is to provide staff and management with objective insight into the processes and associated work products

There are two specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated

Specific Goal 2 (SG 2) – Noncompliance issues are objectively tracked and communicated, and resolution is ensured

Sometimes, under difficult circumstances, project tasks are not always performed correctly. Project personnel and management need to know that the correct tasks are being performed in the correct manner under all circumstances. The reviews of engineering activities and audits of project work products should be performed by a technically qualified, objective group. Project work (both tasks and deliverables) can be checked against the requirements, plan, project standards, and/or project process. When inconsistencies are identified, the issues can be documented, reported to the engineers and management, resolutions identified, and tracked to completion.

The CMMI's view of Quality Assurance encompasses more than just product quality. It also focuses on process quality. The underlying philosophy of the CMMI with regard to quality assurance is that "a quality process will produce a quality product".

The clear intent of the CMMI is that senior management reviews the results of the objective reviews already accomplished to ensure that the processes are being followed, and one function of the PPQA process area is to ensure senior management is fulfilling its duties as required by generic practice 2.10. RUP's role of "Reviewer" engages in many of the CMMI required product reviews such as the SDP review. By including the RUP "Reviewer" role in project and senior management status meetings, some of the CMMI required process reviews can be accommodated.

RUP does advocate the completion of a Software Quality Assurance Plan. This IEEE-based plan template, when completed properly, will address many of the CMMI PPQA requirements such as the product and process review requirements, and audit and deviation escalation procedures. Ultimately, however, the QA group must perform in accordance with the QA plan, and show evidence that it is doing so.

The Rational ClearQuest tool can be effectively used to document and track deviations identified during QA audits and reviews.

Configuration Management (CM)

The purpose of the Configuration Management Process Area is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

There are three specific goals that need to be satisfied in this process area for CMMI Maturity Level 2:

Specific Goal 1 (SG 1) – Baselines of identified work products are established and maintained

Specific Goal 2 (SG 2) – Changes to the work products under configuration management are tracked and controlled

Specific Goal 3 (SG 3) – Integrity of baselines is established and maintained

A constant on every project is change. Changes may include modifications to requirements, schedule, or budget. Changes to requirements typically cause a ripple effect through multiple work products, project interfaces, schedule, and budget. It is imperative that these various work products and deliverables stay consistent with each other, and with the requirements. The mechanism for ensuring this consistency is Configuration Management.

Project work products typically controlled include project documentation (plans, schedules, and other documents), and each release of a deliverable item such as a document, software, or hardware. Deliverables also typically include associated documentation such as requirements, users guides or manuals, version description documents or other similar documents. Each of these items should be considered for control so changes can be understood from one version to the next. Configuration management and control helps to ensure that a deliverable matches the specifying requirements.

The RUP discipline, Configuration and Change Management, satisfies much of the CMMI's Configuration Management requirements.

RUP requires that the Configuration Management Plan be completed and documented. This plan will detail many of the project-specific procedures necessary to complete the CM tasks. A high-level CM plan, in conjunction with product documentation or RUP tool mentors would not be sufficient for CMMI Level 2 since they provide general guidance, not project-specific procedures.

Many of the reports, audits, configuration statuses, and measurements can be automated using Rational ClearCase and ClearQuest. In fact, these tools were built specifically to assist organizations in performing their CM tasks better and more efficiently.

USING IBM RATIONAL SOLUTIONS TO SATISFY CMMI LEVEL 2

IBM Rational provides a number of products and services that help in reaching higher CMMI maturities. This section provides a brief overview of the applicable products and services, and how they help satisfy the various process areas and goals of CMMI maturity level 2. Recommendations are also given in those cases where IBM Rational solutions don't completely satisfy CMMI requirements.

For more detail on each Process Area, refer to the additional CMMI Process Area Modules that address each key practice, and the RUP role that might be responsible for satisfying the practice, what RUP process and procedure/template might help satisfy the practice, and any other observations/recommendations that might be relevant. As they become available, these modules can be found at www.rational.com/solutions/industry/govt/cmmi.

Rational Unified Process (RUP)

The Rational Unified Process, otherwise known as RUP, was developed by IBM Rational as a software engineering process providing a disciplined approach to assigning tasks and responsibilities within a software development organization. Key concepts of the RUP are:

1. Develop Iteratively
2. Manage Requirements
3. Use Component Architectures
4. Model Visually
5. Continuously Verify Quality
6. Manage Change

The RUP product provides a web-based process asset library describing a family of related software engineering processes sharing a common structure, and common process architecture. Its goal is to ensure the production of high-quality software that meets the needs of its end users, within a predictable schedule and budget. RUP captures many of the best practices in modern software development in a form that can be tailored to a wide range of projects and organizations. For more information on RUP, see www.rational.com/products/rup.

RUP is a valuable framework for satisfying many of the CMMI's maturity level 2 goals. The following lists each of RUP's disciplines applicable to maturity level 2, and the CMMI process area(s) they apply to:

- Requirements - CMMI Requirements Management PA
- Project Management - CMMI Project Planning PA, Project Monitoring & Control PA, Process and Product Quality Assurance PA, Measurement and Analysis PA
- Configuration & Change Management – CMMI Configuration Management PA, Measurement & Analysis PA
- Test – Measurement and Analysis PA

The Environment discipline applies to several of the generic practices at CMMI maturity level 2. The activity Develop Development Case specifically addresses GP 2.2 Plan the Process practice by asking projects to tailor RUP to meet their specific requirements.

To fully satisfy CMMI goals, some additional activities must be performed that aren't specifically called out by RUP. These activities include:

- Creation of organizational policies that direct the planning and performing of CMMI ML 2 processes – RUP doesn't specifically call out the creation of policies by senior management for a project to use as guidance.
- Creation of detailed standards and procedures that address the day-to-day performance of all system and software engineering activities – RUP workflows and activities are generally at the process level. Some engineering activities, such as build procedures, project estimation, etc., need to be further documented in more detail.

