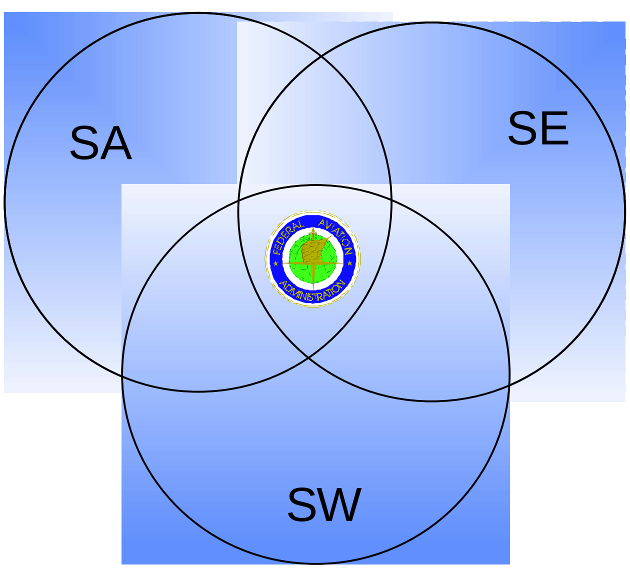
The Federal Aviation Administration Integrated Capability Maturity Model[sm], (FAA-iCMM®), Version 1.0

An Integrated Capability Maturity Model
for the
Acquisition of Software Intensive Systems



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November 1997

The FAA - iCMM

An Integrated Capability Maturity Model for the Acquisition of Software Intensive Systems

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Forewords

From the Acquisition Executive

Recently, my office published the Performance Plan that will drive the actions of ARA over the next several years. Among the 15 goals in that plan is one to increase to FAA-iCMM Level 2 (or equivalent) by December 1999, and to Level 3 by December 2001, the process maturity of 75% of selected major software-intensive programs. Those programs have already been selected, and most have improvement programs underway.

The level of commitment to process improvement cited in the Performance Plan is unprecedented within the FAA. I am extremely pleased that ARA is taking such strong actions to improve its acquisition processes. The challenges we face in modernizing the NAS are immense. We can only succeed by dedication, innovation, and a constant desire to improve how we do our jobs.

I encourage all FAA acquisition programs to pursue appropriate process improvement applying the FAA-iCMM. I look forward to seeing improved performance from our acquisition programs in cost, schedule, and technical performance, as they adopt increasingly more capable processes.

George L. Donohue

From the Chief Scientist for Software Engineering

The release of Version 1.0 of the FAA-iCMM marks a watershed for the FAA's internal process improvement efforts. This model will allow the FAA to improve, in an integrated fashion, many of the acquisition processes described in the Acquisition Management System.

Given the immense challenge the FAA is assuming in accelerating NAS modernization, having an integrated model for process improvement will be a real advantage. The alternative approach of using multiple CMMs in an uncoordinated fashion is simply too expensive, too confusing, and too difficult.

The FAA-iCMM is not only a watershed for the FAA's process improvement efforts, it is the most advanced integration of CMMs that I am aware of anywhere. The FAA is in the forefront of advancing how large organizations improve their acquisition processes. As this model is applied and as new guidance on integrating CMMs comes from the Software Engineering Institute, we will periodically release new versions. We will share our experiences with others in the community in the hope that our efforts will inform others who face similar challenges.

As Chief Scientist for Software Engineering, I am the primary sponsor of this effort. I am especially proud of the substantial team that put this model together. It gives me great pleasure to see their efforts reach fruition. I look forward to the widespread application of this model within the FAA.

Art Pyster

From the Software Engineering Institute

The FAA-iCMM® is the first major attempt to integrate several CMMs® into one document with the help of the SEI. The FAA-iCMM® is consistent with the Common CMM® Framework, Draft E, which is the most current available guidance from the SEI on CMM® integration. The release of the FAA-iCMM® marks a milestone in how Capability Maturity Models^sm are being used by the community. The FAA-iCMM® should be of significant help to the FAA in their ongoing efforts to improve the agency's acquisition processes, and the SEI endorses the use of the FAA-iCMM® within the FAA for such purposes. The SEI looks forward to continuing to work with the FAA to collaboratively evolve and implement the FAA-iCMM®.

The SEI conducted a review of the Federal Aviation Administration's integrated Capability Maturity Model^sm (FAA-iCMM®) and has determined that this model is consistent with the Common CMM Framework, Draft E.

Steve Cross
Director of the Software Engineering Institute

Acknowledgments

The FAA Integrated Capability Maturity Model^{sm} (FAA-iCMM®) is the collaborative work of many individuals[1] who strived enthusiastically to integrate CMMs. There were many roles to play and the authors are grateful to all those who contributed, to whatever extent they could, in creating this model.

First, the authors are deeply indebted to Art Pyster, our sponsor and advisor, whose vision was instrumental in launching this project and whose unyielding support and advocacy provided constant motivation.

We express our appreciation to the Software Engineering Executive Committee (SEEC) for providing valuable oversight as the FAA-iCMM project evolved and progressed, and to the ARA Management Team which has embodied its dedication to FAA process improvement in a performance goal linked to achieving improvements based on the FAA-iCMM (or equivalent).

The authors are very appreciative of the counsel and shared wisdom of our Software Engineering Institute (SEI) advisors. Roger Bate provided valuable insights and encouragement. Suzanne Garcia provided early drafts and interpretations of the Common CMM Framework for use by the FAA-iCMM project team.

The special SEI review team that was formed to review the FAA-iCMM provided an exhilarating forum for exchange of ideas on the application of the latest CMM integration concepts, and we are very grateful for the participation of that team in this effort.

The authors would like to thank our "buddies" for providing special domain knowledge and for participating in peer reviews. We are also indebted to our reviewers who provided valuable feedback on various drafts of the model.

We thank the FAA SEPGs and process action teams for their interest in this model and for their patience as it evolved from a draft to Version 1.0. We acknowledge in advance the valuable feedback we anticipate from them as we validate and improve the FAA-iCMM, based on its use in FAA process improvement.

Lastly, we wish to thank those individuals who provided editorial and administrative support in the preparation of various versions of this document. They are: Mia Jones and Martha Laird of the FAA, Pat Feeney, Tanae Gilmore, Marichelle Flores, and Ironda Campbell of TRW/SETA, and Sandy Shrum of the SEI.

Thank you all for your valued contributions.

[1]Please see section 1.3 for a list of project participants.

Part 1: Overview Information

Chapter 1: Introduction

Chapter 2: Overview of the FAA-iCMM

Chapter 3: Using the FAA-iCMM

Chapter 1 : Introduction

Purpose of this chapter

The purpose of this chapter is to introduce the reader to the document and to the FAA-iCMM Project.

In this chapter

The following table provides a guide to the information found in this chapter.

1.1 About this Document

Purpose of this document	This document is designed to acquaint the reader with the FAA-iCMM Project as a whole and to present the major work product - the FAA Capability Maturity Model (FAA-iCMM), an integrated capability maturity model for the acquisition of software intensive systems.
Basic organization	This document contains five chapters plus appendices, organized into 3 parts as follows: Part 1: Overview Information Chapter 1: Introduction Chapter 2: Overview of the FAA-iCMM Chapter 3: Using the FAA-iCMM Part 2: Model Description Chapter 4: The FAA-iCMM Generic Practices Chapter 5: The FAA-iCMM Process Areas and Base Practices Part 3: Appendices Change History Glossary References CMM Tracing Tables
Chapter 1: Introduction	Chapter 1 provides the document overview and a brief description of the model, the need it is designed to meet, and how the initial version was constructed.
Chapter 2: Overview	Chapter 2 introduces the model, presenting basic concepts that are key to understanding the details and architecture of the model. The architecture of the model is presented and the underlying constructs and conventions used in expressing the model are explained.
Chapter 3: Using the FAA-iCMM	Chapter 3 provides information that will be useful to individuals and groups interested in adopting the model and adapting it to different organizational situations and contexts.

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1.1 About this Document, Continued

Chapter 4:

FAA-iCMM Generic Practices

Chapter 4 contains the generic practices which are grouped by capability level. The generic practices are used in an assessment to determine the capability of any process.

Chapter 5:

FAA-iCMM Process Areas and Base Practices

Chapter 5 presents the base practices, which are characteristics considered essential to successful acquisition of software intensive systems. Base practices are grouped into process areas.

Appendices

The appendices include a document/model change history, a change request form, a glossary of the terms used in project documents, references, and CMM tracing tables.

Related products

In addition to this document, the FAA-iCMM Project will be developing the following work products listed in Table 1-1.

Name	Description
FAA-iCMM Appraisal Method Description	A description of the appraisal method developed for use with the FAA-iCMM
Training Materials	Materials to facilitate learning about the FAA-iCMM and its products
others tbd	

Table 1-1. FAA-iCMM Work Products

Conventions

Within this document the term "acquisition" refers to acquisition in the broad sense, covering all acquisition life-cycle activities from mission needs analysis to service-life extension.

1.2 Background

What is the FAA-iCMM?

The FAA Integrated Capability Maturity Model (FAA-iCMM) describes the essential elements of an organization's acquisition, engineering, and management process that must exist to ensure good acquisition of software intensive systems. The FAA-iCMM does not specify a particular process or sequence, but captures practices generally observed in industry and government. It provides a reference for comparing actual practices against these essential elements.

The model combines the features of three existing CMMs*:* the *Software Acquisition Capability Maturity Model* [SA-CMM], the *Capability Maturity Model for Software*, [SW-CMM], and *A Systems Engineering Capability Maturity Model* [SE-CMM]. This merged model provides guidance for implementing and improving systems/software acquisition, management, and engineering practices in an integrated way.

The FAA-iCMM provides a metric for acquisition, engineering and management practices across the following:

- the entire life cycle of the FAA's Acquisition Management System (AMS) , including mission analysis, investment analysis, solution implementation, in-service management, and service-life extension activities
- the whole organization, including management, organizational, supporting, and engineering activities
- concurrent interactions with other disciplines, such as hardware engineering, security engineering, and human factors
- interactions with other organizations, including external suppliers

This FAA-iCMM model description provides an overall description of the principles and architecture upon which the FAA-iCMM is based, an executive overview of the model, suggestions for appropriate use of the model, the practices included in the model, and a description of the attributes of the model. It also describes how it was constructed and its relationship to its source CMMs and other contributing work products.

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Why was it developed?

Several CMMs are relevant to FAA's business, and before the availability of the FAA-iCMM, the FAA had been dealing with more than one process improvement model at once. Three CMMs in particular were being used in different FAA directorates that work on different aspects of acquisition: the SW-CMM, the SE-CMM, and the SA-CMM. These CMMs have different terminologies, different architectures, different improvement goals, different appraisal methods, and cover different aspects of FAA's acquisition business without indicating linkages and interrelationships between their respective domains. Whereas localized improvements have been made using one model, the goal of corporate-wide process improvement remained elusive. Furthermore, as the FAA moved to using integrated product teams representing various disciplines, these teams needed processes that interrelated their disciplines. An integrated reference model would provide better guidance for developing the integrated processes required for a team.

The FAA-iCMM was developed to increase the efficiency and the effectiveness of FAA processes and process improvement efforts.

Increased efficiency should be realized by achieving the following:

- reducing the number of process areas to improve (from 52 in the three separate CMMs to 23 in the FAA-iCMM)
- replacing separate, largely redundant efforts to improve similar processes with a single effort to improve a merged process
- replacing separate appraisals against each CMM with one appraisal against one model

Increased effectiveness should be realized by using the following:

- one reference model that covers FAA processes across the acquisition life cycle to provide a corporate perspective for FAA-wide improvement tied to FAA business needs
- one reference model that has one architecture, consistent terminology, common process assets, and common improvement goals
- one reference model that enables coordination, synergizing, and focusing of process improvement efforts
- merged process areas that provide guidance for developing improved processes that integrate the management, engineering, and acquisition practices of an integrated product team

What is the scope of the FAA-iCMM?

The domain of the FAA-iCMM is the acquisition of software intensive systems. Acquisition in this context broadly refers to all acquisition life cycle activities, and a software intensive system refers to any system that is entirely software or whose principle functionality depends on the correct functioning of software.

The scope of the FAA-iCMM encompasses the following:

- The FAA-iCMM addresses acquisition activities that span the entire acquisition life cycle, including mission analysis, investment analysis, solution implementation, in-service management, and service-life extension activities.
- The FAA-iCMM applies to those people and organizations responsible for the acquisition, engineering, and management of software intensive systems.
- The FAA-iCMM applies to all types and sizes of acquisition organizations.

The FAA-iCMM encompasses best practices of the following disciplines: system/software acquisition, systems engineering, and software engineering. Other related disciplines such as security engineering, hardware engineering, and human factors are not covered in this version of the model.

How should it be used?

The FAA-iCMM and the method for applying the model (i.e., appraisal method) are intended to be used as a tool for organizations to evaluate their own acquisition, engineering, and management practices and define improvements to them. The techniques can be used in applying the model for self-improvement only if the users of the model and appraisal methods thoroughly understand the proper application of the model and its inherent limitations. The appraisal process is outlined in Chapter 3. Further description of the appraisal method is documented in the *FAA-iCMM Appraisal Method Description. (to be developed)*

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1.2 Background, Continued

Additional information

For further information concerning this model or pilot appraisals using this model contact the FAA-iCMM Project Leader, Dr. Linda Ibrahim, at:

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This document is available at the FAA's Corporate SEPG Web Site:
http://www.faa.gov/ait/sepg

1.3 About the FAA-iCMM Project

Project history

The FAA-iCMM initiative began in the fall of 1996 with an analysis of three CMMs being used by the directorate members of the FAA's Corporate SEPG. That work [Ibrahim 96a] merged the process areas and key process areas of the SW-CMM, the SE-CMM, and the SA-CMM and mapped the combined process areas to the FAA's recently developed Acquisition Management System (AMS). Part of that preliminary work also involved elaborating one sample process area into base practices that combined the practices of the contributing process areas [Ibrahim 96b]. These efforts demonstrated that it was possible to merge CMMs of different architectures, and that the resulting model contained a significant reduction in the number of process areas and practices while still covering the individual CMM domains.

The preliminary merged model, although not fully elaborated, appeared to have promise as a tool for supporting FAA corporate-wide process improvement, and in early 1997 it was agreed that the original work should be elaborated into a complete reference model. The FAA formed a team of FAA and external CMM and domain experts and began work on the FAA-iCMM in March 1997.

Meanwhile, the Software Engineering Institute (SEI) of Carnegie Mellon University commenced development of a Common CMM Framework [CCF] whose purpose is to provide guidance to multiple CMM users and to assist CMM developers and integrators. The FAA-iCMM project team has followed those construction guidelines as they have continued to evolve.

By June 1997 a complete draft of the FAA-iCMM was completed and submitted to the SEI for review. A joint FAA-SEI review/working session was held in late September to ensure consensus that the FAA's CMM integration work faithfully and robustly captured the features of its three source CMMs, and followed CMM principles, construction guidelines, and requirements as identified in the latest draft CCF documents.

FAA-iCMM Version 1.0 was released in November for pilot use in FAA process improvement.

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1.3 About the FAA-iCMM Project, Continued

FAA-iCMM Project composition

The Project Sponsor and Advisors counseled the team, helped obtain resources, provided oversight and guidance, and championed the effort by encouraging acceptance and adoption of the FAA-iCMM.

The Project Leader developed the project plan, ensured the plan was followed, ensured adequate resources were available and provided technical direction and support.

Authors created and reviewed products and provided expertise in areas designated. They are responsible for developing and evolving the FAA-iCMM into a model that can be employed and validated in the FAA. An FAA-iCMM author may have worked with a "buddy" who provided consultation and early review of work products.

Reviewers provided timely comments on FAA-iCMM Project work products.

The SEI Review Team not only reviewed the model, but actively participated in its refinement, especially regarding process area goals.

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FAA-iCMM Project Participants

FAA Participants	External Participants
Sponsor and Advisor	*Advisors*
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Future plans

Version 1.0 of the FAA-iCMM was developed with the intention of providing a model quickly so that it could be used by the FAA's process improvement teams and evolve based on that experience. Application of the model is expected to provide input for updating and validating the model based on its use.

