

Process Improvement Based on the CMMI®

Why base your organization's process improvement initiative on the CMMI®? The CMMI® represents integration of multiple military, ISO, IEEE, and commercial standards and procedures that cover all aspects of building systems. It is closely linked to ISO 9001:2000. The emphasis of the CMMI® is to support the development processes and changing of cultures to show a measurable benefit for the organization's business objectives and vision. The CMMI® provides a framework from which to organize and prioritize engineering, people, and business activities. It supports the coordination of multidisciplined activities that are or may be required to successfully build a project and it returns the concept of "engineering systems think" to project development. Process improvement is about supporting an organization's business with measurable results, and the CMMI® is about providing the necessary guidance to support successful organizational process improvement.

The CMMI® was developed to provide a single model to be used by organizations pursuing enterprise-wide process improvement including all of its divisions and business units. It provides needed guidance for integrating systems, hardware, and software development activities. It supports the coordination of multidisciplined activities that are or may be required to successfully build a project.

A Simple View of the CMMI®

If one were to take a high-level view of the CMMI® and its process areas without the interference of the staged or continuous representation that will be discussed later, it would not be hard to classify the CMMI® as project management, quality management, and engineering all glued together by process management. And until your organization reaches the business need to gain statistical control over processes or subprocesses and use models to predict future process and performance behavior, that is all the CMMI® is. Granted there are more than 100 years of theory and practice about management, quality, and engineering integrated into the CMMI®, and granted that it also focuses on the organizational development side of the equation to have a successful process improvement initiative as well as a concentration on improving the technical processes, but the model is not more complicated than that.

What seems to daunt organizations is the detail that is provided for each of the process areas. We all have "work to do" and do not see improving our processes as support of doing "the real work." Yet it is the details in the CMMI®'s front-end

material, its description of institutionalization factors, its introductory notes, and its goals, practices, subpractices, and examples that make the CMMI® a one-of-a-kind process improvement model in the world today. There are many other standards and some other models that offer short and sweet sentences to give the reader a hint as to what is expected to reach high maturity and how these concepts might help the organization reach its business objectives, but none provide the guidance that the CMMI® provides today.

Some major industry process improvement standards today are merely subsets of high-level standards. What guarantee of process improvement and quality is expected from them? Or is the complaint of the size and complexity of the CMMI® simply a hope that intelligence and hard work on the part of the workforce will be sufficient to overcome all other business constraints?

Process and Business

Why use the CMMI® to support your organization's business objectives? Some reasons were provided in Chapter 2. Here are other thoughts for your consideration:

- Process defines how a business does business:
 - Software engineering processes;
 - Hardware engineering processes;
 - Systems engineering processes;
 - Manufacturing processes;
 - Financial processes;
 - Human resources processes;
 - Legal processes.
- Process helps to establish the business culture and then sets guidelines and expectations.
- Process can be viewed as a methodology that is applied from elicitation of requirements to design through delivery.
- Process helps the development and maintenance efforts to build in and retain the quality of the products and services and ensures profitability for the business.
- There are no shortcuts—there are no other alternative methods that a business can adopt that embraces a “cradle to grave” philosophy to ensure quality and profitability with *control* every step of the way.

The CMMI® through the Verification and Validation process areas states that organization's need to “build the product right” (i.e., meet the requirements) and “build the right product” (i.e., meet the customer's needs in the intended environment). We believe that senior management should adapt this model terminology for its business:

- We will build the business right—through process.

- We will build the right business—with guarantees of product and service quality and customer satisfaction.

Process is the fastest, lowest cost path to get there and know if you are there!

Are Process Descriptions Enough?

Organizations often emphasize the development of technical processes. And indeed, the CMMI® provides detailed practice descriptions to guide the development of those technical processes as well as others such as management processes and service processes. However, as previously stated, the main focus needs to be on the organization's vision and business objectives.

With that in mind, I would like to share the following scenario, which continuously repeats itself during my consulting work. I ask the following four questions:

1. Does your organization have process descriptions at the project and/or organizational level?
2. Does your organization provide training on the processes the project and support groups are supposed to follow?
3. Does your organization perform objective evaluations to ensure the processes that are defined and trained are being adhered too?
4. Does it work?