- Process-oriented reviews – RUP calls out several levels of reviews, but they tend to focus on the products created by the software development process. By adding a process review dimension, and documenting the results, an organization can satisfy these CMMI requirements.
- Managing suppliers – RUP is designed to be used by an organization that typically develops software products or systems directly for a client organization. Thus, the Supplier Agreement Management Process Area is not specifically addressed by RUP. However, one way an organization can become compliant in this PA is by using the IEEE Std. 1062 Recommended Practice for Software Acquisition as a guideline for all supplier agreements, not just software acquisition. This standard outlines the recommended steps an organization should follow when undergoing a software acquisition effort. If the standard is implemented correctly, many of the Supplier Agreement Management Process Area requirements would be satisfied.

By adopting RUP, an organization can shortcut the need to internally develop and document several of the required software development processes. The organization will need to tailor RUP and the templates to best meet its needs, to quickly take advantage of the proven best practices, guidelines, and other assets provided by RUP.

Rational ClearCase

Rational ClearCase® simplifies the process of change with a family of products that scales from small project workgroups to the distributed global enterprise. Rational ClearCase helps project teams control everything that evolves in development — including requirements, models, source code, and test scripts. Rational ClearCase offers the essential functions of version control, workspace management, process configurability, and build management. By automating many of the necessary, yet error-prone tasks associated with a development effort, Rational ClearCase enables teams of all sizes to build the highest-quality deliverables possible. For more information on ClearCase, see www.rational.com/products/clearcase.

Together with RUP, Rational ClearCase specifically addresses the goals of the configuration management process area. It also addresses the CMMI maturity level 2 generic practice 2.6 - Manage Configurations. ClearCase can also, when used properly, provide significant measurements and metrics that can be used to satisfy the Measurement and Analysis process area.

In order to be fully compliant in the Configuration Management process area at CMMI Maturity Level 2, organizations adopting ClearCase should ensure that they document the various procedures team members would use in interacting with the tool. These include:

- Role and procedures for a configuration control board or equivalent
- Check-in, check-out
- Delivery to integration stream
- Branching, merging, rebasing
- Build/baseline creation
- Generation of build report(s)
- Generation of audit report(s)
- Performance of audits

Rational ClearQuest

Rational ClearQuest® is a powerful and highly flexible defect and change tracking system that captures and manages all types of change requests throughout the development lifecycle, helping organizations quickly deliver higher quality software. Compatible with Windows, UNIX, or the Web, the fully customizable interface and workflow engine adapt to any development process. With support for industry standard databases, ClearQuest scales to support projects of any size and integration with other development solutions ensures that your entire team is tied into the defect and change tracking process. For more information on ClearQuest, see www.rational.com/products/clearquest.

Together with RUP and ClearCase, ClearQuest provides a powerful change management capability that goes a long way towards satisfying the CMMI's Configuration Management process area, as well as aspects of the Requirements Management PA, the Measurement and Analysis PA, and the Process and Product Quality Assurance PA.

It is important for organizations pursuing a CMMI improvement effort to document how ClearQuest is used to manage changes, including the various procedures used to enter change requests, create reports and charts, etc. ClearQuest can be used to support the Process and Product Quality Assurance PA by tracking results of process and work product audits, tracking and resolving non-compliance issues, reporting results to management, and maintaining records of quality assurance activities. ClearQuest has also been used to provide objective evidence of the “corrective actions” required in many other process areas by acting as an issues/action item tracking log.

Rational Unified Change Management (UCM)

Unified Change Management (UCM) is the IBM Rational approach to managing change in software development projects from requirements to release. UCM spans the development lifecycle, providing an out-of-the box approach to manage changes to requirements, design models, documentation, components, test cases, source code, etc. UCM is a pre-configured change process model that leverages a tight integration between Rational ClearCase and ClearQuest.

Organizations having difficulty managing change should seriously consider implementing UCM, since the process and tools can be implemented quickly, and the benefits of properly managing change realized faster. Over time, UCM can be tailored to better meet an organization’s specific needs.

UCM addresses the CMMI requirements addressed by ClearCase and ClearQuest (see above), but in a much more expedited fashion. IBM Rational supports UCM through various training courses for administrators and practitioners, and supplies out-of-the box capabilities such as change request state models, configuration and change management reports, baseline and build management functions, and documentation.

Rational RequisitePro

Rational RequisitePro[®], is a powerful, easy-to-use, integrated product for requirements management that uses Microsoft Word. RequisitePro lets you maintain the way you document requirements, while leveraging analytical capabilities such as requirements analysis, coverage and change impact. It promotes better communication, enhances teamwork and reduces project risk. For more information on RequisitePro, see www.rational.com/products/reqpro.

Rational RequisitePro’s requirements management and traceability matrix capabilities help organizations satisfy the Requirements Management PA’s goals by providing the capability to manage change to requirements through a project’s lifecycle. Used correctly, RequisitePro will also help in keeping project work products, such as design documents, project plans, test plans, etc., in sync with project requirements.

Rational RequisitePro can also help in satisfying the Measurement and Analysis PA by providing valuable information to the organization regarding requirements changes, churn, and shifting priorities.

Rational ProjectConsole

Rational ProjectConsole[®], an integral part of every Rational Suite, helps you monitor project progress, identify trends, and improve project predictability. It simplifies access to project information by creating a Web site with artifacts and metrics automatically collected from your development environment. Rational ProjectConsole integrates with Microsoft[®] Project and offers extensive graphical reporting and dashboard displays to give you and your team complete, up-to-date views of project progress.

Implementing Rational ProjectConsole in conjunction with RUP’s Measurement Plan is an effective way to help automate the collection of measurements and reporting of metrics on a software project. Since Rational ProjectConsole can access information stored in various tool repositories, as well as other outside sources, it will help organizations satisfy the requirements outlined in the Measurement and Analysis PA.

Rational University

Rational University offers numerous on-line and in-person training courses that help organizations in Rational solution implementations. Courses range from the process oriented “Requirements Management with Use-Cases” class, to the more technical “Rational ClearCase MultiSite Administration” class. For more information on Rational University, see www.rational.com/university.

RU’s process and product course offerings help in satisfying the CMMI’s Maturity Level 2 Ability to Perform 2.5 generic practice common feature. These courses are invaluable to help organization quickly come up to speed on the new methods, best practices, and tools that will be used on projects.