Plans include developing and piloting the accompanying appraisal method(s), developing training materials on the model and its appraisal method(s), and measuring the effectiveness and efficiency of process improvement work based on these products. Version 1.1 of the FAA-iCMM will incorporate the results of pilot usage of Version 1.0.

As its source CMMs evolve, it is planned that the FAA-iCMM will evolve as well, based on incorporating new versions of those CMMs as they are piloted and updated. It is also possible that features of other CMMs, such as the Systems Security Engineering CMM, the Integrated Product Development CMM, and/or the People CMM may be included in the model at some future time.

The FAA plans to share this model with other multiple CMM users and/or organizations interested in improving processes used for the acquisition of software intensive systems.

Purpose of this chapter

The purpose of this chapter is to provide an overview of the concepts and constructs used in the FAA-iCMM. It provides a description of the architecture, and a section on key concepts and terms which are helpful in understanding the model. It serves as an introduction to the detailed discussion of the model in Chapters 4 and 5.

In this chapter

The following table provides a guide to the information found in this chapter.

2.1 Key Concepts of the FAA-iCMM

Introduction

Terms and concepts are introduced in this document that have particular meaning within the context of the FAA-iCMM. This section elaborates on concepts that are critical to effective understanding, interpretation, and use of the FAA-iCMM. Some concepts specific to the model, such as "generic practice" and "base practice," are defined and discussed in the sections of the model description that address them. Others are defined in the glossary (Appendix B). The concepts discussed in this section are:

- Statistical process control
- Process maturity
- Organization
- Project
- System
- Work product
- Customer
- Process
- Process area
- Role independence
- Process capability
- Institutionalization
- Process management
- Capability maturity model

Statistical Process Control

A process is a set of activities performed for a given purpose. It is the system of tasks, supporting tools, and people involved in the production and evolution of some end result (e.g., product, system). Realizing that process is one of the determinants of product cost, schedule, and quality (the others being people and technology), various communities have started to focus on ways to improve their processes for producing and acquiring products.

Process capability refers to an organization's potential. It is a range within which an organization is expected to perform. Process performance is the measure of actual results on a particular project, which may or may not fall within the range.

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Statistical Process Control, continued

If a process is in statistical process control, its capability is defined by a specific range and the limits of variation are predictable. Statistical control of a process needs to be established to identify where effective improvements can be made. Many organizations have used CMMs as a guide to assist them in achieving statistical process control.

A CMM is a framework for evolving an organization from an ad hoc, less organized, less effective state to a more highly structured and highly effective state. Use of such a model is a means for organizations to bring their practices under statistical process control to increase their process capability. As a result of applying the CMM for Software, many software organizations have shown improvements in cost, productivity, schedule, and quality. The FAA-iCMM was developed with the anticipation that applying the concepts of statistical process control to acquisition, management, and engineering processes would promote similar results for the acquisition of software intensive systems.

Process maturity

Process maturity indicates the extent to which a specific process is explicitly documented, managed, measured, controlled, and continually improved. Process maturity implies a potential for growth in capability and indicates both the richness of an organization's process and the consistency with which it is applied throughout the organization. A more mature process is more likely to result in improved cost, schedule, and quality performance.

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Organizations and projects

Two terms used within the FAA-iCMM to differentiate aspects of organizational structure are “organization” and “project”. Other constructs such as teams exist within business entities, but there is no commonly accepted terminology that spans all business contexts. These two terms were chosen because they are commonly used/understood by most of the anticipated audience of the FAA-iCMM and its source CMMs.

Organization

For the purposes of the FAA-iCMM, an organization is defined as a unit within a company, the whole company or other entity (e.g., government agency or branch of service) within which many projects are managed as a whole. All projects within an organization typically share common policies at the top of the reporting structure. An organization may consist of collocated or geographically distributed projects and supporting infrastructures.

The term "organization" is used to connote an infrastructure to support common strategic, business, and process-related functions. The infrastructure exists and must be maintained for the business to be effective in producing, delivering, supporting, and acquiring its products.

Project

The project is the aggregate of effort and other resources focused on developing and/or maintaining a specific product or providing a service. The product may include hardware, software, and other components. Typically, a project has its own funding, cost accounting, and delivery schedule. A project may constitute an organizational entity of its own or it may be structured as a team, task force, or other entity used by the organization to produce products or provide services.

The process areas in the domain side of the FAA-iCMM have been divided into four categories: life cycle or engineering, management or project, supporting, and organization processes. The management or project, and the organization categories are distinguished based on typical ownership. The FAA-iCMM differentiates by defining the project as focused on a specific product, whereas the organization encompasses one or more projects.

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System

In the FAA-iCMM, system refers to an:

> Integrated composite of people, products, services, and processes that provide a capability to satisfy a need or objective. [MIL-STD-499B]

A system may be a product that is hardware only, hardware/software, software only, or a service. The term “system” is used throughout the model to indicate the sum of the products being delivered to the customer(s) or user(s). Denoting a product as a system is an acknowledgment of the need to treat all the elements of the product and their interfaces in a disciplined and systematic way, so as to achieve the overall cost, schedule, and performance objectives of the business entity developing the product.

Work product

Work products are all of the documents, reports, files, computer programs, data, etc., generated in the course of performing any process. Rather than list individual work products for each process area, the FAA-iCMM lists "typical work products" of a particular base practice, to elaborate further the intended scope of a base practice. These lists are illustrative only and reflect a range of organizational and product contexts. They are not to be construed as "mandatory" work products.

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Customer

A customer is the individual(s) or entity for whom a product is developed or service is rendered, and/or the individual or entity who uses the product or service.

In the context of the FAA-iCMM, a customer may be either negotiated or non-negotiated. A negotiated customer is an individual or entity who contracts with another entity to produce a specific product or set of products according to a set of specifications provided by the customer. A non-negotiated, or market-driven, customer is one of many individuals or business entities who have a real or perceived need for a product. The customer may also be represented by a customer surrogate, such as marketing or product focus groups.

In most cases, the FAA-iCMM uses the term customer in the singular, as a grammatical convenience. However, the FAA-iCMM does not intend to preclude the case of multiple customers.

Note that in the context of the FAA-iCMM, the individual or entity using the product or service is also included in the notion of customer. This is relevant in the case of negotiated customers, since the entity to whom the product is delivered is not always the entity or individual who will actually use the product or service. The concept and usage of the term customer in the FAA-iCMM is intended to recognize the responsibility of the acquisition function to address the entire concept of customer, which includes the user.

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Process

A process is a set of activities performed to achieve a given purpose. Activities may be performed iteratively, recursively, and/or concurrently. Some activities may transform input work products into output work products needed for other activities. The allowable sequence for performing activities is constrained by the availability of input work products and resources, and by management control. A well-defined process includes activities, input and output artifacts of each activity, measurements, and mechanisms to control performance of the activities.

Several types of processes are mentioned in the FAA-iCMM, including "defined" and "performed" processes. A defined process is formally described for or by an organization for use by its practitioners. This description may be contained, for example, in a document or a process asset library. The defined process is what the organization's practitioners are supposed to do. The performed process is what the people actually do.

Process area

A process area (PA) is a defined set of related process characteristics, which, when performed collectively, can achieve a defined purpose.

A PA consists of base practices (BPs) that are mandatory characteristics that must exist within an implemented process before an organization can claim satisfaction of that PA.

Role independence

The process areas of the FAA-iCMM are groups of practices which, when taken together, achieve a common purpose. However, the groupings are not intended to imply that all base practices of a process are necessarily performed by a single individual or role. All base practices are written in verb-object format (i.e., without a specific subject) so as to minimize the perception that a particular base practice "belongs to" a particular role. This is one way in which the syntax of the model supports its use across a wide spectrum of organizational contexts.

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2.1 Key Concepts of the FAA-iCMM, Continued

Process capability

Process capability is defined as the quantifiable range of expected results that can be achieved by following a process. The FAA-iCMM Appraisal Method will be based upon statistical process control concepts which define the use of process capability. (The appraisal method is further described in Section 3). The Appraisal Method can be used to determine process capability levels for each process area within a project or organization. The capability side of the FAA-iCMM reflects these concepts and provides guidance in improving the process capability of the practices which are referenced in the domain side of the FAA-iCMM.

The capability of an organization's process helps to predict the ability of a project to meet goals. Projects in low capability organizations experience wide variations in achieving cost, schedule, functionality, and quality targets. These concepts are further discussed in Chapter 3.

Institutionalization

Institutionalization is the building of infrastructure and corporate culture that supports methods, practices, and procedures, so that they are the ongoing way of doing business even after those who originally defined them are gone. The process capability side of the FAA-iCMM supports institutionalization by providing practices and a path toward quantitative management and continuous improvement. In this way the FAA-iCMM asserts that organizations need to explicitly support process definition, management, and improvement. Institutionalization provides a path toward gaining acceptance and maximum benefit from a process that exhibits sound characteristics.

Process management

Process management is the set of activities, methods, tools, and infrastructures used to define, implement, monitor, predict, evaluate, and control the performance of a process. Process management implies that a process is defined (since one cannot predict or control something that is undefined). The focus on process management implies that a project or organization accounts for both product- and process-related factors in planning, performance, evaluation, monitoring, and corrective action.

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Capability maturity model

A capability maturity model (CMM) describes the key elements of an effective process for a given domain. It also describes stages through which processes progress as they are defined, implemented, and improved from an ad hoc, immature process to a disciplined, mature process with improved quality and effectiveness.

Associated with a CMM are one or more appraisal methods that help determine current process capability and/or define the most critical issues for improved quality and process effectiveness.

Thus, a CMM is used to appraise the existence and institutionalization of a process that implements referenced practices. A capability maturity model covers the processes used to perform the tasks of the specified domain (e.g., the acquisition of software intensive systems).

2.2 FAA-iCMM Architecture Description

Introduction

There are two representations that may be used in developing CMMs: staged and continuous. Two of the source CMMs for the FAA-iCMM integration are staged models (the SA-CMM and the SW-CMM) and one (the SE-CMM) is a continuous model.

The FAA-iCMM is written using the continuous architecture. The continuous architecture was adopted from the Systems Engineering CMM (SE-CMM) which was, in turn, closely based on the SPICE Project Baseline Practices Guide. [SPICE BPG]

Why adopt the continuous architecture?

The continuous architecture separates process areas related to the acquisition domain from generic characteristics related to increasing the process capability of any process. This architecture facilitates addition of new process areas into the model, guides the improvement of any selected process area to any desired level, affords detailed measurability at the process level, and leaves it to the organization to decide the priority and ordering of processes to improve based on business objectives. Thus, these features offer the FAA guidance for improving critical process areas to any desired level.

What about staging?

Staging, or groupings of PAs and GPs into maturity levels, is also provided with the FAA-iCMM so that a summarized maturity level can be determined, if needed, and so that guidance regarding priority and ordering of processes is available, if needed. Thus the FAA-iCMM retains these features of the staged architecture.

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2.2 FAA-iCMM Architecture Description, Continued

Architecture overview	The FAA-iCMM is structured in two parts. The part which describes WHAT must be done consists of process areas and their component base practices. The part which describes HOW WELL these are done consists of capability levels and their component generic practices. This architecture allows the FAA to develop a profile of the processes it carries out, the capabilities of those processes, and areas for improvement.
Capability Aspect	The capability aspect consists of generic practices that are related to overall process management and institutionalization capability. This aspect is used during an appraisal to determine how well an organization performs the practices in the domain aspect. The FAA-iCMM groups process capability into capability levels and generic practices. The capability levels indicate increasing levels of process maturity. The generic practices are staged and organized by capability levels. They are generic because they can apply to any process area. The capability aspect is discussed in detail later in this section.
Domain Aspect	The domain aspect consists of base practices (BPs) that are specific to the acquisition of software intensive systems. In an appraisal, this aspect is used to determine what practices an organization performs. The FAA-iCMM describes the acquisition domain by means of process areas which group together base practices related to achieving a common purpose. The domain aspect is discussed in detail later in this section.
Appraisal	An appraisal determines an organization's capability to perform each part of the domain. In practice, this means that each PA is evaluated against generic practices to determine a capability level. Appraisals are used to understand process capability in order to improve processes. Appraisals and process improvement are described in Chapter 3.

2.3 Capability Aspect of the FAA-iCMM

Introduction

The capability aspect of the FAA-iCMM measures how well an organization performs acquisition, management and engineering processes. Process capability is described by capability levels and generic practices.

A capability level is a set of practices that work together to provide a major enhancement in the capability to perform a process, and a generic practice is an implementation or institutionalization practice that enhances the capability to perform **any** process. Generic practices in a continuous model are roughly analogous to institutionalization common features in a staged model.

Generic practices are grouped by capability level. They are additive, i.e. none of the practices "go away" as you move up the capability levels. Generic practices help determine how well a project manages and improves each process area as a whole.

Why group generic practices by capability level?

The ordering of the generic practices is based on the observation that implementation and institutionalization of some practices benefit from the presence of others. Before an organization can define, tailor, and use a process effectively, individual projects should have some experience managing the performance of that process. Before institutionalizing a specific estimation process for an entire organization, for example, an organization should first attempt to use the estimation process on a project. However, some aspects of process implementation and institutionalization should be considered together (not one ordered before the other) since they work together toward enhancing capability.

Capability levels are important both in performing an assessment and in improving an organization's process capability. In the case of an assessment where an organization has some, but not all, generic practices implemented at a particular capability level for a particular process, the organization usually is operating at the lowest completed capability level for that process. An organization may not reap the full benefit of having implemented a generic practice if it is in place, but not all generic practices at lower capability levels are in place.

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Why group generic practices by capability level?

(cont.)

In the case of improvement, organizing the generic practices into capability levels provides an organization with an "improvement road map," should it desire to enhance its capability for a specific process.

An assessment should be performed to determine the capability level for each relevant process area. Different process areas can, and probably will, exist at different levels of capability. The organization will then be able to use this process-specific information as a means to focus improvements to its processes. The priority and sequence of the organization's activities to improve its processes should take into account its business goals.

Maturity level

Maturity levels are a way of defining characteristics of the evolution of organizations as they improve. In a continuous model, such as the FAA-iCMM, the concept of maturity levels is reflected in two ways: the “capability levels” apply the concept to a single process rather than an organization; and “maturity levels” can be defined to provide a roadmap for suggested implementation of the process areas in the model (e.g. “what to focus on next”). In the latter case, maturity level is a conceptual grouping of process areas that are defined as belonging to that maturity level.

Maturity levels are provided in the FAA-iCMM to provide guidance for sequencing process improvement activities, or for deriving a summarized “level” if either of these is needed. This concept also lends familiarity to users of staged models such as the SA-CMM and the SW-CMM in which all KPAs reside at a specific maturity level.

Maturity levels are discussed later in this chapter.

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FAA-iCMM Capability Levels

The FAA-iCMM has five levels of process capability which can be applied to any process area.[2]

Level 1:

Initial: Performed Informally

Base practices of the process area are generally performed.

At this level, all base practices are generally performed somewhere in the project's or organization's implemented process, but processes are characterized as ad hoc and even occasionally chaotic. Consistent planning and tracking of performance are missing. Good performance, therefore, depends on individual knowledge and effort. Work products are generally adequate, but quality and efficiency of production depend on how well individuals within the organization perceive that tasks should be performed. Based on experience, there is general assurance that an action will be performed adequately when required. However, the capability to perform an activity is not generally repeatable or transferable.

This level is known as the Performed Informally level in the SE-CMM, and the Initial level in the SW-CMM and the SA-CMM.

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[2] Note that the SE-CMM uses six capability levels (0 to 5), and the SA-CMM and the SW-CMM use five maturity levels (1 to 5). Levels 2 through 5 are conceptually the same in all three models. In the SE-CMM: level 0 is the “Not performed level” indicating general failure to perform the base practices of the PA; level 1 is the “Performed Informally” level described above. In the SA-CMM and the SW-CMM, level 1 is an initial level where processes are adhoc or chaotic; performance is not measured at that level in these models. Since the FAA-iCMM seeks fidelity with its source models, distinguishing “not performed” from “performed informally” is necessary for deriving assessment results that can be comparable to an SE-CMM assessment . This is the reason for including the level 1 description below. Since the FAA-iCMM also seeks compliance with the CCF, only five levels have been included in the model as required by the latest CCF Draft.