It is the last question that starts the debates, shouts and frustration. "What do you mean ... Does it work?" I was asked.

I replied, "I mean, does it work? Are you meeting your schedules? Are you keeping with the budget constraints? Are you generating products with the expected quality or higher? Does it work?"

The next response is the one that amazes me the most. "The CMMI® does not say the processes have to work!"

I hope you are now smiling or outright laughing, but this point is not often stressed during assessments and process improvement support activities. Process improvement based on the CMMI® is about achieving measurable business results. Otherwise, there is little point in investing any resources in the process improvement initiative.

Other Groupings of Process Areas to Support Process Improvement

Process improvement based on the CMMI® is linked primarily to two categorizations of the process areas in the staged representation and the continuous representation. Figure 3.1 shows the standard CMMI® staged representation and Figure 3.2 shows the standard CMMI® continuous representation.

Both representations provide ways of implementing process improvement to achieve business goals. Both representations provide essentially the same content

Level	Process Characteristics	Process Areas
5 Optimizing	Focus is on quantitative continuous process improvement	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	Process is measured and controlled	Quantitative Project Management Organizational Process Performance
3 Defined	Process is characterized for the organization and is proactive	Requirements Development Technical Solution Product Integration Verification Validation Decision Analysis & Resolution Risk Management Organizational Process Focus Organization Process Definition Organizational Training Integrated Project Management
2 Managed	Process is characterized for projects and is often reactive	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Product and Process Quality Assurance Configuration Management Measurement & Analysis
1 Initial	Process is unpredictable, poorly controlled, and reactive	

Figure 3.1 CMMI®-DEV v1.2 staged representation.

Module	Process Areas
Process Management Concepts	Organizational Process Focus Organizational Process Definition Organizational Training Organizational Process Performance Organizational Innovation and Deployment
Project Management Concepts	Project Planning Project Monitoring and Control Supplier Agreement Management Integrated Project Management Risk Management Quantitative Project Management
Engineering Concepts	Requirements Development Requirements Management Technical Solution Product Integration Product Verification Validation
Support Concepts	Configuration Management Process and Product Quality Assurance Measurement and Analysis Decision Analysis and Resolution Causal Analysis and Resolution

Figure 3.2 CMMI®-DEV v1.2 continuous representation.

and use the same model components but are organized in different ways. Chapter 24 elaborates on the staged and continuous representations.

An organization's process improvement initiative, however, is not restricted to using either the staged or continuous representation categorizations of the process areas. An organization can, in fact, categorize the process areas in other ways that support the achievement of their business objectives. For example, Figure 3.3 shows the process areas categorized in a project management-oriented categorization.

The organization may have a strong need to improve its project management activities. This might also be an organization that is not supportive of Quality Assurance and Configuration Management as Quality Management functions, but supports them as Project Management functions. Then organizing Requirements Development and Requirements Management as a requirements concepts category and Project Planning, Project Monitoring and Control, Supplier Agreement Management, Risk Management, Process and Product Quality Assurance, Configuration Management, and Measurement and Analysis as project management functions might be the right approach to implementing these process areas in this organization.

In a similar fashion, Figure 3.4 represents one view of a practical usage categorization. This categorization groups together only strongly connected project management functions, creates a category for quality management, and keeps all of the engineering process areas together, as they are in the continuous representation. If the organization truly supports quality management in this manner, this grouping of process areas could be the most beneficial to successfully implementing the CMMI® process areas in the organization.

Module	Process Areas
Requirements Concepts	Requirements Development Requirements Management
Project Management Concepts	Project Planning Project Monitoring and Control Supplier Agreement Management Risk Management Process and Product Quality Assurance Configuration Management Measurement and Analysis
Process Management Concepts	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management
Engineering Concepts	Technical Solution Product Integration Verification Validation Decision Analysis and Resolution
Integrated Teaming Concepts	OPD + IPPD (SG 2) IPM + IPPD (SG 3)
Quantitative Management Concepts	Quantitative Project Management Organizational Process Performance
Optimizing Concepts	Causal Analysis and Resolution Organizational Innovation and Deployment

Figure 3.3 Project management-oriented categorization.