Organizations should not just rely on RU to satisfy CMMI requirements, however. Additional training is expected for the Body of Knowledge each project team member’s role requires, as well as organizational/project orientation and training to help team members understand how IBM Rational solutions are specifically implemented for their project.

Rational Professional Services

IBM Rational Professional Services are based on years of experience helping software development organizations, utilizing a worldwide staff of qualified consultant that help accelerate and ensure implementation of IBM Rational products and best practices. Besides consulting and mentoring, IBM Rational offers packaged service products as well as customized services.

When approaching a CMMI effort, bringing in experienced consultants can be the difference between success and failure. IBM Rational consultants help accelerate tool and process implementations through pre-packaged QuickStarts, provide the needed expertise to solidify the new practices and tools in the organization via consulting and mentoring, and assist in tailoring tools to meet specific organization’s needs.

Through the combination of Rational University, and IBM Rational services, organizations can make the transition of new process and tool implementations permanently take hold, making the most of the company’s IBM Rational investment.

SECTION 2: CONFIGURATION MANAGEMENT PROCESS

This CM paper is part of a continuing series of papers on how a company, organization, or project can leverage the processes and tools provided by IBM Rational® for achieving CMMI ML 2 in the CM process area. At a high level, it describes how the CMMI views configuration management, and discusses how IBM Rational solutions satisfy the Configuration Management Process Area’s specific and generic goals and practices. The scope of this paper is the Capability Maturity Model® Integration (CMMI®) Configuration Management process area maturity level 2 (CMMI ML 2) requirements as a solid foundation for reaching CM maturity level 3. In cases where IBM Rational solutions do not fully address a practice, recommendations are made on how the organization might satisfy the practices to attain CMMI ML 2 compliance.

At the end of this paper a matrix is provided listing each CMMI CM goal/practice, its description, the Rational Unified Process (RUP) role that might be responsible for satisfying the practice, what RUP process, procedure, template, or IBM Rational tool might help satisfy the practice, and any other observations and recommendations that might be relevant.

Throughout this description, the use of italics indicates material taken directly from the CMMI.⁸

Further information on IBM Rational support for CMMI can be found on the Web at

www.rational.com/solutions/industry/govt/cmmi.jsp.

⁸ “CMMI Integration, Version 1.1 – Staged Representation” found at www.sei.cmu.edu/cmmi

Assumptions

The CMMI appraisal model is a verification-based audit that essentially follows the “Say what you do, do what you say, prove it” concept. This means that organizations that wish to achieve a CMMI maturity level 2 rating must document various management and engineering practices, execute them as documented, and be able to prove it by the existence of quality records and/or project artifacts. During an appraisal, an SEI Authorized Lead Appraiser and qualified appraisal team members look for objective evidence that the organization has implemented and institutionalized the practices. Objective evidence consists of direct artifacts, indirect artifacts, and affirmations. Direct artifacts are tangible work products directly created as a result of implementing a practice (e.g. a project plan or CM plan). Indirect artifacts are a side effect of implementing the practice or otherwise indicate the practice was performed (e.g., meeting minutes, reviews, logs). Affirmations are oral or written statements confirming or supporting the practice was implemented.

This paper makes the following organizational assumptions to show how IBM Rational solutions are utilized:

1. Adoption and implementation of the Rational Unified Process (RUP)
2. Use of the RUP as documented
3. Creation of the artifacts as defined by the RUP
4. Project plans which detail how the project team will implement the configuration management process area and describes the role of the RUP in that implementation

This paper will identify the various RUP roles, disciplines, templates and activities that would apply in satisfying the various CMMI maturity level 2 key practices.

The process area (PA) matrix attached to this paper lists each CMMI CM practices by goal (both specific and generic), its description, the RUP role that might be responsible for satisfying the key practice, what RUP process and procedure/template might help satisfy the key practice, and any notes that might be relevant. In situations where RUP does not fully address a key practice, suggestions are made in the notes column of the matrices on how the project might address the key practice to attain compliance.

The version of the CMMI that is addressed here is CMMI SE/SW V1.1. Additional detailed information on the CMMI can be found at the SEI Website at www.sei.cmu.edu/cmmi. An excellent resource describing the CMMI is the book “*CMMI Distilled*“, by Dennis M. Ahern, Aaron Clouse, and Richard Turner, ISBN 0-201-73500-8.

The Rational Unified Process, or RUP, evaluated in this paper is version 2002.05.00.

HOW TO GET THERE

The combination of RUP, Rational ClearCase, Rational ClearQuest, and Unified Change Management (UCM), provide much of the solution needed to meet the CMMI ML 2 requirements in the Configuration Management (CM) process area.

For organizations that are adopting IBM Rational best practices and tools from the ground up, or those wanting to tailor already existing installations, the following steps provide a high-level framework for a successful implementation.

1. Understand the current status of configuration management
 - a. Perform a CMMI-based appraisal of the configuration management process area in the organization
 - b. Document strengths, as well as gaps and deficiencies identified during the appraisal
2. Plan the implementation
 - a. Based on the results of the CMMI-based appraisal, determine the work products needed for successful implementation
 - i. Organizational policy
 - ii. Organizational configuration management plan template
 - iii. High-level organizational configuration management process
 - iv. Required documented procedures