The FAA-iCMM Appraisal Group will investigate these issues when deriving the FAA-iCMM Appraisal Method.

Level 2:

Repeatable: Planned & Tracked

Basic management processes are established. The necessary process discipline is in place to repeat earlier successes with similar work processes. Performance of the base practices in the process area is planned and tracked.

At the Repeatable or Planned and Tracked level, planning and tracking are introduced. There is general recognition that the organization's performance is dependent on how efficiently the base practices are implemented within a project's or organization's process. Therefore, work products related to base practice implementation are periodically reviewed and placed under version control. Corrective action is taken when indicated by variances in work products.

The primary distinction between the Performed Informally and the Planned and Tracked levels is that at the latter level, the execution of base practices in the project's implemented process is planned and tracked. Therefore, it is repeatable within the implementing project, although the practices being repeated may be performed differently in different parts of the organization. Though repeatable within the project, the process is not necessarily transferable across the organization.

This level is known as the Planned and Tracked level in the SE-CMM, and the Repeatable level in the SW-CMM and the SA-CMM.

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Level 3:

Defined: Well Defined

Base practices are performed according to a well-defined process using approved, tailored versions of standard documented processes.

Processes are documented, standardized, and integrated into the activities of the organization. Once the environment is stable, common practices for performing the processes of the process domain are collected, defined in a consistent manner, and used as the basis for long-term improvement across the organization. This results in organizational learning that is sponsored, supported, and addresses strategic business needs.

At this level, base practices are performed throughout the organization via the use of approved, tailored versions of standard, documented processes. Data from using the process are gathered and used to determine if the process should be modified or improved. This information is used in planning and managing the day-to-day execution of multiple projects within the organization and is used for short- and long-term process improvement.

The main difference between the Planned and Tracked and Well Defined levels is the use of organization-wide, accepted standard processes, that implement the characteristics exhibited by the base practices. The capability to perform an activity is, therefore, directly transferable to new projects within the organization.

This level is known as the Well Defined level in the SE-CMM and the Defined level in the SW-CMM and the SW-CMM.

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Level 4:

Managed: Quantitatively Controlled

Processes and products are quantitatively measured, understood, and controlled; detailed measures of performance are collected and analyzed.

Establishing common processes within a domain enables more sophisticated methods of performing domain activities such as controlling its processes and results quantitatively, integrating its processes across process domains, or fine-tuning its processes to different product or service lines.

At the Quantitatively Controlled level, measurable process goals are established for each defined process and associated work products and detailed measures of performance are collected and analyzed. These data enable quantitative understanding of the process and an improved ability to predict performance. Performance, then, is objectively managed, the quality of work products is quantitatively known, and defects are selectively identified and corrected.

The primary distinction from the Well Defined level is that the defined process is quantitatively understood and controlled.

This level is known as the Quantitatively Controlled level in the SE-CMM, the Quantitative level in the SA-CMM, and the Managed level in the SW-CMM.

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Level 5:

Optimizing: Continuously Improving

Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. A focus on widespread, continuous improvement permeates the organization. The organization establishes quantitative performance goals for process effectiveness and efficiency based on its business goals.

Once critical business objectives are consistently evaluated and compared against process capability or other capabilities, continuous improvement can be institutionalized within the organization, resulting in a cycle of continual learning.

This is the highest achievement level from the viewpoint of process capability. The organization has established quantitative, as well as qualitative, goals for process effectiveness and efficiency, based on long-range business strategies and goals. Continuous process improvement toward achievement of these goals using timely, quantitative performance feedback has been established. Further enhancements are achieved by pilot testing of innovative ideas and planned insertion of new technology.

The primary distinction from the Quantitatively Controlled level is that the defined process and the standard process undergo continuous refinement and improvement, based on a quantitative understanding of the impact of changes to these processes.

This level is known as the Continuously Improving level in the SE-CMM, and the Optimizing level in the SA-CMM and the SW-CMM.

2.4 Capability Level Summaries

Level 1: ***Initial: Performed Informally***	The generic practice at this level is: 1.1 Perform the process
Level 2: ***Repeatable: Planned & Tracked***	The generic practices at this level are: 2.1 Establish policy 2.2 Allocate adequate resources 2.3 Assign responsibility 2.4 Ensure training 2.5 Document the process 2.6 Plan the process 2.7 Use a repeatable process 2.8 Manage configurations 2.9 Assess process compliance 2.10 Verify work products 2.11 Measure process 2.12 Review status 2.13 Take corrective action 2.14 Coordinate within the project
Level 3: ***Defined: Well Defined***	The generic practices at this level are: 3.1 Standardize the process 3.2 Use defined process 3.3 Perform reviews with peers 3.4 Coordinate with affected groups
Level 4: ***Managed: Quantitatively Controlled***	The generic practices at this level are: 4.1 Establish quality objectives for product and process 4.2 Select processes for measurement 4.3 Select measures for the process 4.4 Determine quantitative process capability 4.5 Use quantitative process capability
Level 5: ***Optimizing: Continuously Improving***	The generic practices at this level are: 5.1 Perform continual process improvement on the organizational standard and tailored processes 5.2 Implement improved processes

2.5 Domain Aspect of the FAA-iCMM

Domain Aspect of the FAA-iCMM

The domain aspect of the FAA-iCMM describes what an organization does, as distinct from how disciplined it is in doing it. The FAA-iCMM characterizes its domain aspect using categories, process areas, and base practices.

A process area (PA) is a group of related base practices which are essential for achieving the purpose of the PA. This construct in continuous models is roughly analogous to a key process area (KPA) in the staged models.

A base practice summarizes a fundamental essential characteristic of performing a process that meets the purpose of the PA. This construct in continuous models is roughly analogous to an activity performed in staged models. Process areas addressing the same general area of activity are grouped into categories.

The domain of the FAA-iCMM is "acquisition of software intensive systems". The process areas represent systems engineering, system/software acquisition, and software engineering processes merged from the SE-CMM, SA-CMM, and SW-CMM. These process areas span the FAA business environment as represented by FAA's Acquisition Management System (AMS) and its Acquisition Lifecycle. A preliminary mapping of the FAA-iCMM process areas to the AMS Lifecycle is provided in Chapter 3.

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Process areas of the domain aspect

There are 4 process categories and 23 process areas in the FAA-iCMM:

- Life Cycle or Engineering Processes - This category contains 10 process areas
- Management or Project Processes - This category contains 4 process areas
- Supporting Processes (not life-cycle phase dependent) - This category contains 5 process areas
- Organizational Processes - This category contains 4 process areas

Lifecycle or Engineering Processes

This category groups together those processes that are primarily concerned with the technical and engineering aspects of acquisition. They are

- PA 01 Needs
- PA 02 Requirements
- PA 03 Architecture
- PA 04 Alternatives
- PA 05 Outsourcing
- PA 06 Software Development and Maintenance
- PA 07 Integration
- PA 08 System Test and Evaluation
- PA 09 Transition
- PA 10 Product Evolution

Management or Project Processes

This category groups together process areas that are primarily concerned with providing the management infrastructure needed for successful acquisition. These process areas relate to a project, e.g. an effort focused on acquiring a specific product or providing a service. They are

- PA 11 Project Management
- PA 12 Contract Management
- PA 13 Risk Management
- PA 14 Coordination

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Supporting Processes

This category groups together processes that are primarily supportive, and are not life cycle dependent. They are

- PA 15 Quality Assurance and Management
- PA 16 Configuration Management
- PA 17 Peer Review
- PA 18 Measurement
- PA 19 Prevention

Organizational Processes

This category groups together those processes that are primarily concerned with providing a business infrastructure that supports the needs of acquisition but that are usually found concentrated at an organization, rather than a project level. They are

- PA 20 Organization Process Definition
- PA 21 Organization Process Improvement
- PA 22 Training
- PA 23 Innovation

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2.5 Domain Aspect of the FAA-iCMM, Continued

FAA-iCMM Process Area Mapping

The FAA-iCMM integrates the SE-CMM, the SA-CMM, and the SW-CMM as shown in Table 2.1 Each row indicates the major sources that were used to derive the FAA-iCMM process area.

Table 2.1 FAA-iCMM Process Areas mapped across the 3 CMMs

FAA-iCMM Process Area	***Systems Engineering SE-CMM Process Area***	***Software Acquisition SA-CMM Key Process Area***	***Software Engineering SW-CMM Key Process Area***
Lifecycle or Engineering Processes			
PA01 Needs	Understand Customer Needs & Expectations	-	-
PA02 Requirements	Derive & Allocate Requirements	Requirements Development & Management	Requirements Management *(*SW Product Engineering)*
PA03 Architecture	Evolve System Architecture	-	*(*SW Product Engineering)*
PA04 Alternatives	Analyze Candidate Solutions	-	-
PA05 Outsourcing	Coordinate with Suppliers	Solicitation	SW Subcontract Management
PA06 Software Development and Maintenance	-	-	SW Product Engineering
PA07 Integration	Integrate System	-	
PA08 System Test and Evaluation	Verify &Validate System	Evaluation	
PA09 Transition	-	Transition to Support	-
PA10 Product Evolution	Manage Product Line Evolution	-	-
Management or Project Processes			
PA11 Project Management	Plan Technical Effort Monitor & Control Technical Effort	SW Acquisition Planning Project Management Project Performance Management	SW Project Planning SW Project Tracking and Oversight Integrated SW Management
PA12 Contract Management	*(* Coordinate with Suppliers)*	Contract Tracking and Oversight Contract Performance Management	SW Subcontract Management
PA13 Risk Management	Manage Risk	Acquisition Risk Management	*(*Integrated SW Management)*
PA14 Coordination	Integrate Disciplines		Intergroup Coordination

(some of the practices in this process area relate to practices in another process in a different model)*

Table 2.1 FAA-iCMM Process Areas mapped across the 3 CMMs - Continued

FAA-iCMM Process Area	***Systems Engineering SE-CMM Process Area***	***Software Acquisition SA-CMM Key Process Area***	***Software Engineering SW-CMM Key Process Area***
Supporting Processes (not lifecycle phase dependent)			
PA15 Quality Assurance & Management	Ensure Quality		SW Quality Assurance
PA16 Configuration Management	Manage Configurations		SW Configuration Management
PA17 Peer Review	Level 3 Common Features		Peer Reviews
PA18 Measurement	Level 4 Common Features	Quantitative Process Management Quantitative Acquisition Management	Quantitative Process Management SW Quality Management
PA19 Prevention	Level 5 Common Features	-	Defect Prevention
Organizational Processes			
PA20 Organization Process Definition	Define Organization's Systems Engineering Process	Process Definition and Maintenance	Organization Process Focus Organization Process Definition
PA21 Organization Process Improvement	Improve Organization's Systems Engineering Process	Continuous Process Improvement	Process Change Management
PA22 Training	Provide Ongoing Skills & Knowledge	Training Program	Training Program
PA23 Innovation	Manage Systems Engineering Support Environment	Acquisition Innovation Management	Technology Change Management

(some of the practices in this process area relate to practices in another process in a different model)*

Process area selection

The 23 process areas of the FAA-iCMM were developed by analyzing the 52 process areas and key process areas of the 3 source CMMs and aligning them based on their commonality of purpose. All process areas in the source CMMs are represented in some process area of the FAA-iCMM (see Table 2.1)

The following criteria were used to merge and derive the FAA-iCMM process areas:

- Process areas should assemble related activities in one area for ease of use
- Process areas should not be tied to a particular life-cycle phase. Process areas should be implementable in multiple organization and product contexts
- Process areas are generally improvable as a distinct process
- Process areas are generally improvable by a group with similar interests in the process
- Process areas include all base practices that are required to meet the goals of the process area

In some cases, these criteria resulted in the merging of process areas which had been distinct in some source models. This was acceptable because retaining the process area breakdowns of the source CMMs was not used as a criterion for process area selection.

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Base practice selection

The base practices of the FAA-iCMM were developed by analyzing and aligning the practices from the source process areas and key process areas which had been mapped together as being of common purpose. Common features of the SE-CMM were also considered in this derivation if relevant (see Table 2.1).

From this preliminary merger of practices, redundancies were eliminated, and the practices were further refined as required for purposes of the FAA-iCMM domain. In some cases, one or more practices from a process area other than the major source process areas were included if they contributed to meeting the goals of the FAA-iCMM process area. A few practices deemed essential for the FAA-iCMM domain were added. Practices in the staged models which were covered by generic practices were not included as base practices. Practices drawn from KPAs at level 3 or higher in staged models were expressed at a base level to which all generic practices could be applied.

All base practices and key practices in the source CMMs are represented in some process area of the FAA-iCMM, or they are accounted for by the generic practices of the FAA-iCMM. (see CMM tracing tables in Appendix D).

Some activities may occur in different life-cycle phases, at different levels of abstraction, or may be typically performed by individuals in different roles. The FAA-iCMM ignores these distinctions and identifies practices that are essential elements of good acquisition of software intensive systems.

The following criteria were additionally used for base practices:

- Overlap between the base practices should be minimized.
- Base practices should be applicable using multiple methods in multiple business contexts. They should not specify a particular method or tool.
- Results of a base practice should be objectively observable using reasonable means for investigation (e.g. interviews, document review).

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Relationship between generic and base practices	The FAA-iCMM may appear to contain a certain amount of redundancy between the generic practices and base practices. Where this occurs the base practice provides more detail on the topic. This rarely occurs in the engineering or life-cycle processes, but may be noticed when looking at the other categories of process areas.
Example	The FAA-iCMM contains base practices in the Project Management process area (PA10) and the Coordination process area (PA14) plus some generic practices at levels 2 and 3 that address coordination. The focus of the PAs is the *process* being used for coordinating acquisition activities. The generic practices, however, address whether a project's or organization's process for coordinating actually results in action (e.g. coordination with various entities, within the acquisition activities, with other engineering disciplines, and with external organizations). In general, the base practices should be viewed as guidance on the basic aspects of the topic, and the related generic practices deal with application of the base practices to the project. The application of generic practices to each PA results in a unique interpretation of the generic practice for the subject PA. When appropriate, and deemed particularly useful for FAA-iCMM users, the PA descriptions include guidance for interpretation of selected GPs.