Module	Process Areas
Project Management Concepts	Project Planning Project Monitoring and Control Risk Management Integrated Project Management
Quality Management Concepts	Configuration Management Process and Product Quality Assurance Measurement and Analysis Decision Analysis and Resolution
Engineering Concepts	Requirements Development Technical Solution Requirements Management Product Integration Product Verification Validation
Acquisition Concepts	Supplier Agreement Management
Process Management Concepts	Organizational Process Focus Organizational Process Definition Integrated Project Management Organizational Training
Integrated Teaming Concepts	OPD + IPPD (SG 2) IPM + IPPD (SG 3)
Quantitative Management Concepts	Quantitative Project Management Organizational Process Performance Causal Analysis and Resolution Organizational Innovation and Deployment

Figure 3.4 Practical usage categorization.

The CMMI® as the Complete Whole

Although the CMMI® was initially integrated from the CMM® for Software, the Systems Engineering CMM® (EIA-731), and the Integrated Product Development CMM® and has undergone several evolutions to become CMMI®-DEV v. 1.2, which includes systems, hardware, and software engineering practices and examples, there are still weak areas that can and will be improved in the CMMI® over time. And although most of us would like to have only one model to have to learn and be responsible for compliance with, the goal of achieving measurable business objectives must be brought to the surface one more time. There are a number of standards and books available that should be part of any process improvement champion's tool kit. The ones listed here are not being offered as the absolute best or as an exhaustive list, but they have served me well and I offer the list to you for your consideration as well.

- Systems engineering
 - EIA-731—Systems Engineering CMM®
 - EIA-632—Processes for Engineering a System
 - IEEE 1220—IEEE Standard for Application and Management of the Systems Engineering Process
 - ISO/IEC 15288—System Lifecycle Processes

- *Handbook of Systems Engineering*—Andrew Sage, John Wiley & Sons, 1999
- Software engineering
 - ISO/IEC 12207—Software Lifecycle Processes
- SPICE - ISO 15504—Software Process Improvement and Capability Determination—highly used in the automotive engineering industry
- Quality management
 - ISO 9001:2000—Quality Management System Design
 - AS9100—ISO 9000 for Aerospace
 - TL 9000—ISO 9000 for Telecommunications
 - ISO 16949—Automotive Engineering
 - *Handbook of Software Quality Assurance* (4th ed.)—G. Gordon Schulmeyer, Artech House, 2007
- ITIL—IT Infrastructure Library (focuses on service management and service delivery; major input to the CMMI-SVC v1.2 model that is under development)
- Six Sigma
 - *The Six Sigma Handbook*—Thomas Pyzdek
 - *CMMI® and Six Sigma*—Jeannine Sivy, Lynn Penn, and Robert Stoddard
- Lean manufacturing
- Project Management Institute (PMI) (PMI's PMBOK has gained popularity and OPM3 has extended the project management to the “organizational level” to be more in line with CMMI®)
- Basic statistics (see Chapter 19).

A book I would like to give special mention to is *CMMI® Survival Guide—Just Enough Process Improvement* by Suzanne Garcia, Richard Turner (Addison-Wesley). After reading the book, I was compelled to write a phrase of praise. I found it to be a great reference even for those of us who helped start the industry because it provides clear and useful answers to those tough questions we are asked all of the time.

Other CMMI® support references are available and you are encouraged to pick up a new or different one now and then so you can keep challenging your thinking on how the CMMI® can be better used to support an organization's process improvement initiative.