- v. Project-specific CM orientation and training materials
 - vi. Measurements needed to support status of configuration management activities, and continuous improvement
 - b. Determine the steps necessary for successful implementation (a tailored version of this list)
 - c. Determine the number of resources required
 - vii. Number of Rational ClearQuest, ClearCase, and RUP licenses
 - viii. Other hardware and software resources to support the configuration management infrastructure
 - ix. Personnel to support the configuration management planning and rollout
 - x. Personnel to support configuration management on an ongoing basis
 - xi. Tool and process training
 - xii. Project-specific implementation training
 - d. Determine stakeholders who should review and approve the CM rollout plan
 - e. Determine if out-of-the-box UCM will be implemented, or the customized Rational ClearQuest/ClearCase implementation that will be installed
 - f. Develop the configuration management implementation plan and obtain approval from stakeholders
- 3. Rollout the implementation
 - a. Tool implementation
 - i. Install and configure Rational ClearQuest, Rational ClearCase, RUP, and UCM
 - ii. Develop necessary reports to satisfy CMMI requirements
 - b. Develop and approve project-specific plans and procedures (for each project)
 - iii. Project-specific configuration management plan
 - iv. Project-specific configuration management procedures
 - c. Orientation & Training (for each project)
 - v. Publicizing the organizational policy for configuration management to all team members
 - vi. Deliver “body of knowledge” configuration management training to the appropriate project team members
 - vii. Deliver IBM Rational process and tool training to the appropriate project team members
 - viii. Deliver project-specific configuration management implementation training to all project team members
 - d. Project-specific configuration management implementation
 - ix. Bring configuration items into Rational ClearCase
 - x. Track and control changes/manage configuration items
 - xi. Create/manage baselines and releases
 - xii. Report status of configuration items/baselines
 - e. Manage and track the configuration management implementation plan
- 4. Oversee the implementation
 - a. Evaluate the configuration management rollout against the plan
 - b. Perform configuration audits
 - i. Physical
 - ii. Functional

- c. Evaluate project-specific implementation of configuration management against the project-specific configuration management plan, and organizational guidance
 - iii. By the project manager
 - iv. By the quality assurance organization
 - v. By senior management
- d. Improve the implementation based on measurements and metrics, project team feedback, and management oversight

THE CONFIGURATION MANAGEMENT PROCESS AREA

[Note: The use of *italics* indicates material taken directly from the CMMI.]

The purpose of Configuration Management is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

The CM process area involves the following:

- Identifying the configuration of selected work products that compose the baselines at given points in time
- Controlling changes to configuration items
- Building or providing specifications to build work products from the configuration management system
- Maintaining the integrity of baselines
- Providing accurate status and current configuration data to developers, end users, and customers

The work products placed under configuration management include the products that are delivered to the customer, designated internal work products, acquired products, tools, and other items that are used in creating and describing these work products. Examples of work products that may be placed under configuration management include: plans, process descriptions, requirements, design data, drawings, product specifications, code, compilers, product data files, product technical publications.

Configuration management of work products may be performed at several levels of granularity. Configuration items can be decomposed into configuration components and configuration units. Therefore, in these practices, “configuration item” may be interpreted as “configuration component” or “configuration unit” as appropriate.

Baselines provide a stable basis for continuing evolution of configuration items. An example of a baseline is an approved description of a product that includes internally consistent version of requirements, requirements traceability matrices, design, software/hardware configurations, and end-user documentation. Baselines are added to the configuration management system as they are developed. Changes to baselines and the release of work products built from the configuration management system are systematically controlled and monitored via the configuration control, change management, and configuration auditing functions of configuration management.

This process area applies not only to configuration management on projects, but also to configuration management on organization work products such as standards, procedures, and reuse libraries. This process area covers the practices for performing the configuration management function and is applicable to all work products that are placed under configuration management.

Refer to Figure 5 for a graphical representation of the Configuration Management process area.⁹

⁹ From “CMMI v1.1 Tutorial” by Mike Phillips

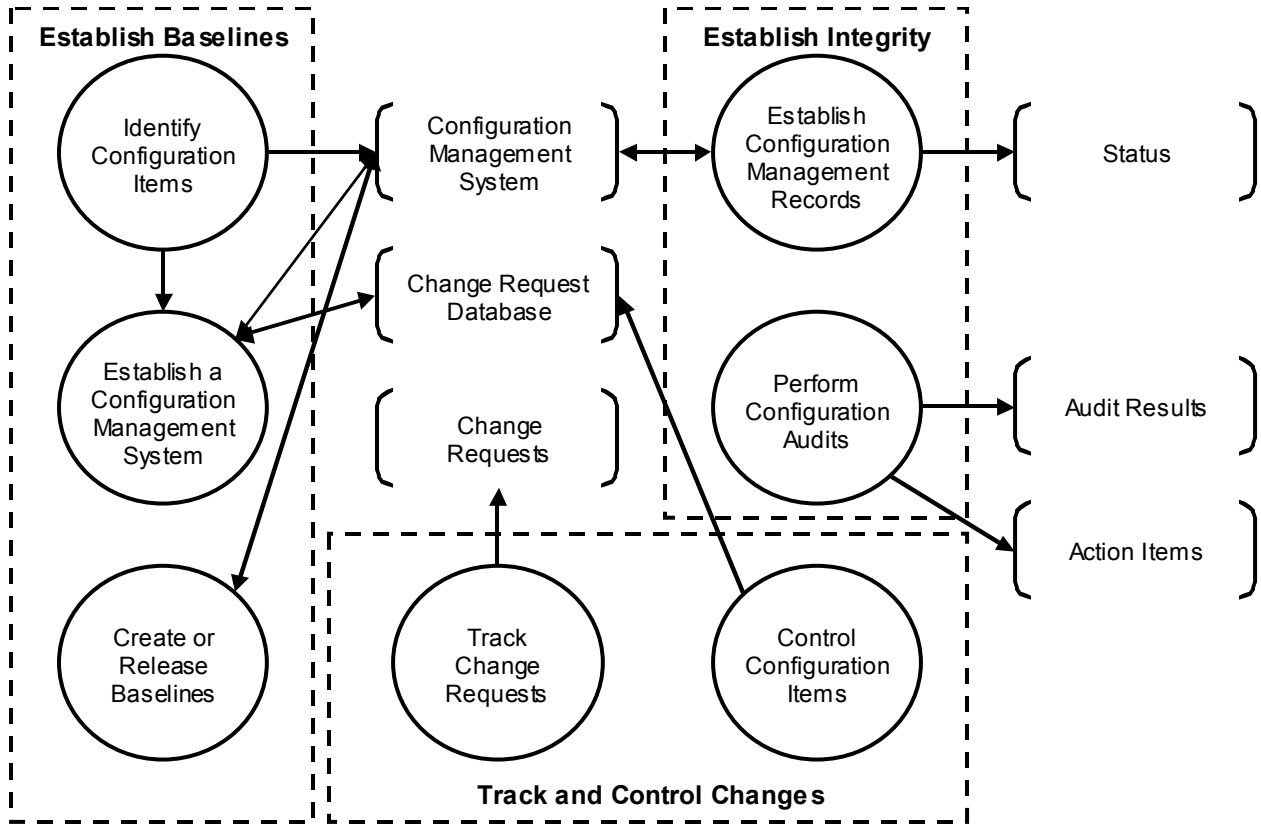


Figure 5: Graphical representation of the Configuration Management process area.