2.6 Process Area Summaries

Life Cycle or Engineering Processes		
FAA-iCMM Process Area	***Purpose***	***Base Practices***
PA01 Needs	to elicit, stimulate, analyze, and communicate customer needs and expectations to obtain a better understanding of what will satisfy those needs.	BP 01.01 Elicit Needs BP 01.02 Analyze Needs BP 01.03 Develop System Requirements BP 01.04 Obtain Customer Agreement BP 01.05 Inform Customer
PA02 Requirements	to develop requirements to meet the customer's operational needs, to analyze the system and other requirements, to derive a more detailed and precise set of requirements, and to manage those requirements throughout the acquisition life cycle.	BP 02.01 Develop detailed operational concept BP 02.02 Identify key requirements BP 02.03 Derive and partition requirements BP 02.04 Identify interface requirements BP 02.05 Allocate requirements BP 02.06 Analyze requirements BP 02.07 Capture and baseline requirements BP 02.08 Analyze and incorporate requirements changes BP 02.09 Maintain consistency and traceability
PA03 Architecture	to provide a basis for establishing and evolving a system design.	BP 03.01 Derive system architecture requirements BP 03.02 Identify key design issues BP 03.03 Develop architectural structure BP 03.04 Develop architectural interface requirements BP 03.05 Allocate architecture requirements BP 03.06 Capture system architecture:
PA04 Alternatives	to perform studies and analyses that will result in the selection of a solution to meet the identified problem or issue and its defined constraints.	BP 04.01 Establish Evaluation Criteria BP 04.02 Define Analysis Approach BP 04.03 Identify Alternatives BP 04.04 Analyze Alternatives BP 04.05 Select Solution. BP 04.06 Capture the Disposition of Each Alternative
PA05 Outsourcing	to address the needs of organizations to identify the portions of product that are to be outsourced, identify potential sources, and selct the supplier for the needed capability	BP 05.01 Identify Needed System or Process Components BP 05.02 Identify Competent Suppliers BP 05.03 Prepare for the solicitation BP 05.04 Choose Supplier BP 05.05 Communicate with Suppliers

PA06 Software Development and Maintenance	to produce and maintain correct, consistent software products effectively and efficiently	BP 06.01 Integrate methods and tools BP 06.02 Analyze allocated requirements BP 06.03 Design software BP 06.04 Implement software BP 06.05 Test software BP 06.06 Perform integration testing BP 06.07 Develop documentation BP 06.08 Maintain consistency across software work products
PA07 Integration	to ensure that system elements will function as a whole.	BP 07.01 Define Interfaces BP 07.02 Verify Receipt of System Elements BP 07.03 Verify System Element Correctness BP 07.04 Verify System Element Interfaces BP 07.05 Assemble Aggregates of System Elements BP 07.06 Test System Level Integration BP 07.07 Develop Integration Strategy
PA08 System Test and Evaluation	to determine that the system products and services satisfy specified requirements.	BP 08.01 Develop Evaluation Strategy Requirements BP 08.02 Define Procedures BP 08.03 Incorporate Evaluation Requirements into the Solicitation and Contract BP 08.04 Assess Developer Performance BP 08.05 Perform Planned Evaluations BP 08.06 Analyze Evaluation Results
PA09 Transition	to provide for the transition of the system being acquired to the eventual support organization.	BP 09.01 Conduct inventory BP 09.02 Develop and follow transition to support strategy BP 09.03 Demonstrate support capability BP 09.04 Oversee the configuration management of the system BP 09.05 Oversee the requirements management of the system BP 09.06 Transfer and tailor developer's processes to the support organization
PA10 Product Evolution	to introduce services, equipment, and new technology to achieve the optimal benefits in product evolution, cost, schedule, and performance over time as the product line evolves throughout its lifecycle toward its ultimate objectives.	BP 10.01 Define Product Evolution BP 10.02 Identify new product technologies BP 10.03 Adapt development processes BP 10.04 Ensure critical component availability BP 10.05 Insert Product Technology

2.6 Process Area Summaries, continued

Management or Project Processes		
FAA-iCMM Process Area	***Purpose***	***Base Practices***
PA11 Project Management	to assure that the project meets its objectives	BP 11.01 Identify the Activities BP 11.02 Identify the Life Cycle Approach BP 11.03 Establish Estimates BP 11.04 Establish Schedules BP 11.05 Establish and Maintain Plans BP 11.06 Establish Commitment BP 11.07 Monitor the Project according to Established Plans BP 11.08 Track Technical Process BP 11.09 Review Performance against Established Plans BP 11.10 Take Corrective Action
PA12 Contract Management	to ensure that the activities under contract are being performed in accordance with contractual requirements, and that evolving products and services will satisfy contractual requirements.	BP 12.01 Review and use planning documents BP 12.02 Conduct periodic reviews BP 12.03 Maintain Contract Integrity BP 12.04 Maintain Contractor's Support Processes BP 12.05 Foster Cooperative Environment
PA13 Risk Management	to identify, assess, monitor, and mitigate risks to help ensure that the project meets its objectives.	BP 13.01 Develop Risk Management Approach BP 13.02 Identify Risks BP 13.03 Assess Risks BP 13.04 Review and Validate Risk Assessment BP 13.05 Execute Risk Mitigation Plans
PA14 Coordination	to identify those disciplines necessary for effective system development and create an environment in which they jointly and effectively work together toward a common agenda.	BP 14.01 Involve Disciplines BP 14.02 Promote Cross-Discipline Understanding BP 14.03 Establish Coordination Methods BP 14.04 Establish Resolution Methods BP 14.05 Communicate Interdisciplinary Activity Results BP 14.06 Develop and Communicate Project Goals

2.6 Process Area Summaries, continued

Supporting Processes (not lifecycle phase dependent)		
FAA-iCMM Process Area	***Purpose***	***Base Practices***
PA15 Quality Assurance and Management	to address not only the quality of the system, but also the quality of the process being used to create the system, and to provide management with appropriate visibility into the process and product.	BP 15.01 Monitor Process Compliance BP 15.02 Evaluate Product and Process BP 15.03 Detect Need for Corrective Actions BP 15.04 Record and Report Results BP 15.05 Analyze Quality BP 15.06 Initiate Quality Improvement Opportunities
PA16 Configuration Management	to establish and maintain data on and status of identified configuration units/items, analyze and control changes to the system and its configuration units, and ultimately, establish and maintain the integrity of the work products of the project throughout the project's life cycle	BP 16.01 Establish configuration management methodology BP 16.02 Identify configuration units/items BP 16.03 Establish and Maintain a repository for work product baselines BP 16.04 Control and track changes BP 16.05 Communicate configuration status BP 16.06 Conduct configuration audits
PA17 Peer Review	to remove defects from work products early and efficiently.	BP 17.01 Conduct peer reviews. BP 17.02 Record and analyze peer review data.
PA18 Measurement	to support the successful management of a project and related product engineering activities, as well as overall process improvement within an organization.	BP 18.01 Establish Measures Based on Quantitative Goals BP 18.02 Collect and Analyze Measurement Data BP 18.03 Communicate Quantitave Status BP 18.04 Take Corrective Action
PA19 Prevention	to identify the cause of defects and prevent them from recurring.	BP 19.01 Conduct causal analysis meetings BP 19.02 Coordinate action proposals BP 19.03 Document and track prevention data BP 19.04 Revise processes for defect prevention

Organizational Processes		
FAA-iCMM Process Area	***Purpose***	***Base Practices***
PA20 Organization Process Definition	to define and maintain a usable set of process assets that support organizational learning and improve process performance across the projects.	PB 20.01 Appraise processes PB 20.02 Identify process goals BP 20.03 Establish standard processes BP 20.04 Develop tailoring guidelines BP 20.05 Maintain process assets BP 20.06 Coordinate and communicate process definition
PA21 Organization Process Improvement	to gain competitive advantage by continuously improving the effectiveness and efficiency of the processes used by the organization.	BP 21.01 Establish process improvement program BP 21.02 Change the standard process
PA22 Training	to develop the skills and knowledge of individuals so they can perform their roles effectively and efficiently.	BP 22.01 Identify strategic needs BP 22.02 Identify unique training needs BP 22.03 Train individuals BP 22.04 Obtain training BP 22.05 Establish and maintain records BP 22.06 Assess training effectiveness
PA23 Innovation	to ensure that the people engaged in system development and acquisition activities are provided with a support environment that is continuously improved.	BP 23.01 Maintain New Technology Awareness BP 23.02 Select New Technologies BP 23.03 Prepare for Infusion BP 23.04 Infuse New Technologies BP 23.05 Support Innovation

2.7 Maturity Levels and Staging

Description

Maturity levels are a way of defining characteristics of organizations as they improve. They provide guidance on what processes together contribute to each evolutionary step of organizational maturity. The same concepts apply to process capability levels and organizational maturity levels, i.e. the same five levels are employed. However, in one case individual process capability is measured and in the other, the capability levels of selected groups of process areas are measured.

The FAA-iCMM defines maturity levels in order to provide guidance on "what to focus on next," if needed, and also to enable development of a summary rating of an organization's process maturity, if needed.

In this section, the process areas of the FAA-iCMM are grouped into maturity levels.

Allocation of PAs to maturity levels was made using the following guidelines:

- Process areas that explain generic practices at that level. These PAs are essential to institutionalizing the process at that level.
- Process areas which resulted from merging KPAs at that level in their source CMMs. These PAs embody maturity level placements already made in the source CMMs. When KPAs from different maturity levels in the source CMMs were merged, the lower maturity level was selected.
- Others process areas deemed essential to establishing and sustaining organizational capability at that level.

In general, the group of PAs at one maturity level is considered to be an essential foundation for the next increment of progress reflected in the maturity level that follows.

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Level 2 Process Areas

Level 2 is the Repeatable or Planned and Tracked Level. The following process areas are grouped at maturity level 2:

Lifecycle/Engineering Processes
- PA 01 Needs
- PA 02 Requirements
- PA 05 Outsourcing
- PA 08 System Evaluation
- PA 09 Transition

Management/Project Processes
- PA 11 Project Management
- PA 12 Contract Management

Supporting Processes
- PA 15 Quality Assurance & Management
- PA 16 Configuration Management

For an organization to have level 2 maturity, the above process areas should be at level 2 (or higher) capability according to an FAA-iCMM appraisal. This would indicate a “level 2” organizational maturity.

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Level 3 Process Areas

Level 3 is the Defined or Well Defined Level. The following process areas are grouped at maturity level 3:

Lifecycle/Engineering Processes
- PA 03 Architecture
- PA 04 Alternatives
- PA 06 Software Development and Maintenance
- PA 07 Integration

Management/Project Processes
- PA 13 Risk Management
- PA 14 Coordination

Supporting Processes
- PA 17 Peer Review

Organizational
- PA 20 Organization Process Definition
- PA 22 Training

For an organization to have level 3 maturity, all level 2 process areas plus all level 3 PAs should be at level 3 (or higher) capability according to an FAA-iCMM appraisal. This would indicate a "level 3" organizational maturity.

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Level 4 Process Areas

Level 4 is the Managed or Quantitatively Controlled Level. The following process areas are grouped at maturity level 4:

Lifecycle/Engineering Processes
- PA 10 Product Evolution*

Supporting Processes
- PA 18 Measurement

For an organization to have level 4 maturity, all level 2, 3, and 4 process areas of the FAA-iCMM should be at capability level 4 (or higher) according to an FAA-iCMM appraisal. This would indicate a "level 4" organizational maturity.

*Note: It was not completely clear to the FAA-iCMM project team whether Product Evolution should be at level 4 or 5. As a clearer understanding of these maturity levels evolves, this PA placement may be revisited.

Level 5 Process Areas

Level 5 is the Optimizing or Continuously Improving Level. The following process areas are grouped at maturity level 5:

Supporting Processes
- PA 19 Prevention

Organizational Processes
- PA 21 Organization Process Improvement
- PA 23 Innovation

For an organization to have level 5 maturity, all process areas of the FAA-iCMM should be at capability level 5 according to an FAA-iCMM appraisal. This would indicate a "level 5" organizational maturity.

Chapter 3: Using the FAA-iCMM

Introduction

This chapter provides information on using the FAA-iCMM for organizational process improvement and design.

In this chapter

3.1 Usage Contexts

Introduction

The FAA-iCMM is useful in several contexts. These are discussed in this section.

Applicability of the FAA-iCMM

Every organization reflects its own particular culture, terminology, and communication style. By minimizing role dependencies and organization structure implications, it is anticipated that the FAA-iCMM concepts can be easily translated by all organizations into their own language and culture.

The FAA-iCMM was designed to be flexible with regard to the type of software intensive system or product being acquired, developed, and operated or with regard to the context of the service being provided. The model was designed for application to organizations that focus on high-level issues (e.g., ones dealing with operational use or system architecture), on low-level issues (e.g., mechanism selection or design), and for organizations that do both. Use of the FAA-iCMM should not imply that one focus is better than another or that both are necessary. An organization's business focus should not be biased by use of the FAA-iCMM.

Based on the focus of the organization, some, but not all, of the practices defined will apply. In addition, the organization may need to look at relationships between different practices within the model to determine their applicability.

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FAA-iCMM Use

There are two major ways that the FAA-iCMM is intended to be used:

- Self-appraisal - which involves understanding the organization's or project's process capability level for process improvement purposes.
- Independent capability evaluation - which involves an external evaluation by an organization desiring to evaluate the FAA's process capability

FAA-iCMM Appraisal Scenarios

The FAA-iCMM was developed to integrate three existing CMMs relevant to the acquisition of software intensive systems: the SA-CMM, the SE-CMM, and the SW-CMM. The FAA has conducted internal appraisals, or has been evaluated externally, based on all three CMMs.

One FAA-iCMM goal is to provide a model that not only would be an effective tool for internal process improvement but would also allow the FAA to be evaluated against any of its source CMMs with equivalent evaluation results for intersecting process areas. Thus, satisfying an FAA-iCMM process area at the planned and tracked level (capability level 2) should be equivalent to satisfying its source KPAs if they are level 2 KPAs in the staged models, and attaining level 2 capability for related source PAs from a continuous model. Similarly, achieving FAA-iCMM level 3 process capability should imply satisfying the level 2 criteria above, plus satisfying source KPAs if they are level 3 KPAs in the staged models, or attaining level 3 capability for source PAs from a continuous model, and so forth.

For example, assessing PA 11 Project Management at process capability level 2 would imply the following:

- SA-CMM: Software Acquisition Planning and Project Management have been satisfied
- SW-CMM: Software Project Planning and Software Project Tracking and Oversight have been satisfied
- SE-CMM: Plan Technical Effort, and Monitor and Control Technical Effort are at level 2 capability

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FAA-iCMM Appraisal Scenarios, continued

Assessing PA 11 Project Management at process capability level 3 would imply the following:

- SA-CMM: Software Acquisition Planning, Project Management, and Project Performance Management have been satisfied
- SW-CMM: Software Project Planning, Software Project Tracking and Oversight, and Integrated Software Management have been satisfied
- SE-CMM: Plan Technical Effort, and Monitor and Control Technical Effort are at level 3 capability

Assessing PA11 Project Management at process capability levels 4 or 5 would indicate that the project management process is quantitatively controlled or continuously improving.

Viewed the other way, improving one FAA-iCMM PA to a given process capability implies improving at least one process area from a source CMM. Thus, one can think that concerted efforts to move up the FAA-iCMM capability levels lead to moving up all 3 CMMs in an integrated way.

A major advantage of following a continuous architecture lies in the fact that an improvement path has been laid out to improve to any level those processes that are most critical to the business needs of the organization.

Further elaboration regarding appraisals using the FAA-iCMM is provided in the FAA-iCMM Appraisal Method description. Maturity levels in the FAA-iCMM are discussed in chapter 2.

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3.2 Common Misconceptions about CMMs *(* adapted from SSE-CMM)*

Common Misunder-standing 1
"CMMs define the process"

A common misconception is that CMMs define a specific process. CMMs provide guidance for organizations to define their processes and then improve them over time. The guidance applies regardless of the particular processes that are performed. CMMs describe WHAT activities must be performed to help define, manage, monitor, and improve the organization's process rather than exactly HOW the specific activities must be performed. Discipline-specific CMMs require that certain fundamental activities be performed as part of a process for that discipline, but they do not specify exactly how these activities must be performed.

The basic philosophy behind CMMs is to empower organizations to develop and improve a process that is most effective for them. This is based on the ability to define, document, manage, and standardize the process throughout the entire organization. The philosophy is not focused on any specific lifecycle, organizational structure, or techniques.

Common Misunder-standing 2
"CMMs are handbooks or training guides"

CMMs are intended to guide organizations in improving their capability to perform a particular process (e.g., the acquisition of software intensive systems). CMMs are not intended to be handbooks or training guides for helping individuals improve particular skills. The goal is for an organization to adopt the philosophy described in the CMM and use the techniques defined in the CMM as a guide for defining and improving its process.

Common Misunder-standing 3
"CMMs replace product evaluations"

It is unlikely that an organizational rating against a CMM would replace a product evaluation or system certification. But, it could certainly focus the analysis being performed on areas that have been indicated as weak by the CMM evaluation. Having a process under statistical process control does not mean that there are no defects. Rather, it makes defects more predictable, so some sampling and analysis are still necessary.

Common Misunder-standing 4
"Too much documentation is required"

When reading a CMM, it is easy to get overwhelmed by the plethora of implied processes and plans. CMMs include requirements to document processes and procedures and then make sure they are performed as documented. However, CMMs do not intend to dictate the number or type of documents to be developed but rather to indicate the type of information that is to be documented.