The CMMI® Is Not an Engineering Handbook

The CMMI® is not an engineering handbook. No matter how badly we would like the CMMI® to answer all of the management, engineering, and business questions we may have, it was not designed for that. Organizations must understand or get training, mentoring, and coaching in the engineering principles behind the CMMI® model. The CMMI®:

- Won't tell you how to conduct requirements analysis or what technique to use or what requirements traceability tool to use;
- Won't tell you how to establish a quality engineering group;
- Won't tell you what configuration management tool to use;
- Won't tell you what your business objectives are;
- Won't tell you to use PMI or Prince2 or any other project management standard or tool;
- Won't tell you how to build your product integration environment or whether you can use it for verification and validation as well;
- Won't set the risk management thresholds for you to trigger the implementation of the risk mitigation plans;
- And so forth.

Sticky Areas

A quick glance at the CMMI® process area purpose statement or introductory notes might give one a false sense of security that the basic concepts found in the CMMI® are known and understood and for the most part practiced throughout the organization. The author and his associates have extensive appraisal experience by virtue of conducting hundreds of appraisals worldwide. It is our experience that there are classic “sticky areas” that have caused many organizations problems and appraisal teams late nights, grief, and frustration. Examples of these “sticky areas” include:

- Project management
 - Size and complexity estimation (LOC, function points, gates on a gate array, number of interfaces, and so on);
 - Having “historical data” to support the estimation;
 - Making estimations based on hours is *not* size estimation;
 - Understanding the importance of the WBS for project management and for supplier management;
 - Commitment process (see Special Goal 3 on commitment and reconciliation of differences between the estimates and the available resources);
 - Stakeholders are not “just the project team members”; they include both internal and external groups such as quality assurance, configuration management, regulatory agencies, customers, end users, independent test, and so forth.
- Configuration management
 - Status accounting (supporting project managers, verification, and evaluation of system completeness)
 - Configuration auditing: baseline auditing, functional configuration audits, and physical configuration audits.
- Quality assurance

- Project quality plan describes how the “quality functions” are going to be handled on the project throughout the project life cycle and by whom. The project quality plan does not contain the details of quality audits, configuration management, testing, peer reviews, and so forth.
- The quality assurance plan is a separate plan from the project quality plan that describes the quality function support the quality assurance representatives or group are going to provide to the project.
- Quality assurance and quality control are different focuses on quality. Quality control is exemplified by peer reviews and testing on life-cycle products. Quality assurance focuses on process and product compliance.

See the Appendix A for a full set of sticky areas descriptions.

Entry Strategies into Process Improvement

One of the more important steps in starting a process improvement initiative is to determine the appropriate tasking and the scope of the process improvement program [1]. There is a great temptation for an organization to attempt to take on too much too fast, especially if it feels that it must catch up to its competition. Although it is natural to want to initiate a program quickly, it is important for an organization trying to get a process improvement initiative started to be as realistic as possible during these beginning stages. It might not be appropriate for one organization to conduct an appraisal straightaway; yet another organization might want to focus on only a few areas to get its process improvement initiative started, show positive results, and then expand.

Many factors must be taken into consideration when an organization is trying to establish its organizational process. The process improvement entry strategy an organization chooses depends on a number of factors. These factors have been critical for organizations that have started their process improvement programs in the past 20 years:

- History of previous process improvement programs or quality improvement programs;
- Financial resources to fund the process improvement initiative;
- Human resources able to be dedicated to process improvement;
- Software engineering capability of the developers;
- Technology support available;
- Contractual obligations;
- Scope;
- Customs and culture of the organization;
- Standards (industry, corporate, organizational, project, customer, environmental);
- Understanding and support from all levels of management and practitioners;
- Corporate political pressure;
- Vision;

- Business objectives;
- Measurement objectives.

Now more than 20 years ago when the Software Engineering Institute, under the direction of Watts Humphrey, was beginning to conduct software process assessments, the path to process improvement was clear:

- Watts Humphrey would conduct an assessment and process improvement briefing with the senior management team of an organization.
- The senior manager would commit to the assessment and to the action planning afterward.
- The organization was invited to the SEI to receive training in the assessment process.
- The assessment was conducted.
- The assessment results were delivered to the senior management team.
- Six weeks later an assessment report was delivered to the organization that contained the assessment results and a set of recommendations.
- The organization was expected to develop an action plan that the SEI would review.
- The organization was expected to implement the action plan and advance to the next level of process maturity.