SATISFYING CONFIGURATION MANAGEMENT PROCESS AREA SPECIFIC GOALS AND PRACTICES

[Note: The use of *italics* indicates material taken directly from the CMMI.] The Configuration Management process area’s specific goals, and the practices that support those goals are:

Specific Goal 1 (SG 1) Baselines of identified work products are established

Specific practices to establish baselines are covered by this specific goal. The specific practices under the Track and Control

Changes specific goal serve to maintain the baselines. The specific practices of Establish Integrity specific goal document and audit the integrity of the baselines.

Specific Practice 1.1 (SP 1.1) Identify the configuration items, components, and related work products that will be placed under configuration management

Configuration identification is the selection, creation, and specification of the following:

- Products that are delivered to the customer
- Designated internal work products
- Acquired products
- Tools
- Other items that are used in creating and describing these work products

Items under configuration management will include specifications and interface documents that define the requirements for the product. Other documents, such as test results, may also be included, depending on their criticality to defining the product.

A “configuration item” is an entity designated for configuration management, which may consist of multiple related work products that form a baseline. This logical grouping provides ease of identification and controlled access. The selection of work products for configuration management should be based on criteria established during planning.

Configuration items can be decomposed into configuration components and configuration units. Only the term “configuration item” is used in this process area. In these practices, “configuration item” may be interpreted as “configuration component” or “configuration unit” as appropriate. For example, configuration items in the area of requirements management could vary from each individual requirement to a set of requirements.

Typical work products include:

- Identified configuration items

SP 1.1 Implementation Approach

By following the “Configuration Management->Plan Project Configuration Management and Change Control->Write CM Plan” activity, the project should address the identification of configuration items documented in RUP’s Software Configuration Management Plan (SCMP) template. In order to meet the intent of this goal, each project team must identify the items placed under configuration control. A filled out SCMP template for each project satisfies this requirement.

Specific Practice 1.2 (SP 1.2) Establish and maintain a configuration management and change management system for controlling work products

A configuration management system includes the storage media, the procedures, and the tools for accessing the configuration system.

A change management system includes the storage media, the procedures, and tools for recording and accessing change requests.

Typical work products include:

- Configuration management system with controlled work products
- Configuration management system access control procedures
- Change request database

SP1.2 Implementation Approach

Installing and configuring Rational ClearCase, ClearQuest, and UCM provides the foundation for establishing a configuration and change management system. The RUP activity, “Configuration and Change Management->Create Project CM Environments,” gives guidance on how to accomplish this. The RUP role of Tool Specialist is responsible for managing the system.

Any type of project work product can be managed through ClearCase, including requirements, documents, code, plans, etc.

The CMMI expects that a part of the CM system includes documented access control procedures. Since RUP/UCM does not provide detailed documented procedures, the project must create and maintain these as part of the SCMP, or a separate “project procedures” document. These project procedures should also document the roles and responsibilities for CM personnel on both the project and in the organization. This should include specific assignment of responsibility and accountability for managing the project’s configuration (i.e. control authority).

Specific Practice 1.3 (SP 1.3) Create or release baselines for internal use and for delivery to the customer

A baseline is a set of specifications or work products that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through change control procedures. A baseline represents the assignment of an identifier to a configuration item and its associated entities.

For software engineering, a set of requirements, design, source code files, and the associated executable code, build files, and user documentation (associated entities) that have been assigned a unique identifier can be considered to be a baseline. Release of a baseline constitutes retrieval of source code files (configuration items) from the configuration management system and generating executable files. A baseline that is delivered to a customer is typically called a “release” whereas a baseline for an internal use is typically called a “build”.

Typical work products include:

- Baselines
- Description of baselines

SP 1.3 Implementation Approach

The RUP activities “Configuration and Change Management->Manage Baselines and Releases->Create Baselines”, “Configuration and Change Management->Manage Baselines and Release->Promote Baselines”, and “Configuration and Change Management->Manage Baselines and Releases->Create Deployment Unit” address how a project creates and releases baselines.

Coupled with Rational ClearCase and ClearQuest, this specific practice can be almost completely addressed. The project will have to document build and release procedures, and ensure that the proper reports are created that adequately describe baselines.

Specific Goal 2 (SG 2) Changes to the work products under configuration management are tracked and controlled

The specific practices under this specific goal serve to maintain the baselines after they are established by the specific practices under the Establish Baselines specific goal.

Specific Practice 2.1 (SP 2.1) Track change requests for the configuration items

Change requests address not only new or changed requirements, but also failures and defects in the work products. Change requests are analyzed to determine the impact that the change will have on the work product, related work products, and schedule and cost.

Typical work products include:

- Change requests

SP 2.1 Implementation Approach

Under the RUP process “Configuration and Change Management->Manage Change Requests”, the activities “Submit Change Requests”, “Update Change Requests”, and “Review Change Requests” address how the specific practice can be satisfied.

Rational ClearQuest serves as the change request database.

The project will have to document the procedures used for entering and updating change requests.

Specific Practice 2.2 (SP 2.2) Control changes to configuration items

Control is maintained over the configuration of the work product baseline. This control includes tracking the configuration of each of the configuration items, approving a new configuration if necessary, and updating the baseline.

Typical work products include:

- Revision history of configuration items
- Archives of the baselines

SP 2.2 Implementation Approach

Rational ClearCase provides control over configuration items, as well as provide revision history of CIs and archives of baselines. The RUP activities “Schedule and Assign Work”, “Make Changes”, and “Deliver Changes” under the “Configuration Management->Change and Deliver Configuration Items” process shows how this should be accomplished.