3.3 Using the FAA-iCMM to Support Appraisal

Introduction

The FAA-iCMM is structured to support a wide variety of improvement activities, including self-administered appraisals, or internal appraisals augmented by expert "facilitators" from inside or outside of the organization. Although it is primarily intended for internal process improvement, the FAA-iCMM might also be used for external evaluation of the FAA's acquisition process. This approach is in contrast to the SE-CMM, which does not recommend its model be used for capability evaluations, but in concert with SW-CMM and SA-CMM usage.

The FAA-iCMM Appraisal Method

It is not required that any particular appraisal method be used with the FAA-iCMM. However, an appraisal method designed to maximize the utility of the model will be developed by the FAA-iCMM Project. It is planned that this appraisal method will be adapted from the Systems Engineering Capability Maturity Model Appraisal Method (SAM) and the CMM-based Appraisal for Internal Process Improvement (CBA-IPI) methods. This will be studied by the Appraisal Group of the FAA-iCMM Project.

The FAA-iCMM Appraisal Method will be fully described, along with support materials for conducting appraisals, in *FAA-iCMM Appraisal Method Description*. The basic premises of the appraisal method are listed in this document to provide context for how the model might be used in an appraisal.

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Features

The FAA-iCMM Appraisal Method will be an organizational or project-level appraisal method that uses multiple data-gathering methods to obtain information on the processes being practiced within the organization or project selected for appraisal. The purposes of a FAA-iCMM appraisal in its first version will be to

- Obtain a baseline or benchmark of actual practice within the organization or project.
- Create and support momentum for improvement

The method will be tailorable to meet the organization's or project's need. Guidance on tailoring for a variety of appraisal scenarios will be provided in the method description document.

In general, data gathering consists of 1) questionnaires that directly reflect the contents of the model, 2) a series of structured and unstructured interviews with key personnel involved in the performance of the processes, and 3) review of evidence generated.

Multiple feedback sessions are conducted with the appraisal participants. This culminates in a briefing to all participants plus the sponsor of the appraisal. The briefing includes capability levels determined for each of the process areas appraised. It also includes a set of strengths and weaknesses that support process improvement based on the stated appraisal goals and may include a rating of organizational maturity.

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Defining the context for appraisal

The first step in assessing an organization is to determine the context within which acquisition is practiced in the organization or project. The FAA-iCMM is intended to be applicable in all contexts. Determination of the context must be made to decide

1) Which PAs are applicable to the organization
2) How the PAs may need to be interpreted (for example, development vs. operational environment)
3) Which personnel need to be involved in the assessment

Using both sides of the architecture in appraisal

The first step in developing a profile of an organization's capability to perform its acquisition processes is to determine whether the basic processes (all the base practices) are *implemented* within the organization (not just written down) via their performed processes. The second step is to assess how well the characteristics (base practices) of the processes that have been implemented are managed and institutionalized by looking at the base practices in the context of the generic practices. Consideration of both the base practices and generic practices in this way results in a process capability profile that can help the organization to determine the improvement activities that will be of most benefit in the context of its business goals.

In general, the appraisal consists of evaluating each process area against the generic practices. The base practices should be viewed as guidance on the basic aspects of the topics that need to be addressed. The related generic practices deal with deployment of the base practices to the project.

Goals summarize practices and are used during an appraisal. They also help motivate improvement by depicting an outcome or desired state that can be expected if the base practices are implemented.

Keep in mind that the application of the generic practices to each process area results in a unique interpretation of the generic practice for the subject process area.

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Sequencing	The practices of many of the process areas would be expected to be seen a number of times in the execution of an organization's processes through the lifecycle of a project. The process areas should be considered a source for practices whenever there is a need to incorporate the purpose of a process area in a project's or organization's process. In an appraisal, always keep in mind that the FAA-iCMM does not imply a sequence. Sequencing should be determined based on an organization's or project's selected life cycle and other business parameters (see Section 3.4, Using the FAA-iCMM in Process Design).

3.4 Using the FAA-iCMM to Support Process Improvement

Introduction	Any process improvement effort, using any reference model, should be constructed to support the business goals of an organization. An organization using the FAA-iCMM should prioritize the process areas relative to its business goals and strive for improvement in the highest priority process areas first.
Tailoring	The model defines those elements that are considered to be essential for the acquisition of software intensive systems. However, not all projects may need to use processes that exhibit all the characteristics associated with each process area. Under such circumstances, the project should follow a process to tailor out the activity related to the unnecessary process area from an organization's process. Tailoring should, in all cases, be based on the organization's goals and customer needs. Tailoring is intended to be done at the PA level. The PAs were written with the intention that all base practices need to be in place to meet the goals of the PA.

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Process Improvement Principles

The business goals are the primary driver in interpreting a model such as the FAA-iCMM. However, there is a fundamental order of activities and basic principles that drive the logical sequence of typical improvement efforts. This order of activities is expressed in the generic practices of the capability level side of the FAA-iCMM architecture. These principles and order of activities are summarized in Table 3-3[3].

Principle	How Expressed in FAA-iCMM
You have to do it before you can manage it.	The Performed Informally level focuses on whether an organization or project performs a process that incorporates the base practices.
Understand what's happening on the project (where the products are!) before defining organization-wide processes.	The Planned and Tracked level focuses on project-level planning, and performance issues.
Use the best of what you've learned from your projects to create organization-wide processes.	The Well Defined level focuses on disciplined tailoring from defined processes at the organization level.
You can't measure it until you know what "it" is.	Although it is essential to begin collecting and using basic project measures early (i.e., at the Planned and Tracked level), measurement and use of data is not expected organization wide until the Well Defined and particularly the Quantitatively Controlled levels have been achieved.
Managing with measurement is only meaningful when you're measuring the right things.	The Quantitatively Controlled level focuses on measurements being tied to the business goals of the organization.
A culture of continuous improvement requires a foundation of sound management practice, defined processes, and measurable goals.	The Continuously Improving level gains leverage from all the management practice improvements seen in the earlier levels, then emphasizes the cultural shifts that will sustain the gains made.

Table 3-3. Process Improvement Principles in the FAA-iCMM

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[3]adapted from the Systems Security Engineering CMM

Some expected results	Based on analogies in the software and other communities, some results of process and product improvement can be predicted. These are discussed below.
Improving predictability	The first improvement expected as a project or an organization matures is *predictability*. As capability increases, the difference between targeted results and actual results decreases across projects. For instance, immature organizations often miss their originally scheduled delivery dates by a wide margin, whereas organizations at a higher capability level should be able to predict the outcome of cost and schedule aspects of a project with increased accuracy.
Improving control	The second improvement expected as a project or an organization matures is *control.* As process capability increases, incremental results can be used to establish revised targets more accurately. Alternative corrective actions can be evaluated based on experience with the process and other projects' process results to select the best application of control measures. As a result, organizations with a higher capability level will be more effective in controlling performance within an acceptable range.
Improving process effectiveness	The third improvement expected as a project or organization matures is *process effectiveness*. Targeted results improve as the maturity of the organization increases. As an organization matures, costs decrease, development time decreases, and productivity and quality increase. In an immature organization, development time can be quite long because of the amount of rework that must be performed to correct mistakes. In contrast, organizations at higher maturity levels can shorten overall development times via increased process effectiveness and reduced rework.

3.5 Using the FAA-iCMM in Process Design

Introduction

This section provides brief guidance on issues related to using the FAA-iCMM to support process design.

Analyzing your organizational context

Organizations often overlook many internal and/or intermediate processes or products when first defining their processes. However, it is not necessary to address all of the possibilities when first defining an acquisition process for an organization. An organization should describe with reasonable accuracy its current process as a baseline. It is best to focus on capturing a reasonable baseline process that can be produced in six months to a year, and one that can be improved over time.

Organizations must have a stable baseline to determine whether future changes constitute improvements. There is no value in looking for improvements in a process that the organization does not perform. An organization may find it useful to include current "delays" and "queues" in the baseline process. During subsequent process improvement efforts, these allow a good starting point for cycle-time reduction.

An organization may define its process by analyzing the responsibilities of its practitioners. This may include interfaces with the other disciplines, such as security engineering, hardware engineering, or human factors.

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Analyzing your organiza-tional context

(cont.)

The first step in designing processes that will meet the business needs of an enterprise is to understand the business, product, and organizational context that already exists or that will be present when the process is being implemented. Some questions that need to be answered before the FAA-iCMM can be used for process design include

- How is acquisition practiced within the organization?
- What lifecycle will be used as a framework for this process?
- How is the organization structured to support projects?
- How are support functions handled (e.g., by the project or the organization)?
- What are the management and practitioner roles used in this organization?
- How critical are these processes to organizational success?

Understanding the cultural and business contexts in which the FAA-iCMM will be used is a key to its successful application in process design.

Adding role and structure information

Role assignment, organizational structure, work products, and lifecycle need to be added to the content of the FAA-iCMM process areas and generic practices to come up with a performable and sustainable process design. It is an organization's context regarding these factors, combined with guidance from FAA-iCMM generic practices and base practices, that produce sound organizational processes with the potential for deliberate improvement.

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3.6 Using the FAA-iCMM with the Acquisition Management System

Introduction

The process areas of the FAA-iCMM cover the essential activities carried out during the Acquisition Management System (AMS) life cycle phases. Table 3.2 provides a preliminary mapping of the FAA-iCMM's process areas to AMS life cycle phases/ activities.

Note: This draft mapping is provided as a first approximation since AMS is evolving and the FAA-iCMM has not yet been applied in this context. As improvement teams start using the FAA-iCMM during piloting of the model, it is intended that AMS mappings will be updated and validated.

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3.6 Using the FAA-iCMM with the Acquisition Management System, Continued

Table 3.2 FAA-iCMM Process Areas across the Acquisition Life Cycle

FAA-iCMM Process Area	FAA Acquisition Life Cycle				
	Mission Analysis	Invest-ment Analysis	Solution Implementation	In-Service Management	Service-Life Ext.
Life Cycle or Engineering Processes					
PA01 Needs	x	x	x	x	x
PA02 Requirements	x	x	x	x	x
PA03 Architecture	x	x	x	x	x
PA04 Alternatives		x	x	x	x
PA05 Outsourcing			x	x	
PA06 Software Development and Maintenance			*xxx*	x	
PA07 Integration			x	x	
PA08 System Test and Evaluation		x	x	x	
PA09 Transition			x		
PA10 ProductEvolution				x	
Management or Project Processes					
PA11 Project Mgmt	x	x	x	x	x
PA12 Contract Mgmt			x	x	x
PA13 Risk Mgmt		x	x	x	x
PA14 Coordination	x	x	x	x	x
Supporting Processes					
PA15 Quality Assurance & Mgmt	x	x	x	x	x
PA16 Config Mgmt	x	x	x	x	x
PA17 Peer Review	x	x	x	x	x
PA18 Measurement	x	x	x	x	x
PA19 Prevention	x	x	x	x	x
Organizational Processes					
PA20 Org Process Def	x	x	x	x	x
PA21 Org Process Imp	x	x	x	x	x
PA22 Training	x	x	x	x	x
PA23 Innovation	x	x	x	x	x

x = processes and activities match; processes or at least some or their practices would or might be carried out during this AMS phase/activity

xxx = typically, though not necessarily, carried out by supplier

Part 2: Model Description

Chapter 4: FAA-iCMM Generic Practices

Chapter 5: FAA-iCMM Process Areas and Base Practices

Chapter 4: Generic Practices

Introduction

This chapter contains the generic practices, that is, the practices that apply to all processes. Generic practices provide a guide to institutionalization of a process and they are also used in a process appraisal to determine the capability of any process. The generic practices are grouped according to capability level.

In this chapter

The following table provides a guide to the information found in the chapter.

Capability Level Sources and Format

Sources

The FAA-iCMM generic practices have been derived and adapted from the Common CMM Framework (CCF) and the SE-CMM, with two additional generic practices developed by the FAA-iCMM team.

More specifically:

- All generic practices identified in the Common CMM Framework, Draft E are included, but are more broadly developed, as appropriate, in the FAA-iCMM
- Two additional generic practices from the SE-CMM are included: one at level 1 (1.1 Perform the process) and one at level 2 (2.5 Document the Process)
- Two generic practices were added by the FAA-iCMM authors: one at level 2 (2.14 Coordinate within the Project) and one at level 3 (3.4 Coordinate among Affected Groups).

The “Not Performed” level (level 0) of the SE-CMM was eliminated as required by the CCF, which states there will be five levels. Also the SE-CMM concept of common features was eliminated.

Goals for capability levels 2 to 5 were added, and these are the process management goals identified in the CCF, Draft E.

Lastly, references in the “Notes” and “Relationships” sections of the generic practices were added or modified to reference the FAA-iCMM constructs.

Format

Capability levels are described in the following general format:

- Capability level number and title
- Capability level summary description
- Capability level goal
- Generic practices at that level
    - Generic practice number
    - Generic practice title
    - Generic practice statement
    - Notes (optional)
    - Relationship to other generic practices (optional)
    - Relationship to process areas (optional)

Capability Level 1 - Initial: Performed Informally

Description

Base practices of the process area are generally performed.

At this level, all base practices are generally performed somewhere in the project's or organization's implemented process, but processes are characterized as ad hoc and even occasionally chaotic. Consistent planning and tracking of performance are missing. Good performance, therefore, depends on individual knowledge and effort. Work products are generally adequate, but quality and efficiency of production depend on how well individuals within the organization perceive that tasks should be performed. Based on experience, there is general assurance that an action will be performed adequately when required. However, the capability to perform an activity is not generally repeatable or transferable.

This level is known as the Performed Informally level in the SE-CMM, and the Initial level in the SW-CMM and the SA-CMM.

Level 1 Goal

There is no goal in the CCF at this level.

Level 1 Generic Practice

1.1 Perform the Process

Perform a process that implements the base practices of the process area to provide work products and/or services to a customer.

Note: This process may be termed the "informal process." The customer(s) of the process area may be internal or external to the organization.

Capability Level 2 - Repeatable: Planned and Tracked

Description

Basic management processes are established. The necessary process discipline is in place to repeat earlier successes with similar work processes. Performance of the base practices in the process area is planned and tracked.

At the Repeatable or Planned and Tracked level, planning and tracking are introduced. There is general recognition that the organization's performance is dependent on how efficiently the base practices are implemented within a project's or organization's process. Therefore, work products related to base practice implementation are periodically reviewed and placed under version control. Corrective action is taken when indicated by variances in work products.

The primary distinction between the Performed Informally and the Planned and Tracked levels is that at the latter level, the execution of base practices in the project's implemented process is planned and tracked. Therefore, it is repeatable within the implementing project, although the practices being repeated may be performed differently in different parts of the organization. Though repeatable within the project, the process is not necessarily transferable across the organization.

This level is known as the Planned and Tracked level in the SE-CMM, and the Repeatable level in the SW-CMM and the SA-CMM.

Level 2 Goal

The activities for the process are institutionalized to support a repeatable process.

Note: A repeatable process is a set of activities performed to achieve a given purpose (a process) that is institutionalized by:

- adhering to organizational policies
- following documented plans
- allocating adequate resources (including funding, people, and tools)
- assigning responsibility, authority, and accountability
- training the affected people
- measuring the process and its work products
- objectively reviewing and verifying the process and its work products
- reviewing status with appropriate levels of management, and
- taking corrective action, as necessary

Level 2 Generic Practices

2.1 Establish Policy

Establish and maintain a policy for performing the process.

Note: Policy is a visible way for organizations and their leaders to set expectations. The form policies take varies widely depending on the local culture.

Policy typically specifies that process plans are documented, that the plans are managed and controlled, and that reviews are conducted. Policy provides guidance for performing the process.

2.2 Allocate Adequate Resources

Allocate and obtain adequate resources for performing the process.

Note: Resources include adequate funding, appropriate physical facilities, skilled people, and appropriate tools. This practice ensures that level of effort, appropriate skill mix, tools, workspace, and other direct resources are available to perform the process.

Relationship to process areas: Identification of critical resources is done in Project Management (PA 11).

2.3 Assign Responsibility

Assign responsibility and authority for developing the work products and/or providing the services of the process.

Note: This practice implies assignment and acceptance of responsibility for outcomes to persons or roles. Responsibility includes both duty to perform and accountability for successful performance.