The very strong assumption implicit in all of this was that the organization had the skills to develop an action plan and implement it. Years later, the process improvement industry is still seeing more and more organizations getting involved with process improvement initiatives now based on the CMMI® that may not be able to succeed on such a process improvement path. The factors that may affect a process improvement initiative must be determined and used to guide the organization into choosing the right entry strategy. One size does not fit all, and an assessment may not even be the right place to start! Note that the entry strategies presented here are not mutually exclusive.

Training in the CMMI®

While those of us heavily involved with CMMI®-based process improvement believe that the CMMI® is a de facto standard in the world, many individuals, departments, business units, and companies are not very familiar with the CMMI®. The senior management team may have been told that their business unit must be a CMMI® Level 2, but there is often a lot of ignorance about what the CMMI® is and what guidance it offers.

One process improvement entry strategy is to provide CMMI® training for all levels of management and practitioners to build a process improvement and CMMI® vocabulary. Once the intent and value of the CMMI® are understood at every level in the organization, its value as a process improvement support tool goes up. Practitioners will know what it can and cannot provide. Practitioners will understand and eventually realize how CMMI® can be used to guide an organization to

support the organization's business objectives and management's vision. As a result, the threat of the CMMI® to the management team can be eliminated or at least greatly reduced. The CMMI® training may be carried out in two stages:

- Detailed CMMI® training for EPG members, project managers, and quality management members as a way of introducing the CMMI® as a road map so that the CMMI® concepts can be supported by internal members of the organization. This training should emphasize how the process areas of the CMMI® are interrelated to each other.
- Training in the CMMI® concepts for all levels of management and practitioners as a way of introducing the terminology and helping them to understand what guidance the CMMI® can provide the organization. Such training can help the organization achieve its process improvement goals. It is important for each level of management and the practitioners to have a common CMMI® vocabulary.

Focused Training on the Management and Engineering Principles Behind the CMMI® Model

While the CMMI® serves as an excellent road map that an organization can follow in its quest to achieve product excellence, it is not, as we have previously stated, an engineering handbook. Training in the engineering principles that support the achievement of the management and technical practices of the CMMI® may be the next step for an organization that has had basic CMMI® training, but it also may be an appropriate process improvement entry strategy.

Training in process areas such as Project Management, Requirements Engineering, Quality Engineering, and Configuration Management will provide the management team and select practitioners with a more in-depth understanding of these critical activities. This more detailed understanding of the management and technical practices can lead to a desire to learn how to integrate and apply these practices. This in turn could lead to training in the CMMI® for all levels of management and practitioners to gain the understanding of the CMMI® road map that can help guide the organization in the action planning and implementation of these practices.

Engineering Workshop Training, Action Planning, and Process Mentoring

Training in the engineering principles behind the CMMI® management and technical practices sets the framework for investigation into what the organization is currently doing in those areas and for subsequent improvement. One conclusion is that an organization could conduct an engineering workshop in the management practices and follow this up with an appraisal and action plan. But experience has shown that an appraisal may still not be an appropriate follow-up activity. Detailed training in one or more of the management practices, such as quality assurance, provides a vocabulary, but does not institutionalize it in the project or the organization.

Obtaining the training is not the same as incorporating the practices into the organization, so an appraisal would only serve to show that the concepts were not being used and that they did not perform the management practices well. A more

interesting approach might be to combine the engineering workshop training together with a small amount of diagnosis, action planning and implementation, and process mentoring.

In this approach, an organization could first conduct a 3- to 5-day workshop in a particular area, for example quality assurance (QA). Following the workshop, QA group members might examine available documentation and conduct spot interviews to get a better understanding of what documented processes exist and to what level they are being implemented. This small amount of diagnosis is important as a catalyst to build an action plan for improvement in that specific area.

Another alternative that has been used with documented success is to develop a blend of training, diagnosis, and recommendations-action planning. The individual training modules are followed up with spot interviews and recommendations-action planning.