The project must document the procedures used for checking in, checking out, obtaining revision history, and accessing archives of baselines.

Specific Goal 3 (SG 3) Integrity of baselines is established and maintained

The integrity of the baselines, established by processes associated with the Establish Baselines specific goal, and maintained by processes associated with the Track and Control Changes specific goal, is provided by the specific practices under this specific goal.

Specific Practice 3.1 (SP 3.1) Establish and maintain records describing configuration items

Typical work products include:

- Revision history of configuration items
- Change log
- Copy of change requests
- Status of configuration items
- Differences between baselines

SP 3.1 Implementation Approach

The use of ClearQuest and ClearCase provides the required records needed to satisfy this key practice. ClearCase provides a change history/log of configuration items, as well as the status of configuration items and the differences between baselines. ClearQuest provides access to change requests. The RUP process “Configuration and Change Management->Change and Deliver Configuration Items”, and activities “Make Changes” and “Deliver Changes” apply.

Procedures used to create these reports need to be documented.

Specific Practice 3.2 (SP 3.1) Perform configuration audits to maintain integrity of the configuration baselines

Audit configuration management activities and processes to confirm that the resulting baselines and documentation are accurate, and record the audit results as appropriate.

Typical work products include:

- Configuration audit results
- Action items

The RUP activity “Configuration and Change Management->Monitor and Report Configuration Status->Perform Configuration Audits” provides guidance on this CMMI requirement.

The project needs to document how these audits will be conducted.

SATISFYING CONFIGURATION MANAGEMENT PROCESS AREA GENERIC GOALS AND PRACTICES

[Note: The use of *italics* indicates material taken directly from the CMMI.] The Configuration Management process area's generic goals, and the practices that support those goals are:

Generic Goal 2 (GG 2) The process is institutionalized as a managed process

This generic goal must be satisfied to reach maturity level 2 in the configuration management process area. The intent of this goal is that a project puts in place, follows, and sustains a set of processes. Satisfying this generic goal shows that an organization has institutionalized the processes for the configuration management process area at maturity level 2. The generic practices that map to the generic goal includes practices for the project to

- Follow a policy,
- Plan its process and its work,
- Provide resources and assigns responsibility to perform the process and project work,
- Train its personnel on the process, tools, and additional required knowledge for each process area,
- Manage and control project work products and processes,
- Evaluate how well it adheres to the identified process, and
- Review project status with project management and senior management.

RUP and Rational tools provide the foundation for a managed process. Rational process flows, roles, responsibilities, templates, oversight, etc. must be reviewed and tailored by the organization and project in order to fulfill their unique needs.

Commitment to Perform Generic Practice 2.1 (GP 2.1 – CO 1) Establish and maintain an organizational policy for planning and performing the configuration management process

This policy establishes organizational expectations for establishing and maintaining baselines, tracking and controlling changes to the work products (under configuration management), and establishing and maintaining integrity of the baselines.

For each process area, the CMMI requires that a written organizational policy be in place and followed by the organization via the Commitment to Perform common feature. RUP does not specifically address the need for policies (or a single, overarching policy), although the Software Engineering Process Authority (SEPA) described in RUP would be the appropriate entity to help develop the policies. Typically these policies are authorized or signed by a senior level manager in the organization.

An organization must establish, publicize, and maintain a configuration management policy to comply with this generic practice.

Ability to Perform Generic Practice 2.2 (GP 2.2 – AB 1) Establish and maintain the plan for performing the configuration management process

This plan for performing the configuration management process can be included in (or referenced by) the project plan, which is described in the Project Planning process area.

By completing and maintaining RUP's software configuration management plan (SCMP) via the template provided, a project satisfies this Ability to Perform generic practice. Various documented procedures related to configuration management can be documented as appendices to the SCMP.

The RUP activity that satisfies this generic practice is Configuration and Change Management->Plan Project Configuration and Change Control.

Ability to Perform Generic Practice 2.3 (GP 2.3 – AB 2) Provide adequate resources for performing the configuration management process, developing the work products, and providing the services of the process

Examples of resources provided include the following tools:

- Configuration management tools
- Data management tools
- Archiving and reproduction tools
- Database programs

Organizations can map the required CMMI resources to RUP roles, keeping in mind the CMMI activities those roles are responsible for have to be performed, even if RUP does not address them. Of course, funding must be provided if the roles are to effectively perform their responsibilities. The RUP activity Project Management->Develop Software Development Plan->Define Project Organization & Staffing is the appropriate place to define and plan for the necessary roles.

The RUP activity Select and Acquire Tools is the appropriate place where the configuration management toolset and environment is planned for.

Ability to Perform Generic Practice 2.4 (GP 2.4 – AB 3) Assign responsibility and authority for performing the process, developing the work products, and providing the services of the configuration management process
Similar to the previous Ability to Perform generic practice, the RUP activity Project Management->Develop Software Development Plan->Define Project Organization & Staffing is the appropriate place to assign responsibility and authority for performing the configuration management process.

Ability to Perform Generic Practice 2.5 (GP 2.5 – AB 4) Train the people performing or supporting the configuration management process as needed

Examples of training topics include the following:

- Roles, responsibilities, and authority of the configuration management staff
- Configuration management standards, procedures, and methods
- Configuration library system

This CMMI Ability to Perform common feature requires various roles and groups in the organization to be trained or oriented in configuration management. Informal training/orientation can be provided by the RUP itself. It is Web-based and can be available to all project team members via a Web browser.

Rational University provides many classes and workshops where formal CM process and tool training can be acquired. A large number of books have been published that focus on RUP and the various best practices it advocates. Finally, a number of “body of knowledge” courses and books are available to provide specific guidance to configuration management professionals.

It is important to note that project personnel must be oriented and trained on the project-specific configuration management processes, procedures, and tools.

Directing Implementation Generic Practice 2.6 (GP 2.6 – DI 1) Place designated work products of the configuration management process under appropriate levels of configuration management

Examples of work products placed under configuration management include the following:

- Access lists
- Change requests status reports
- Change request database
- CCB meeting minutes
- Archived baselines

Like code modules, project plans and specifications must also be managed. By placing the configuration management process descriptions, plans, procedures, and policies under configuration management, this generic practice can be satisfied.