Assigning responsibility does not necessarily entail detailed job descriptions. Responsibility could be assigned through living documents, such as a task plan. Dynamic assignment of roles is another legitimate implementation of this practice, so long as there are mechanisms in place to assure that the responsibility is assumed.

Relationship to process areas: This practice is particularly related to Project Management (PA 11).

2.4 Ensure Training

Ensure that the individuals performing the process are appropriately trained in how to perform the process.

Note: Training in how the project expects the process to be performed provides a common basis for repeatable performance. Ensuring that performers can perform the skills adequately provides the confidence basis for schedule and cost estimation. Even if apparently satisfactory technical skills and knowledge are available via staffing or partnering, there is almost always a need to establish a common understanding of the project or organizational process activities and how skills are applied in them.

Training, and how it is delivered, will change with process capability due to changes in how the process is performed and managed.

Relationship to process areas: Organizational training and training management are described in Training (PA 22), but this PA may provide some insights regarding training at the repeatable level.

2.5 Document the Process

Document the approach to performing the process area.

Note: When documenting the process, participation of the people who perform a process (its owners) is essential to creating a usable process description. Processes in an organization, or on a project, need not correspond one to one with the process areas in the FAA-iCMM. Therefore, a process covering a process area may be described in more than one way (e.g., policies, standards, plans and/or procedures) to cover a process area, and a process description may span more than one process area.

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2.5 Document the Process (continued)

Relationship to other generic practices: This is the “level 2” process description that focuses on the information needed for the project or process, not on the organization-wide formal defined process. The process descriptions evolve with increasing process capability to a defined process (see 3.2) and a continuously improving process (see 5.1).

Standards and procedures that describe the process at this level are likely to include measurements, so that the performance can be tracked with measurement (see 2.11).

2.6 Plan the Process

Establish and maintain a plan for performing the process.

Note: Establishing a plan typically includes documenting it in some fashion. Maintaining the plan includes changing it as a result of corrective actions as necessary.

At capability level 2, the plan is the most likely repository of the information needed to execute the process. Informal recording of elements of the process as it is intended to be performed is more likely than a formal documentation of the end to end process related to the process area.

Plans for process areas in the life cycle or engineering and project management categories may be in the form of a project plan, whereas plans for the organizational category may be at the organizational level. Some planning notes are provided in individual PA descriptions.

Relationship to process areas: Project planning is described in Project Management (PA 11).

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2.7 Use a Repeatable Process

Perform the activities of the process according to a repeatable process.

Note: A repeatable process is a set of activities performed to achieve a given purpose (a process) that is institutionalized by:

- adhering to organizational policies,
- following documented plans
- allocating adequate resources (including funding, people, and tools)
- assigning responsibility, authority, and accountability
- training the affected people
- measuring the process and its work products
- objectively reviewing and verifying the process and its work products
- reviewing status with appropriate levels of management, and
- taking corrective action, as necessary

Work products of a repeatable process are, as appropriate:

- reviewed by those affected
- compliant with specified standards and requirements
- placed under configuration management or change control

Relationship to other generic practices: The standards and procedures used were documented in 2.5 The plans used were documented in 2.6. This practice is an evolution of 1.1 and evolves to 3.2.

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2.8 Manage Configurations

Place identified work products of the process under version or parts control, or configuration management.

Note: Placing identified work products of the process under version control, parts control, or configuration management provides a means of controlling work products. This practice is focused on controlling the work products, parts, components, etc. resulting from an individual process.

Where Configuration Management (PA 16) focuses on the general practices of configuration management, this generic practice is focused on the deployment of these practices in relation to the work products of the individual process area under investigation.

Relationship to process areas: The typical practices needed to support acquisition in the configuration management discipline are described in Configuration Management (PA 16).

2.9 Assess Process Compliance

Assess adherence of the implemented process to the repeatable process.

Note: The review of the implemented process is an attribute of a repeatable process; the implemented process is the one actually performed, the repeatable process is the one that is institutionalized for use in performing the process on this project or in this activity.

Relationship to other generic practices: The applicable standards and procedures were documented in 2.5 and used in 2.7.

Relationship to process areas: The quality management and/or assurance process is described in Quality Assurance and Management (PA 15).

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2.10 Verify Work Products

Verify adherence of work products to the applicable requirements.

Note: See the definition of work product. Verification is checking against the design. The design is a set of applicable requirements that a product as built must satisfy. These requirements may come from the customer, policies, standards, laws, regulations, etc. The applicable requirements are documented and available for verification activities.

Relationship to other generic practices: The applicable standards and procedures were documented in 2.5 and used in 2.7.

Relationship to process areas: Product requirements are developed and managed in Needs (PA 01) and Requirements (PA 02). Verification and validation is further addressed in System Test and Evaluation (PA 08).

2.11 Measure Process

Measure the status of the implemented process against the plan.

Note: The use of measurement implies that the measures have been defined and selected, and data have been collected. Building a history of measures, such as cost and schedule variances, is a foundation for managing by data, and is begun here. Quality measures may be collected and used early, but result in maximum impact at level 4, when they are subjected to quantitative process control.

Relationship to other generic practices: The use of measurement implies that the measures have been defined and selected in 2.5 , and data have been collected in 2.7.

Relationship to process areas: Project tracking is described in Project Management (PA 11).

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2.12 Review Status

Review the status of the process with management.

Note: A requirement of an effective process is management visibility. This practice makes explicit that requirement. The purpose is to ensure an environment in which decisions on the performance of the process can be made appropriately. Therefore reviews are expected to be both routine and event-driven.

Different levels of management will have different oversight needs. The project manager will need to remain informed of status and take corrective action when issues that cannot be handled at a lower level are escalated for their intervention. Senior management will typically keep strategic oversight of the process and take corrective action on issues which span multiple projects. Customer management may choose to oversee specific processes and/or products.

Relationship to process areas: Project status is addressed in Project Management (PA 11).

2.13 Take Corrective Action

Take corrective action when status varies significantly from that planned.

Note: Progress may vary because estimates were inaccurate, performance was affected by external factors, or the requirements, on which the plan was based, have changed. Corrective action may involve changing the process, changing the plan, changing the technology, changing the skills and knowledge base, or all of the above, or an explicit decision not to act. Corrective action may be taken at the level of the individual worker, but this generic practice focuses on issues that have been raised as a result of measurement or management reviews.

Relationship to process areas: Project control is described in Project Management (PA 11).

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2.14 Coordinate Within the Project

Coordinate and communicate among those performing the process within the project.

Note: Coordination ensures that there is common or mutual understanding, that decisions are arrived at as a group, and that project participants are kept aware of decisions made. Items requiring coordination include changes to plans, products, processes, activities, requirements, and responsibilities. The commitments, expectations, and responsibilities of the project are documented and agreed upon within the project group. Commitment may be obtained by negotiation, by using inputs and feedback on input, or through joint development of solutions to issues. Issues are tracked and resolved within the group.

Communication occurs periodically and whenever status changes. The project participants have access to data, status information, and recommended actions.

Relationship to other generic practices: This GP evolves to 3.4

Relationship to process areas: Commitment, coordination, and communication at a project level are addressed in Project Management (PA 11).

Capability Level 3 - Defined: Well Defined

Description

Base practices are performed according to a well-defined process using approved, tailored versions of standard documented processes.

Processes are documented, standardized, and integrated into the activities of the organization. Once the environment is stable, common practices for performing the processes of the process domain are collected, defined in a consistent manner, and used as the basis for long-term improvement across the organization. This results in organizational learning that is sponsored, supported, and addresses strategic business needs.

At this level, base practices are performed throughout the organization via the use of approved, tailored versions of standard, documented processes. Data from using the process are gathered and used to determine if the process should be modified or improved. This information is used in planning and managing the day-to-day execution of multiple projects within the organization and is used for short- and long-term process improvement.

The main difference between the Planned and Tracked and Well Defined levels is the use of organization-wide, accepted standard processes, that implement the characteristics exhibited by the base practices. The capability to perform an activity is, therefore, directly transferable to new projects within the organization.

This level is known as the Well Defined level in the SE-CMM and the Defined level in the SW-CMM and the SW-CMM.

Level 3 Goal

The activities of the process are institutionalized to support a defined process.

Note: A defined process is a repeatable process that has clearly stated inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria and is tailored from an organizational standard process. Exceptions may be driven by customer requirements or by the need to pilot new processes. Exceptions should not omit lower level practices without explicit review and risk assessment.

continued on next page

Level 3 Generic Practices

3.1 Standardize the Process

Document a set of standard processes for the organization.

Note: The critical distinction between the capability level 2 generic practice "Use a repeatable process" and this practice is the scope of application of the policies, standards, and procedures. In the repeatable practice, the standards and procedures may be in use in only a specific instance of the process, e.g. on a particular project. In this practice, however, policies, standards, and procedures are being established at an organizational level for common use throughout the organization.

The processes in an organization need not correspond one-to-one with the process areas in the capability maturity model. An organization's process may span multiple process areas. CMMs do not dictate the structure of an organization's process descriptions. Therefore, the organization may define more than one standard process for a process area to address differences among application domains, customer constraints, etc.

Relationship to other generic practices: The "level 2" process description was documented in 2.5. The "level 3" process description is tailored in 3.2.

Relationship to process areas: The process for developing a process description is described in Organization Process Definition (PA 20).

continued on next page

3.2 Use Defined Process

Perform the process according to a defined process.

Note: A defined process is a repeatable process that has clearly stated inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria and is tailored from an organizational standard process. Exceptions may be driven by customer requirements or by the need to pilot new processes. Exceptions should not omit lower level practices without explicit review and risk assessment.

Relationship to other generic practices: The set of organization's standard processes is documented in 3.1. The tailored process definition is used in 3.2.

Relationship to process areas: Tailoring guidelines are defined in Organization Process Definition (PA 20).

3.3 Perform Reviews with Peers

Perform defect reviews of key work products of the process with peers.

Note: Work product reviews are typically called defect or peer reviews. The purpose of defect reviews is to use a peer-staffed review technique to identify sources of defects, mistakes, or misunderstandings in early or interim work products. The review techniques described in the software literature (“Fagan Inspections”) are readily adaptable to other disciplines and needs.

Relationship to process areas: Peer reviews are described in Peer Review (PA17).

continued on next page

3.4 Coordinate with Affected Groups

Coordinate and communicate among affected groups within and external to the organization.

Note: This type of coordination ensures that relationships are addressed among affected groups both across the organization and external to it. There is common or mutual understanding, decisions are arrived at as a among affected groups, and affected groups are kept aware of decisions made. Items requiring coordination include changes to plans, products, processes, activities, requirements, and responsibilities

A relationship between affected groups (e.g., customer, other engineering groups, user, supplier) is established via a common understanding of the commitments, expectations, and responsibilities of each group within an organization and external to it. Commitment may be obtained by negotiation, by using inputs and feedback on input, or through joint development of solutions to issues. The affected groups will identify, track, and resolve issues.
Communication occurs periodically and whenever status changes. The project participants have access to data, status information, and recommended actions.

Relationship to other generic practices: This GP builds on 2.14 and extends coordination beyond the project.

Relationship to process areas: Coordination objectives and approaches are addressed in Coordination (PA 14). Needs of the customer are identified in Needs (PA 01). Supplier coordination is addressed in Outsourcing (PA 05) and Contract Management (PA12).

Capability Level 4 - Managed: Quantitatively Controlled

Description

Processes and products are quantitatively measured, understood, and controlled; detailed measures of performance are collected and analyzed.

Establishing common processes within a domain enables more sophisticated methods of performing domain activities such as controlling its processes and results quantitatively, integrating its processes across process domains, or fine-tuning its processes to different product or service lines.

At the Quantitatively Controlled level, measurable process goals are established for each defined process and associated work products and detailed measures of performance are collected and analyzed. These data enable quantitative understanding of the process and an improved ability to predict performance. Performance, then, is objectively managed, the quality of work products is quantitatively known, and defects are selectively identified and corrected.

The primary distinction from the Well Defined level is that the defined process is quantitatively understood and controlled.

This level is known as the Quantitatively Controlled level in the SE-CMM, the Quantitative level in the SA-CMM, and the Managed level in the SW-CMM.

Level 4 Goal

The activities of the processes are institutionalized to support quantitative management of defined processes.

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Level 4 Generic Practices

4.1 Establish Quality Objectives for Product and Process

Establish measurable quality objectives for the work products of the organization's standard and defined processes.

Note: These quality objectives can be tied to the strategic quality goals of the organization, the particular needs and priorities of the customer, or the tactical needs of the local unit or project. The measurements referred to here go beyond the traditional end-product measurements. They are intended to imply sufficient understanding of the processes being used to enable the organization to set and use intermediate goals for work-product quality. Quality objectives can be set that are by definition achievable when the processes involved are within quantitative process capability.

Relationship to other generic practices: Data gathered via peer reviews (3.3) can be particularly important in setting goals for work product quality.

Relationship to process areas: Quality goals are addressed in Measurement (PA 18) and Organization Process Definition (PA 20).

4.2 Select Processes for Measurement.

Select processes for use from the organization's set of standard processes.

4.3 Select Measures for the Process

Select measures for the process that support determination and use of its quantitative process capability.

Note: This is a quantitative process capability based on a defined process. Measurements are inherent in the process definition and are collected as the process is being performed.

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***4.4 Determine Quantitative Process Capability*.**	Determine the quantitative process capability of the defined process. *Note:* This is a quantitative process capability based on a defined process. Measurements are inherent in the process definition and are collected as the process is being performed. *Relationship to other generic practices:* The defined process is described in 3.2. *Relationship to process areas*: Process capability is addressed in Organization Process Definition (PA 20) and Measurement (PA 18).
4.5 Use Quantitative Process Capability	Use the quantitative process capability to manage the process. *Note:* This is quantitative process capability based on a defined process. Its use is as a basis of decision-making in and about the process and its work products. That is, if the process is "out of control", then corrective action should be taken to re-establish in-control conditions. The term "manage by facts" conveys the intent of this practice. Special causes of variation, identified based on an understanding of process capability, are used to understand when and what kind of corrective action is appropriate.

Capability Level 5 - Optimizing: Continuously Improving

Description

Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. A focus on widespread, continuous improvement permeates the organization. The organization establishes quantitative performance goals for process effectiveness and efficiency based on its business goals.

Once critical business objectives are consistently evaluated and compared against process capability or other capabilities, continuous improvement can be institutionalized within the organization, resulting in a cycle of continual learning.

This is the highest achievement level from the viewpoint of process capability. The organization has established quantitative, as well as qualitative, goals for process effectiveness and efficiency, based on long-range business strategies and goals. Continuous process improvement toward achievement of these goals using timely, quantitative performance feedback has been established. Further enhancements are achieved by pilot testing of innovative ideas and planned insertion of new technology.

The primary distinction from the Quantitatively Controlled level is that the defined process and the standard process undergo continuous refinement and improvement, based on a quantitative understanding of the impact of changes to these processes.

This level is known as the Continuously Improving level in the SE-CMM, and the Optimizing level in the SA-CMM and the SW-CMM.

Level 5 Goal

Continually improving processes are deployed throughout the organization.

continued on next page

Level 5 Generic Practices

5.1 Perform Continual Process Improvement on the Organizational Standard and Tailored Processes

Continually improve the set of organizational processes and the defined processes tailored from them by changing them to increase their effectiveness.

Note: The improvements may be based on incremental organizational improvements or innovations such as new technologies (perhaps as part of pilot testing). Improvements will typically be driven by the goals established at level 4, based on targets or data from process control charts, customer needs, or previous business results.

Removing sources of common variation in the organization's standard processes is a continuation of special cause variation removal begun at level 4. Once disasters are prevented (special causes) then common variation can be squeezed out, and efforts to "move the mean" or expected outcome towards higher customer value will be much more meaningful and results obvious, faster.

The information learned from managing individual projects is communicated back to the organization for analysis and deployment to other applicable areas. Changes to the organization's standard processes may come from innovations in technology or incremental improvements. Innovative improvements will usually be externally driven by new technologies. Incremental improvements will usually be internally driven by improvements made when tailoring the defined process.