Quick Check

When an organization thinks it should get involved with process improvement, but is not sure just what that is, a Quick Check can provide an understanding of the principles of process improvement and develop a gestalt of what the management and practitioners think are their most pressing problems.

The first day of the Quick Check is dedicated to reviewing the concepts of process improvement through a process improvement seminar. Some of the topics covered include:

- Process improvement model;
- Process management concepts;
- Assessment principles and general flow;
- Guidance for Action Planning;
- Action planning;
- Managing process change;
- Process improvement infrastructure;
- CMMI® overview;
- Approaches of the process improvement leaders;
- Getting process improvement support from above and below;
- Putting process improvement into perspective.

The second day of the Quick Check consists of a series of interviews, set up by the organization, in which the process consultant moves from one group or person to another and brainstorms or serves as a sounding board. This allows the individuals or groups of managers and practitioners to test their understanding of process improvement and suggest their theories in privacy. At the end of the day of interviews, the process consultant usually has a reasonable view of the key process issues facing the organization and can suggest the next step, which normally involves training, action planning, and implementation focused on a few areas.

Workshop Assessment

In a workshop assessment, the senior management team, project leaders, process improvement champions, quality managers, quality engineers, and other interested groups and individuals in process improvement participate in a 2- to 3-day workshop that includes:

- An overview of process management concepts and principles;
- An overview of the CMMI®;
- An understanding of the principles of managing change;
- Completion of a process maturity questionnaire;
- A high level understanding of the organization's process maturity;
- A determination of which process areas to focus on for an initial process improvement effort.

The workshop assessment provides an organization with an overview of its processes as they relate to the CMMI®. During the workshop assessment, the participants receive a broad introduction to the concepts and techniques for improving the organization's processes and gain a high-level understanding of the CMMI®'s process areas. They also characterize their organization's and/or project's process capability and maturity by responding to a key practices questionnaire. The key practices questionnaire that I have used had five possible answers:

1. ☐ Always _____...
2. ☐ Usually _____...
3. ☐ Sometimes _____...
4. ☐ Rarely _____...
5. ☐ Never _____...

In addition to the squares to be checked next to the possible answers, the respondents were asked to offer comments especially when their answer was "Always" or "Usually" or even "Sometimes." These comments were to include the respondent's "confidence level." Frequently a respondent would check the "Always" box and then add "Except in the following situations...." The confidence level was an attempt to get the respondent to think about what he/she actually did and answer the questionnaire responsibly.

The first part of the workshop assessment is a process improvement seminar described in the Quick Check section of this chapter. Next, the key practices questionnaire is filled out by selected participants. At the conclusion of the seminar, the data from the filled out questionnaire is placed into a spreadsheet that produces a process area (PA) profile, which is then fed back to the selected participants. During the brainstorming, the confidence level with the resulting profile is discussed. The end result of this discussion is a determination by the participants as to which two or three PAs are the most problematic for the organization.

Although the workshop assessment is not very reliable (no documentation is reviewed and no interviews are conducted outside of the brainstorming with the selected participants), it can provide a focus for the organization. At this point, the

organization can decide to engage in a detailed assessment, get training in the areas they feel are the most critical, or simply focus on recommendations and action planning.

Focused Process Area Assessment

Some organizations realize that they are not able to support a process improvement initiative with six to nine target areas that require improvement. There may be concerns about whether the process improvement effort will provide a business benefit or there may be other company constraints that restrict the process improvement initiative. In this situation, an organization may choose to do a detailed assessment, but limit it to two or three focused PAs. Those areas of focus may be determined by a workshop assessment or they may be already known in the organization. The focused PA assessment uses the maturity questionnaires mentioned in the workshop assessment description. It includes interviews with senior management, middle management, project leaders, and practitioners; however, each interview focuses on just the PAs that were chosen for this assessment. It produces results that include:

- *Process capability*: those PA strengths the project or organization is demonstrating in comparison to the activities described in the specific PAs of the CMMI®;
- *Findings*: the weaknesses or process problems that are having a negative effect on the organization's or project's process capabilities with regard to that PA;
- *Consequences*: the perceived, derived, or real risks that are associated with having those weaknesses in that PA;
- *Recommendations*: a description of how the process problems might be solved to result in process and product quality improvement.