The RUP activities that satisfy this generic practice (assuming the previously identified items are managed) are: “Schedule and Assign Work,” “Make Changes,” and “Deliver Changes.”

Directing Implementation Generic Practice 2.7 (GP 2.7 – DI 2) Identify and involve the relevant stakeholders of the configuration management process as planned

Examples of activities for stakeholder involvement include the following:

- Establishing baselines
- Reviewing configuration management system reports and resolving issues
- Assessing the impact of changes for the configuration items
- Performing configuration audits
- Reviewing the results of configuration management audits

To satisfy this generic practice, it is important that the relevant project stakeholders review and approve the project’s configuration management plan. By following the “Write CM Plan” activity, and obtaining approval, the project will partially satisfy this practice. This practice is intended to be a proactive effort to identify those stakeholders that are directly affected by this process area and overtly planning for their involvement. Typically, the group of relevant stakeholders is much larger than the number of signatories on the CM Plan. Care should be taken to ensure all relevant stakeholders are considered and addressed in the plan.

Directing Implementation Generic Practice 2.8 (GP 2.8 – DI 3) Monitor and control the configuration management process against the plan for performing the process and take appropriate corrective action

Examples of measures used in monitoring and controlling include the following:

- Number of changes to configuration items
- Number of configuration audits conducted

Reviews required by this CMMI Verifying Implementation common feature generic practice can be satisfied by any number of the following RUP reviews:

1. Project Approval Review
2. Project Planning Review
3. Iteration Plan Review
4. PRA Project Review
5. Iteration Criteria Evaluation Review
6. Iteration Acceptance Review
7. Lifecycle Milestone Review
8. Project Acceptance Review

These project reviews can be accomplished through the Monitor Project Status activity of RUP. This activity requires that the various project team members submit status reports to the project manager.

RUP does not, however, specifically look for configuration management process status against the configuration management plan. To properly satisfy this generic practice, review minutes must show that the configuration management process is monitored and controlled.

Verifying Implementation Generic Practice 2.9 (GP 2.9 – VE 1) Objectively evaluate adherence of the configuration management process against its process description, standards, and procedures, and address noncompliance

Examples of activities reviewed include the following:

- Establishing baselines
- Tracking and controlling changes
- Establishing and maintaining integrity of baselines

Examples of work products reviewed include the following:

- Archives of the baselines
- Change request database

CMMI-required objective reviews can be easily satisfied by having RUP's "Project Reviewer" role represented at the project status meetings and senior management reviews required by other Verifying Implementation generic practices. It is important for the project to undergo both configuration management process and product reviews by the objective source.

In some cases, a separate review meeting should be held to specifically address the configuration management process area. Generally, these separate reviews are defined in the organization's Quality Assurance plan.

Verifying Implementation Generic Practice 2.10 (GP 2.10 – VE 2) Review the activities, status, and results of the configuration management process with higher level management and resolve issues

Higher-level management reviews can be accommodated by the RUP's PRA project review activity. This review requires that the project's senior management review the project's process activities and milestones. An outcome of this review is the Review Record. The Review Record must reflect that the project's configuration management process and products were reviewed during the activity to satisfy this Verifying Implementation generic practice.

CREDITS

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APPENDIX

CMMI Goal or Practice	Practice Description	RUP Role	RUP Process	RUP Procedure	Tool	Observation/ Recommendation
SG 1	Establish Baselines - Baselines of identified work products are established					
SP 1.1	Identify Configuration Items - Identify the configuration items, components, and related work products that will be placed under configuration management	Configuration Manager Change Control Manager	Configuration and Change Management, Plan Project Configuration and Change Control	Activity: Write CM Plan Template: SCMP		Obs: RUP allows for the identification of all types of configuration items and work products. The CM Plan template provides a place holder for what types of data to identify as a configuration item. Rec: Complete the RUP-supplied SCMP, identifying all CIs.
SP 1.2	Establish a Configuration Management System - Establish and maintain a configuration management and change management system for controlling work products	Configuration Manager Change Control Manager	Configuration and Change Management, Create Project CM Environments	Activity: Write CM Plan Template: SCMP Activity: Setup CM Environment Activity: Establish Change Control Process	ClearCase, ClearQuest	Obs: RUP allows for the establishment of a configuration management system that can be used by the project for requirements, documents, code, and other work products. Need to document configuration management access control procedures. This is typically done via Rational ClearCase and ClearQuest. Rec: Need to document procedures outlining all configuration and change management access, build, and report procedures.
SP1.3	Create or Release Baselines - Create or release baselines for internal use and for delivery to the customer	Integrator	Configuration and Change Management, Manage Baselines and Releases	Activity: Create Baselines Activity: Promote Baselines Activity: Create Deployment Unit Template: SCMP	ClearCase	Obs: RUP allows a project to create and control baselines of the different work products. Release of baselines will need to be done by the project team. Rec: Need to document create baseline, release product, create bill of materials and other procedures outlining the set of configuration items contained in a baseline.

CMMI Goal or Practice	Practice Description	RUP Role	RUP Process	RUP Procedure	Tool	Observation/ Recommendation
SG 2	Track and Control Changes - Changes to the work products under configuration management are tracked and controlled					
SP 2.1	Track Change Requests - Track change requests for the configuration items	Any Role CCB	Configuration and Change Management, Manage Change Requests	Activity: Submit Change Request Activity: Update Change Request Activity: Review Change Request	ClearQuest	Obs: RUP provides guidance on how to manage changes. Rational ClearQuest is for tracking change requests. Rec: Need to document change request control procedures.
SP 2.2	Control Configuration Items - Control changes to the configuration items	Project Manager CCB	Project Management, Monitor & Control Project Configuration and Change Management, Change and Deliver Configuration Items	Activity: Schedule & Assign Work Activity: Make Changes Activity: Deliver Changes	ClearCase ClearQuest	Obs: RUP provides guidance on how to manage CIs. Rational ClearCase is used for the control and management of configuration items. Rec: Need to document procedures describing how CIs are controlled.
SG 3	Establish Integrity - Integrity of baselines is established and maintained					
SP 3.1	Establish Configuration Management Records - Establish and maintain records describing configuration items	Any Role	Configuration and Change Management, Change and Deliver Configuration Items	Activity: Make Changes Activity: Deliver Changes	ClearCase ClearQuest	Obs: ClearCase and ClearQuest can provide reports needed outlining CIs. Rec: Need to create reports detailing the status of baselines and CIs. Need to document these procedures.