Relationship to process areas: Refer to Organization Process Improvement (PA21) and Innovation (PA23).

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5.2 Implement Improved Processes

Deploy "best practices" across the organization.

Note: Improved practices must not only be codified, but also deployed across the organization to allow their benefit to be felt across the organization.

Relationship to process areas: Refer to Organization Process Improvement (PA21) and Innovation (PA23).

Chapter 5: Process Areas and Base Practices

In this chapter

This chapter contains the process areas and their base practices

	Topic
	Process Area Format
Life Cycle or Engineering Processes	PA 01: Needs
	PA 02: Requirements
	PA 03: Architecture
	PA 04: Alternatives
	PA 05: Outsourcing
	PA 06: Software development and maintenance
	PA 07: Integration
	PA 08: System Test and Evaluation
	PA 09: Transition
	PA 10: Product Evolution
Management or Project Processes	PA11: Project Management
	PA 12: Contract Management
	PA 13: Risk Management
	PA 14: Coordination
Supporting Processes	PA 15: Quality Assurance and Management
	PA 16: Configuration Management
	PA 17: Peer Review
	PA 18: Measurement
	PA 19: Prevention
Organizational Processes	PA 20: Organization Process Definition
	PA 21: Organization Process Improvement
	PA 22: Training
	PA 23: Innovation

Process Area Format

Overview

The FAA-iCMM domain aspect consists of 23 process areas (PAs), each of which contains a number of base practices (BPs). Each process area is identified in the following subsections.

The general format of the process areas is shown in Figure 5-1. The summary description contains a brief overview of the PA, including its purpose, major points addressed, goals, and BP list. A BP is meant to summarize a fundamental essential characteristic of performing a process that meets the intent of the PA, as expressed in its purpose. Each BP is described in detail following the PA summary.

Traceability to source CMMs is provided at both the process area and base practice levels.

Although these PAs are described separately, they are all interrelated and together contribute to the creation of sound processes for the acquisition of software intensive systems.

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Process Area Format, Continued

Format

Figure 5-1 provides the general format of the process areas and describes the content of each part.

PA #: PA Title	<PAxx, where xx is a unique integer associated with this PA: > <title describes the primary topic of the process area>
Process Area Summary	
Purpose	The purpose of <PA Title> is <statement of contents and purpose of the PA>
Major points addressed	<summarizing statements providing an abstraction of process area activities>
Goals	<list of goals that summarize an expected state to be achieved if the purpose is met and the process area is successfully implemented, with mappings to BPs that support achievement of each goal>
Notes	<additional explanatory information>
Relationships between this PA and other PAs	<notes on relationships between different PAs or other practices>
Base practices list	The following list contains the base practices that are essential elements of good acquisition of software intensive systems: BP #: <tag> <base practice statement>
FAA-iCMM Traceability	<process areas and key process areas, from the source CMMs, that contribute to this PA>

BP # BP Title	<BPxx.yy where xx is the PA number, and yy is the base practice number> <phrase that captures primary topic or issue addressed by the base practice>
Statement	<imperative, verb-object statement that describes an essential element for attaining the purpose of the PA>
Description	< elaboration of the base practice statement and guidance that would be useful for those implementing the practice>
Typical Work Products	<list of generically named typical work products that could be expected to be the results of implementing the practice>
Notes	<elaboration on concepts and use of the base practice, conceptual examples, potential techniques, methods, etc. Content varies from BP to BP>
FAA-iCMM Traceability	<list of the practices from the source PAs and KPAs that are merged or contribute to this base practice>
	. . .
CMM Mapping Table	<summarizing table mapping each base practice of the PA to the practices from source PAs and KPAs that are merged or contribute to it>

Figure 5-1. Process Area Format

PA 01: Needs

Process Area Summary

Purpose

The purpose of the Needs process area is to elicit, stimulate, analyze, and communicate customer needs and expectations to obtain a better understanding of what will satisfy those needs.

Major points addressed

The Needs process area involves engaging the customer or surrogate in an ongoing dialogue designed to translate needs and expectations into a verifiable set of requirements which the customer understands and which provides the basis for agreements between the customer and the systems engineering/acquisition effort.

Customer needs change over time. Organizations need to have a workable way to incorporate such changes into current and future versions of the product.

Goals

1. Customer needs are represented in a statement of system requirements. *(BP 1.01, BP 01.02, BP 01.03, BP 01.04)*
2. Changes to the system requirements are communicated to the customer for agreement. *(BP01.01, BP 01.04, BP 01.05)*

Notes

"Customer," as used here, denotes either a directly contracted customer or a customer surrogate who represents a particular market segment.

Relationships between this PA and other PAs

Since this process area supports the dialogue between systems acquisition and the customer, all other process areas will use it to keep the customer informed throughout the project life cycle. This process area is performed iteratively with the Requirements and Architecture process areas PA 02 and PA 03.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 01.01	**Elicit Needs:** Elicit the customer's needs, expectations, and measures of effectiveness.
BP 01.02	**Analyze Needs:** Analyze the customer's needs and expectations to develop a preliminary operational concept of the system.
BP 01.03	**Develop System Requirements:** Develop a statement of system requirements.
BP 01.04	**Obtain Customer Agreement:** Obtain the customers' agreement that system requirements satisfy their needs and expectations.

BP 01.05 **Inform Customer:** Inform the customer on a regular basis about the status and disposition of needs, expectations, and measures of effectiveness.

FAA-iCMM Traceability

The Needs process area is adapted from the SE-CMM, Understand Customer Needs and Expectations, PA 06. No process areas from the SA-CMM or the SW-CMM were applicable.

BP 01.01 Elicit Needs

Elicit the customer's needs, expectations, and measures of effectiveness.

Description
Frequently, customer needs and expectations are poorly identified or in conflict. The needs and expectations, as well as customer limitations, must be clearly identified and prioritized. An iterative process is used throughout the life of the project to accomplish this. During this process, an effort is made to identify any unique end-user needs and expectations and to obtain customer approval to include them or customer justification to omit them from the needs statement.

Typical Work Products
- technical performance parameters
- needs statement

Notes
Examples of techniques to elicit needs include
- Joint Applications Design (JAD) meetings
- interface control working groups
- technical control working groups
- interim program reviews
- questionnaires, interviews, operational scenarios obtained from users
- prototypes and models
- brainstorming
- Quality Function Development (QFD)
- market surveys
- beta testing
- extraction from documents, standards, specs., etc.
- observation of existing systems, environments, and workflow patterns
- information modeling

Environmental, legal, and other constraints which may be external to the customer must also be applied when creating and resolving the set of system requirements.

In the case of non-negotiated situations, the surrogate for the end user or customer is frequently the customer relations or marketing part of the organization.

FAA-iCMM Traceability
1. Elicit the customer's needs, expectations, and measures of effectiveness. *(SE: BP 06.01)*

BP 01.02 Analyze Needs

Analyze the customer's needs and expectations to develop a preliminary operational concept of the system.

Description
An analysis is performed to determine what impact the intended operational environment will have on the ability to satisfy the customer’s needs and expectations. Feasibility, mission needs, cost constraints, potential market size, etc., must all be taken into account, depending on the product context. The objective of the analysis is to determine system concepts that will satisfy the customer needs and expectations, and then translate these concepts into top-level system requirements. In parallel with this activity, the parameters that will be used to evaluate system effectiveness are determined based on customer input and the preliminary system concept.

Typical Work Products
- operational concept
- system concept
- system cost
- technical parameters
- market-segment description

Notes
It is often necessary to help the customer formulate complete concepts. The customer's needs and expectations should be probed to ensure that the developer adequately understands them and has prioritized them correctly.

Expression of the logistics, support, maintenance, training, etc., are ways to capture system needs for feedback to the customer.

Examples of formal methodologies used to analyze needs include
- Quality Function Deployment (QFD)
- trade studies
- mathematical techniques (design of experiments, sensitivity analysis, timing, sizing, Monte Carlo simulation)
- prototypes
- customer value determination cycle

FAA-iCMM Traceability
1. Analyze the customer's needs and expectations to develop a preliminary operational concept of the system. *(SE: BP 06.02)*

BP 01.03 Develop System Requirements

Develop a statement of system requirements.

Description
Once a complete set of customer needs and expectations and a preliminary operational and system concept are available, they are translated into top-level system requirements.

Typical Work Products
- system requirements

Notes
System requirements may be initially provided by the customer. In this case, these requirements are analyzed, finding any inconsistencies or holes, and revised as necessary to ensure the integrity of the requirements set. In other cases, the systems engineering effort creates the entire set of system requirements.

System requirements may be documented formally using a customer-specified format or internal organization, or they may be captured informally.

FAA-iCMM Traceability
1. Develop a statement of system requirements. *(SE: BP 06.03)*

BP 01.04 Obtain Customer Agreement

Obtain customer agreement that system requirements satisfy their needs and expectations.

Description
Customer concurrence on interpretation of needs, operations concept, results of analyses, and translation of needs into system requirements is obtained initially via extensive communication.

Typical Work Products
- validated system requirements
- storyboards
- models

Notes
Examples of forums to obtain customer concurrence include
- working groups
- formal program reviews
- payment milestones
- in-process reviews
- status meetings
- weekly telephone conferences
- focus groups
- beta tests

FAA-iCMM Traceability
1. Obtain customer agreement that system requirements satisfy their needs and expectations. *(SE: BP 06.04)*

BP 01.05 Inform Customer

Inform the customer on a regular basis about the status and disposition of needs, expectations, and measures of effectiveness.

Description
Communication with the customer is particularly crucial while analyzing customer needs and deciding on general approaches. A key aspect of refining the common understanding of customer needs and expectations is communicating the results of preliminary analysis and obtaining the customer's feedback. Informing the customer continues throughout the life of the project as needs evolve and requirements change. Another aspect of building customer understanding could be eliciting and stimulating new needs.

Typical Work Products
- technical interchange minutes
- prototypes
- requirement traceability tables

Notes
Examples of forums to inform the customer include
- working groups
- formal program reviews
- payment milestones
- in-process reviews
- status meetings
- weekly telephone conferences
- focus groups
- beta tests

FAA-iCMM Traceability
1. Inform the customer on a regular basis about the status and disposition of needs, expectations, and measures of effectiveness. *(SE: BP 06.05)*

Table PA 01 - 1. Merging Needs Practices

Needs ***Base Practices***	***SE-CMM*** **Understand Customer Needs and Expectations:** ***Base Practices***
1. Elicit needs	6.1 Elicit the customer's needs, expectations, and measures of effectiveness.
2. Analyze Needs	6.2 Analyze the customer's needs and expectations to develop a preliminary operational concept of the system.
3. Develop System Requirements	6.3 Develop a statement of system requirements.
4. Obtain Customer Agreement	6.4 Obtain customer agreement that system requirements satisfy their needs and expectations.
5. Inform Customer	6.5 Inform the customer on a regular basis about the status and disposition of needs, expectations, and measures of effectiveness.

PA 02: Requirements

Process Area Summary

Purpose

The purpose of the Requirements process area is to develop requirements to meet the customer's operational need, to analyze the system and other requirements, to derive a more detailed and precise set of requirements, and to manage those requirements throughout the acquisition life cycle.

Major points addressed

This process area addresses the concept of operations, functional partitioning, object identification, and performance allocation, as well as capturing and maintaining the status and traceability of requirements.

The Requirements process area involves

- establishing and maintaining an agreement with the customer on the requirements for the project. This agreement covers technical and non-technical requirements and forms the basis for estimating, planning, performing, and tracking activities throughout the product life cycle.
- deriving and allocating requirements, and analyzing them to ensure they are traceable, verifiable and unambiguous. This involves both the analysis of system-level requirements and the allocation of system-level or derived requirements to lower level functions or objects. Requirements are allocated to system functions, objects, people, and supporting processes, products, and services that can be used to synthesize solutions.
- ensuring that requirements are baselined, controlled, traced, and used in plans, products, and activities. The derived and allocated requirements will evolve as the systems requirements evolve over time. When corrective actions have an impact on requirements, it may be necessary to revise the derived and allocated requirements.

Goals

1. Requirements are derived from customer needs and other appropriate sources. *(BP 02.01, BP 02.02, BP 02.03, BP 02.04)*
2. Requirements are allocated to support the synthesis of solutions. *(BP 02.05)*
3. Requirements are unambiguous, traceable, and verifiable. *(BP 02.06, BP 02.09)*
4. Requirements are controlled to establish a baseline for engineering and management use. *(BP 02.07, BP 02.09)*
5. Plans, products, and activities are kept consistent with requirements. *(BP 02.08, BP 02.09)*

Notes

Requirements form the basis for engineering the product and for managing the acquisition of the product through all acquisition life-cycle phases. Requirements are used as a documentation of system expectations, as a baseline for designing a system solution, and as proof of compliance of the designed and built system. In addition, requirements changes must be able to be incorporated at appropriate times in the life cycle.

Relationships between this PA and other PAs

The Requirements process area takes the statement of operational concept and top-level system requirements to a more detailed and precise set of requirements or specifications. The Requirements process area is interleaved with Architecture (PA 03), and may be performed concurrently with Needs (PA 01). Potential derived requirements are evaluated for feasibility against the functional partitions or objects, and are evaluated iteratively against the components of the architecture. The terms "function" and "functional" do not preclude object-oriented methods. Objects perform functions, and functions may be performed by objects. When conflicts or issues are identified with customer or derived requirements (e.g., requirements are not verifiable per System Test and Evaluation (PA 08)), the issues may be referred to the practices of Needs (PA 01) or Alternatives (PA 04). Project Management practices (PA 11) use requirements as the basis for managing the project throughout the life cycle. Configuration Management (PA 15) provides the change control necessary to manage baselines and requirements efficiently.

Base Practice List

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 02.01 **Develop detailed operational concept**: Develop a detailed operational concept of the interaction of the system, the user, and the environment, that satisfies the operational need.

BP 02.02 **Identify key requirements:** Identify key requirements that have a strong influence on cost, schedule, functionality, risk, or performance.

BP 02.03 **Derive and partition requirements:** Derive and partition requirements that may be logically inferred and implied as essential to system effectiveness, from the system and other (e.g., environmental) requirements.

BP 02.04 **Identify interface requirements:** Identify the requirements associated with external interfaces to the system and interfaces between functional partitions or objects.

BP 02.05 **Allocate requirements:** Allocate requirements to functional partitions, objects, people, or support elements to support synthesis of solutions.

BP 02.06 **Analyze requirements:** Analyze requirements to ensure that they can be implemented, verified, and validated by methods available to the development effort.

BP 02.07 **Capture and baseline requirements:** Capture, baseline, and place under change control the system and other requirements, derived requirements, derivation rationale, allocations, traceability, and requirements status.

BP 02.08 **Analyze and incorporate requirements changes**: Analyze all requirements change requests for impact on the product being acquired and upon approval, incorporate the approved changes into the product, work plans, and activities.

BP 02.09 **Maintain consistency and traceability:** Maintain consistency and traceability among requirements and between requirements and plans, work products, and activities.

FAA-iCMM Traceability

The Requirements process area merges the following process areas and key process areas:

- SE-CMM: Derive and Allocate Requirements (PA 02)
- SA-CMM: Requirements Development and Management (RDM)
- SW-CMM: Requirements Management (RM)

A few practices from the following are also mapped here:

- SE-CMM: Evolve System Architecture (PA 03)
- SA-CMM: Evaluation (EV)
- SW-CMM: Software Product Engineering (SPE)

BP 02.01 Develop Detailed Operational Concept

Develop a detailed operational concept of the interaction of the system, the user, and the environment that satisfies the operational need.

Description

This practice adds detail to the operational concept used to develop system requirements in PA 01, Needs. The detailed operational concept may include scenarios and timelines of the system's responses to stimuli. The behavior of the system and its elements is organized by states, modes, and time sequences. The behavior is flowed down via requirements allocation to subsystem elements as appropriate to discover the derived requirements for each system element. The operational behavior of the system and subsystems includes the behavior that meets the customer's operational need and any exceptional behavior that may be caused by the environment or system faults.