The third part of the focused PA assessment is the Guidance for Action Planning (GAP). The output of the GAP indicates to senior management what support must be provided to get action going in the particular PA. It also provides guidance for the EPG and working group(s) that will be tasked with fully developing the action plan for improvement in a particular process area.

The advantage of the focused PA assessment approach is that it allows the organization to get started on action planning and implementation right away. The price of a focused PA assessment is significantly less than that for a full assessment because of the reduced time necessary to complete the diagnosis. Also, the demand on the organization's resources is reduced. If the process improvement effort is successful focusing on the chosen two to three areas, then it is probable that the organization will expand into the next set of PAs.

SEI SCAMPISM Appraisals

Of course, an organization may feel that it is in a comfortable enough position to ask for an SEI SCAMPISM B or A appraisal. The scope of the SCAMPISM appraisal should be thoroughly discussed with the senior management team, the process improvement champions, and the lead appraiser.

Establishing and Maintaining an Action Plan

It is one thing to have an assessment conducted to get your process improvement initiative going, but it is quite another to develop a complete action plan that looks and acts just like a project plan for the process improvement initiative. An organizational action plan may be composed of many chapters that concentrate on one or more process areas or even a subset of a process area we might call a focus area.

Typical contents of a process action plan include:

- Improvements that will be covered;
- Procedures for planning and tracking progress for each process action;
- Strategies for implementing the process actions including the identification and selection of pilot projects;
- Training, mentoring, and coaching needed for the pilot project members;
- Responsibility and authority for implementing the process actions;
- Resources, schedules, and assignments for implementing the process actions;
- Evaluation criteria for successful implementation of the process actions;
- Methods for determining the effectiveness of the process actions;
- Risks associated with the process action plans;
- Progress reviews with senior management and the steering committee.

I should point out that even with multiple and difficult business constraints, senior management teams frequently promise their support for improvement in up to 18 process areas without having a sound idea of what that commitment will actually mean for all of the levels of management, the process improvement champions, the quality assurance group or in terms of tools, training, and funding that may be needed. The impact to critical projects is often ignored. A frequent statement made is “We know that we are under tremendous pressure right now but we have to make this process improvement initiative happen and reach CMMI® ML 3!” It is great to have that type of spirit from the senior management team, but it is often impractical if not impossible. A workforce that is already working 125% of the time is not always too interested in adding another 25% to 50% to their load for the sake of CMMI®-based process improvement. And when reality sets in and project management gets pressured for delivery dates, process improvement activities are often the ones that get ignored.

It has been my experience that it is better for the senior management team to promise to support improvement in one process area and support that one 150% than it is to promise improvement in most of the process areas of ML 2 and ML 3 and fail to accomplish any of them.

Process Improvement for Systems, Hardware, Software, and Business Based on the CMMI®

Why base your organization’s process improvement success on the CMMI®? This indeed may be the question on your mind if you are thinking about all of the models, standards, and methods that have been produced so far and are still in existence.

First and foremost, the emphasis of the CMMI® is to support the development processes and changing of cultures to show a measurable benefit for the organization's business objectives and vision. The CMMI® provides a framework from which to organize and prioritize engineering, people, and business activities. It supports the coordination of multidisciplinary activities that are or may be required to successfully build a project. As the CMMI® is used as the basis for improving an organization's software, hardware, and systems processes, it is being discovered that these processes can be translated into other organizational departments such as human resources, finance, marketing, computer services, and contract management.

The CMMI® provides the basis for an organization to develop and control its own project management and engineering processes so that it can, in turn, manage the results of its suppliers' processes. It ensures identification and control of an organization's core competencies and it enables an organization to competitively "posture" itself in today's fast changing world.