CMMI Goal or Practice	Practice Description	RUP Role	RUP Process	RUP Procedure	Tool	Observation/ Recommendation
SP 3.2	Perform Configuration Audits - Perform configuration audits to maintain the integrity of the configuration baselines	Configuration Manager	Configuration and Change Management, Monitor and Report Configuration Status	Activity: Perform Configuration Audits Template: SCMP		Obs: The process exists that, when followed by the project, provides for the performing of configuration audits. Rec: Need to document these audit procedures and show evidence they are occurring.
GG 1	Institutionalize a Managed Process - The process is institutionalized as a managed process					
GP 2.1 CO 1	Establish an Organizational Policy - Establish and maintain an organizational policy for planning and performing the configuration management process	Senior Management Software Engineering Process Authority (SEPA)				Obs: RUP does not provide for the creation of a policy as defined by the CMMI. Rec: The organization's senior management is responsible for creating software engineering policies. RUP Refers to the concept of the software engineering process authority (SEPA) that might drive/maintain policies. To satisfy this practice, these policies must be written, publicized, and followed.
GP 2.2 AB 1	Plan the Process - Establish and maintain the plan for performing the configuration management process	Project Manager	Configuration and Change Management, Plan Project Configuration and Change Control	Activity: Write CM Plan Template: SCMP		Obs: RUP provides for the creation of a project configuration management plan. Project personnel will be required to provide the critical thinking and actually enter the data into the supplied template. Rec: Complete the RUP-supplied SCMP.
GP 2.3 AB 2	Provide Resources - Provide adequate resources for performing the configuration management process, developing work products, and providing the services of the process	Project Manager Tool Specialist	Project Management, Develop Software Development Plan Environment, Prepare Environment for Project	Activity: Define Project Organization and Staffing Activity: Select and Acquire Tools		Obs: RUP has several processes that together provide for allocating resources against the tasks and deliverables of a work breakdown structure. Rec: Document the necessary resources in the project's SDP or SCMP.

CMMI Goal or Practice	Practice Description	RUP Role	RUP Process	RUP Procedure	Tool	Observation/ Recommendation
GP 2.4 AB 3	Assign Responsibility - Assign responsibility and authority for performing the services of the configuration management process	Project Manager	Project Management, Develop Software Development Plan	Activity: Define Project Organization and Staffing		Obs: RUP has several processes that together provide for allocating resources against the tasks and deliverables of a work breakdown structure. Rec: Document the roles and responsibilities in the project's SDP or SCMP.
GP 2.5 AB 4	Train People - Train the people performing or supporting the configuration management process as needed	Project Manager	Project Management, Manage Iteration	Activity: Acquire Staff		Obs: Rational University provided training that more than adequately covers tools (ClearCase, ClearQuest) and process (RUP, UCM). Rec: CM practitioners would be required to obtain CM body of knowledge training above and beyond the training available from IBM Rational. Also, team members require training on the project's specific CM environment/processes/procedures.
GP 2.6 DI 1	Manage Configurations - Place designated work products of the configuration management process under appropriate levels of configuration management	Project Manager Any Role	Project Management, Monitor & Control Project Configuration and Change Management, Change and Deliver Configuration Items	Activity: Schedule & Assign Work Activity: Make Changes Activity: Deliver Changes Template: SCMP	ClearCase ClearQuest	Obs: The process exists in RUP that, when followed by the project, provides for the placing of work products under control. Rec: Project personnel must define what appropriate work products to control, and show evidence they are being controlled.
GP 2.7 DI 2	Identify and Involve Relevant Stakeholders - Identify and involve the relevant stakeholders of the configuration management process as planned	Project Manager Configuration Manager Change Control Manager	Configuration and Change Management, Plan Project Configuration and Change Control	Activity: Write CM Plan Template: SCMP		Obs: RUP provides guidance for stakeholders to review and approve the configuration management plan. Rec: The project must identify those stakeholders, and have them review and approve the SCMP. They also need to show involvement throughout the project.

CMMI Goal or Practice	Practice Description	RUP Role	RUP Process	RUP Procedure	Tool	Observation/ Recommendation
GP 2.8 DI 3	Monitor and Control the Process - Monitor and control the configuration management process against the plan for performing the process and take appropriate corrective action	Project Manager	Project Management, Monitor and Control Project	Activity: Monitor Project Status		Obs: The Monitor Project Status activity allows for product monitoring, but lacks specific process monitoring guidance. Rec: Need to ensure that configuration management activities are monitored during the Monitor Project Status activity, and that the meeting's minutes reflect the review.
GP 2.9 VE 1	Objectively Evaluate Adherence - Objectively evaluate adherence of the configuration management process against its process description, standards, and procedures, and address noncompliance	Project Manager	Project Management, Monitor and Control Project	Activity: Monitor Project Status		Obs: RUP and the supplied SQAP template tend to concentrate on the product reviews/audits, with little on how the process is evaluated. Rec: Need to ensure that configuration management activities are monitored by the SQA group during the Monitor Project Status activity, and that the minutes reflect the review.
GP 2.10 VE 2	Review Status with Higher Level Management - Review the activities, status, and results of the configuration management process with higher level management and resolve issues	Project Review Authority (PRA)	Project Management, Monitor and Control Project	Activity: Project Review Authority (PRA) Project Review		Obs: The PRA Project Review activity allows for product monitoring, but lacks specific process monitoring guidance. Rec: Need to ensure that software configuration management activities are reviewed during the PRA Project Review, and that the minutes reflect the process review.
End Configuration Management						

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