A frequently overlooked advantage of the CMMI® is that the CMMI® captures lessons learned from the use of the CMM® for Software and other models, methods, and standards during the past 15 years. These lessons learned can be found in many of the CMMI®-DEV v1.2's process areas including:

- Engineering process areas of Requirements Development, Technical Solution, Requirements Management, and Product Integration, Verification, and Validation;
- Decision Analysis and Resolution;
- Project Planning and Project Monitoring and Control;
- Integrated Project Management;
- Supplier Agreement Management;
- Measurement and Analysis;
- Risk Management;
- Integrated Product and Process Development;
- Organizational Process Focus;
- Organizational Process Definition;
- Organizational Process Performance;
- Quantitative Project Management;
- Organizational Innovation and Deployment.

The CMMI® supports:

- Systems engineering;
- Software engineering;
- Hardware engineering:
 - Electrical engineering;
 - Mechanical engineering;
 - Optical engineering;
 - Electro-optical;

- Electromagnetics;
- Electromechanical;
- Hydraulics.
- Manufacturing;
- “Glass factories”;
- Embedded systems;
- Information systems;
- Information technology,
- Banks and insurance companies;
- Medical systems;
- And so forth.

The SEI supports the CMMI® worldwide.

The CMMI® and Engineering Systems Thinking

Because the CMMI® has integrated the concepts of the Systems Engineering CMM® and the CMM® for Software, it returns the concept of “engineering systems think” to projects and organizations where it has been sorely lacking for more than a decade.

The laws of engineering systems thinking, presented in Chapter 1 can be encapsulated in a few key ideas here:

- In all of the project’s phases/stages, and along the system’s life, the systems engineer has to take into account:
 - The customer’s organizational vision, goals, and tasks;
 - The customer’s requirements and preferences;
 - The problem to be solved by the system and the customer’s needs.
- The whole has to be seen as well as the interaction between the system’s elements, that is, iterative or recursive thinking must replace the traditional linear thinking.
- The solution is not always an engineering one. We must remember to always take into account:
 - Business and economic costs;
 - Reuse or utilization of products and infrastructure already developed;
 - Organizational, managerial, political, and personal considerations.

Consider these benefits of a CMMI®-based process improvement initiative:

- Increased control of costs and ability to predict development cycle length and costs of multidisciplinary product and product components;
- The ability to remove defects early and efficiently from the life-cycle work products;

- Reduced rework leading to reduced development cycle time;
- Increased predictability and control of product quality;
- Enhanced ability to make cost–benefit trade-offs of development methodologies, technologies, and processes;
- Increased capability to select and manage qualified suppliers;
- Enhanced ability to make risk management decisions based on quantitative data;
- More time available for top innovators to spend on problems and challenges requiring creative energy;
- Knowledge retention and expansion;
- Satisfied customers.

It is the CMMI® and only the CMMI® that has successfully combined the tried and true ideas presented by the CMM® for Software and embraced engineering systems thinking at the same time.

Summary

The CMMI® represents integration of multiple military, ISO, IEEE, and commercial standards and procedures that cover all aspects of building systems. It is closely linked to ISO 9001:2000. The emphasis of the CMMI® is to support the development processes and changing of cultures to show a measurable benefit for the organization's business objectives and vision. The CMMI® provides a framework from which to organize and prioritize engineering, people, and business activities. It supports the coordination of multidisciplined activities that are or may be required to successfully build a project and it returns the concept of "engineering systems think" to project development.

Process defines how a business does business. It helps to establish the business culture and then sets guidelines and expectations. The CMMI® provides detailed practice descriptions to guide the development of technical processes as well as management processes and service processes. However, as previously stated, the main focus needs to be on the organization's vision and business objectives. The CMMI® is not about process descriptions, but about supporting measurable business objectives.

The CMMI® provides a framework from which to organize and prioritize engineering, people, and business activities. Regardless of what process improvement approach your organization starts with or evolves too, the CMMI® framework can yield the necessary guidance for your organization's success.

Reference

- [1] Kasse, T. C., and P. A. McQuaid, "Entry Strategies into the Process Improvement Initiative," *Software Process: Improvement and Practice*, Vol. 4, 1998, pp. 73–88.