Typical Work Products

- operational concept
- user interaction sequences
- maintenance operational sequences
- simulations

Notes

Examples of activities to develop a detailed operational concept include

- Develop a prototype of the user interface and capture descriptions of user interaction.
- Develop a system simulation or prototype.

Development and analysis of operational concepts are valuable tools used in the practices of the Needs process, PA 01. They help the analyst to discover derived requirements via dependencies or gap analysis, and to verify and validate existing or potential requirements. Operational concepts, simulations, and prototypes are important tools to develop user-centered product or system development and maintenance processes.

FAA-iCMM Traceability

1. Develop a detailed operational concept of the interaction of the system, the user, and the environment, that satisfies the operational need.*(SE:BP 02.01)*
2. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.02 Identify Key Requirements

Identify key requirements that have a strong influence on cost, schedule, functionality, risk, or performance.

Description

In analyzing system and derived requirements, requirements are often identified that have an especially strong influence on the cost, development schedule, risk, or performance of a product. The total set of requirements is screened for potential key requirements. A cost-benefit analysis is then performed on these requirements using the process areas Alternatives (PA 04) and Architecture (PA 03). The results of analyzing these requirements are reviewed with the customer. Key requirements that show a relatively low benefit-to-cost ratio, high risk, or long development schedule are candidates for negotiation with the customer. Key requirements are a primary input to the activities of the Risk Management process area (PA 13).

Typical Work Products

- key requirements issues
- benefit-to-cost sensitivity analyses for key requirements

Notes

An example activity: Identify performance requirements that are near the state of the art, stretch limits, limits that anyone has been able to achieve.

Key requirements may be mapped to critical issues uncovered during mission analysis activities (see Needs (PA 01). They may be key because of their impact on the critical path.

FAA-iCMM Traceability

1. Identify key requirements that have a strong influence on cost, schedule, functionality, risk, or performance *(SE: BP 02.02)*

2. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.03. Derive and partition requirements

Derive and partition requirements that may be logically inferred and implied as essential to system effectiveness from the system and other (e.g., environmental) requirements.

Description

Derived requirements are those requirements that are explicitly identified or discovered as necessary implications of stated system and other top-level requirements. A system requirement's derived requirements "represent" the system requirement in terms of development constraints and verification. Typically, a system requirement may have to be decomposed into one or more derived requirements to allocate responsibility and to provide for feasible verification. Derived requirements apply to all aspects of the developed system, including the development, production, environmental, and operational parameters. Derived requirements may result from a single higher level requirement or partitions of higher level requirements.

Derive those requirements necessary to ensure that the developed product can be produced economically, operated reliably, and maintained cost effectively. A producibility analysis, as described in the Risk Management process area (PA 13), is performed to identify any critical or production engineering requirements that constrain the design. Requirements and constraints are also derived from the operational concept and system mission to ensure that the customer needs are met by providing for reliable and cost-effective operation and maintenance. These new requirements are included in the applicable requirements documentation.

Partitioning requirements into groups based on established criteria can facilitate and focus the requirements analysis. Requirements are evaluated for similarity in function and grouped into appropriate partitions. Criteria for appropriate functional partitions are established and may include functional similarity, high coupling within functional partition, low coupling between functional partitions, and object partitioning. Functional partitions are chosen so that overall performance requirements can be budgeted to the functions.

Typical Work Products

- derived operational requirements assigned to a functional or object partition
- derived performance requirements
    - producibility related design constraints
    - reliability goals for program phases
    - quantified maintainability requirements
    - operation-related derived requirements
- identified functional partitions
- functional performance budgets

Notes

Examples include

- produce derived requirements necessary to render system requirements testable
- assess system requirements for derived requirements relating to the operational environment.

- produce derived requirements necessary to allocate system timing budgets to functional partitions.
- produce rationale for derived requirements.

Derived functional and performance requirements are allocated directly, or as appropriate, to functional partitions, derived requirements, and ultimately to physical architecture elements.

Examples of requirements related to production and operations include
- mechanical or electrical design-related requirements to ensure systems can be manufactured efficiently at low risk.
- quantified maintainability requirements that are necessary to allocate to components.
- derived requirements by program phases that are necessary to meet the system mission and to allocate to components.
- operational requirements that address educational and skill levels of system operators/users.

Examples of activities to partition requirements include
- group all requirements that apply to user interaction.
- group all requirements that apply to data storage and retrieval.
- use affinity diagrams.

Functional partitions include functions and subfunctions whose requirements are ultimately allocated to physical architecture elements.

Examples of views of requirements are
- functional, object, timeline, and context.

FAA-iCMM Traceability
1. Identify appropriate derived requirements that address the effectiveness and cost of life cycle phases following development, such as production and operation *(SE: BP 03.08)*
2. Derive, from the system and other (e.g., environmental) requirements, requirements that may be logically inferred and implied as essential to system effectiveness. *(SE: BP 02.04)*
3. Partition requirements into groups based on established criteria (such as similar functionality, performance, or coupling) to facilitate and focus the requirements analysis. *(SE: BP 02.03)*
4. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.04 Develop interface requirements

Identify the requirements associated with external interfaces to the system and interfaces between functional partitions or objects.

Description
External and internal interfaces are identified throughout the analysis of system requirements. Identification of the interfaces is essential to the development of a complete set of requirements for the physical architecture. The early and complete definition of external interfaces is especially important in characterizing the overall functionality of the system because the interfaces are typically independent of the internal architecture. Also, external interfaces may be a driver of the internal architecture and functionality. This is especially true of the user interface. The internal interfaces and their related derived requirements are identified in conjunction with the functional or object partitioning. After partitions are identified, their interfaces and logical data flows are defined.

Typical Work Products
- interface requirements
- interface control document (ICD)

Notes
Examples include
- identify the input and output data for each user interface function.
- identify the input and output data of all external systems that must interface to the subject system.
- identify the physical requirements of all external system interfaces.
- identify physical mounting requirements
- identify operator stimuli and control points.
- identify signal and control structures.
- identify interfaces to the environment.

External stimuli identified in Develop Detailed Operational Concept (BP 02.01) are candidates for external interfaces. The identification of external interfaces is facilitated by the development and understanding of the detailed operational concept. In addition, the identification of external interfaces forms the basis for derived external interface requirements, as well as many derived functional and performance requirements. Interfaces are captured and controlled according to the practices of the FAA-iCMM Integration process area (PA 07).

FAA-iCMM Traceability
1. Identify the requirements associated with external interfaces to the system and interfaces between functional partitions or objects. *(SE: BP 02.05)*
2. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.05 Allocate Requirements

Allocate requirements to functional partitions, objects, people, or support elements to support synthesis of solutions.

Description
The purpose of this practice is to facilitate development of the functional architecture at successively lower partitions. Requirements are initially allocated to functional partitions (which may include functions or objects, and subfunctions) and ultimately to system elements and components. The allocations are performed so that the derived requirements can be implemented to satisfy the higher level requirements. Where it appears that a requirement is to be satisfied jointly by several system elements, it is necessary to derive separate requirements for each system element.

Alternatives should be considered regarding the allocation of requirements to people versus systems. Support elements (including processes, production, maintenance, and environmental constraints) should be evaluated for allocation of derived requirements.

Typical Work Products
- allocated requirements

Notes
Examples include
- Identify the requirements that apply to all functions or objects and allocate these requirements to all elements.
- Identify requirements that constitute a performance partition and uniquely allocate these requirements to the appropriate function or object.

Allocations of functional and performance requirements facilitate the division of responsibilities for development and testing (refer to practices of Project Management (PA 11). The practices of the process areas Needs (PA 01), Requirements (PA 02), and Architecture (PA 03) iterate the allocation of requirements.

FAA-iCMM Traceability
1. Allocate requirements to functional partitions, objects, people, or support elements to support synthesis of solutions. *(SE: BP 02.06)*
2. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.06 Analyze requirements

Analyze requirements to ensure that they can be implemented, verified, and validated by methods available to the development effort.

Description
The purpose of this practice is to ensure that the requirements that are developed for the system and the subsystems will serve for the purposes for which they are needed.
The method and feasibility of verifying requirements is established early in the development cycle. It is essential for a system or derived requirement to have characteristics that can be verified to prove that the resulting product meets the intended purpose. Evaluating the feasibility of verifying a potential requirement facilitates the production of good requirements. Examples of attributes for good requirements are correctness, completeness, consistency, clarity, non-ambiguity, verifiability, and feasibility. Throughout the life cycle, requirements are continually assessed to ensure the feasibility of verification, especially in connection with evaluating changes to requirements. Methods of verification include inspection, test, demonstration, and analysis.

Typical Work Products
- verifiability status of requirements
- captured verification method
- requirements database connected with automated tools
- requirements models in several views
- intended methods for verification of requirements
- results of feasibility, consistency and completeness checks

Notes
An example activity is assessing the feasibility of verifying each requirement.
Examples of verification methods are demonstration, unit test, system test, analysis, and inspection. It is important that requirements verification be performed iteratively and recursively with the practices of the System Test and Evaluation (PA 08).

FAA-iCMM Traceability
1. Analyze requirements to ensure they are verifiable by the methods available to the development effort. *(SE: BP 02.07)*
2. The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process. *(SW: SPE-Ac2)*
3. The project's evaluation requirements are developed in conjunction with the development of the system or software technical requirements. *(SA: EV-Ac2)*
4. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.07 Capture and baseline requirements
Capture, baseline, and place under change control, system and non-technical requirements, derived requirements, derivation rationale, allocations, traceability, and requirements status.

Description
This base practice forms the basis for systematically developing and verifying a system that meets the customer's operational and performance expectations within acceptable constraints of cost and schedule. Captured results also include other attributes of requirements such as a unique requirement number, interpretation, test method, issues, and acceptance/change status.

Baselined requirements are documented and reviewed for completeness, understandability and priority. Acceptance criteria for requirements are established and controlled.

Typical Work Products
- requirements document
- requirements databases
- interface requirements document
- functional architecture
- requirement allocation sheet
- contracting requirements

Notes
Examples of activities for capturing results and rationale include
- Enter requirements, their traceability, allocation, and status into a requirements database.
- Distribute, review and coordinate requirements data with the development team.

Configuration Management (PA 16) practices support capturing and baselining of requirements. The collection of work products from this process area is sometimes called the functional architecture.

The capture of results and rationale applies to all the practices associated with the requirements as well as the analysis of candidate solutions and design decisions.

FAA-iCMM Traceability
1. Capture system and other requirements, derived requirements, derivation rationale, allocations, traceability, and requirements status. *(SE: BP 02.09)*
2. The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of solicitation package. *(SA: RDM-Ac2)*

BP 02.08 Analyze and incorporate requirements changes

Analyze all requirements change requests for impact on the product being acquired and upon approval, incorporate the approved changes into the product, work plans, and activities.

Description
The product-related contractual requirements are unambiguous, traceable, and verifiable. These requirements establish the product baseline and are managed during the acquisition, product development, and operational use. Proposed changes to these established baseline requirements are documented and appraised to determine the impact on the product being acquired. The appraisal will also determine any impacts on the performance, architecture, supportability, and resource utilization, and on contract schedule and cost. Changes are analyzed for risk. Changes that will bear impact require negotiation for approval before they are incorporated into the product, work plans, and activities. Unapproved changes (or deviations) are documented and maintained for an audit trail. Changes are tracked to completion.

Typical Work Products
- project plan
- configuration management plan
- change control notices, including version and other change history

Notes
By requiring requirements change requests to be validated and tracking the rationale, spurious change requests can be minimized.

FAA-iCMM Traceability
1. The project team appraises system requirements change requests for their impact on the software being acquired. *(SA: RDM-Ac3)*
2. The project team appraises all changes to the software-related contractual requirements for their impact on performance, architecture, supportability, system resource utilization, and contract schedule and cost. *(SA: RDM-Ac4)*
3. Changes to the allocated requirements are reviewed and incorporated into the software product. *(SW: RM-Ac3)*

BP 02.09 Maintain consistency and traceability

Maintain consistency and traceability among requirements and between requirements and plans, work products, and activities.

Description
Capture, maintain, and control the traceability and status of requirements throughout the product life cycle. Of particular importance is the relationship between higher level requirements and their associated derived requirements, which represent the higher level requirement. A continuous assessment of the lower level requirements and their traceability and sufficiency is conducted to ensure that the developed system or product meets all the requirements, but does not have features beyond those necessary to meet the requirements. That is, lower level requirements are necessary and sufficient to meet the objectives of higher level requirements. Traceability of requirements to plans, designs, work products, and activities is also maintained.

Typical Work Products
- requirement exception report
- requirement traceability tables

Notes
Requirements form the basis for work plans and for the development and maintenance of the product throughout the product life cycle. When proposed changes to these requirements are approved, the affected project plans, work products, and activities are adjusted to remain consistent with the updated approved requirements. Appropriate steps are taken to ensure that the requirements are documented, controlled, and used as the basis for plans, work products, and activities. Verification activities are performed to demonstrate the product satisfies its requirements.

Implementation of this base practice ensures consistent project processes that integrate project activities to produce correct, consistent products. The requirements, design, code, and test cases are traced to the source from which they were derived and to the products of the subsequent engineering activities. Plans and products are kept consistent with the requirements.

Examples include
- Perform analyses to ensure that related sets of derived requirements, taken as a whole, meet the intent of the parent requirement.
- Perform analyses to ensure that there are no unnecessary requirements.
- Verify requirements traceability.

All practices involving creating, changing, or verifying of requirements (especially those of the process areas Needs (PA 01), Requirements (PA 02), Architecture (PA 03), and System Test and Evaluation (PA 08)) must maintain requirements traceability. Requirements form the basis for practices in the Project Management (PA 11) and Software Development and Maintenance (PA 06) process areas.

FAA-iCMM Traceability

1. Maintain requirements traceability to ensure that lower level (derived) requirements are necessary and sufficient to meet the objectives of higher level requirements. *(SE: BP 02.08)*

2. Bi-directional traceability between the software-related contractual requirements and the contractor's software work products and services is maintained throughout the effort. *(SA: RDM-Ac5)*

3. Consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures. *(SW: SPE-Ac10)*

4. The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities. *(SW: RM-Ac2)*

5. Maintain requirement traceability for the architecture's requirements to ensure that lower level (derived) requirements are necessary and sufficient to meet the needs of higher level requirements or design. *(SE:BP 03.06)*

Table PA02-1: Merging Requirements Practices

Requirements base practices	***SE-CMM*** **Derive and Allocate Requirements:** ***Base Practices*** **(* Evolve System Architecture)**	***SA-CMM*** **Requirements Development and Management:** ***Activities Performed*** **(* Evaluation)**	***SW-CMM*** **Requirements Management:** ***Activities Performed***	***SW-CMM*** **Software Product Engineering:** ***selected Activities Performed***
1. Develop operational concept	2.1 Develop a detailed operational concept of interaction of system, user, and environment, that satisfies the operational need.	2. The project team develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
2. Identify key requirements	2.2 Identify key requirements that have a strong influence on cost, sched, functional-, risk,or performance.	2. The project team develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
3. Derive and partition requirements	2.4 Derive, from the system and other reqmts, requirements that may be logically inferred and implied as essential to system effectiveness. 2.3 Partition functions into groups based on established criteria to facilitate & focus reqmts analysis. * 3.8 Identify appropriate derived requirements that address the effectiveness and cost of life cycle phases following development, such as production and operation.	2. The project team develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
4. Identify	2.5 Identify the	2. The project team		

Requirements base practices	***SE-CMM*** **Derive and Allocate Requirements:** ***Base Practices*** **(* Evolve System Architecture)**	***SA-CMM*** **Requirements Development and Management:** ***Activities Performed*** **(* Evaluation*)***	***SW-CMM*** **Requirements Management:** ***Activities Performed***	***SW-CMM*** **Software Product Engineering:** ***selected Activities Performed***
interface requirements	requirements assoc. with external interfaces to the system and interfaces between functional partitions or objects.	develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
5. Allocate requirements	2.6 Allocate requiremts to functional partitions, objects, people, or support elements to support synthesis of solutions.	2. The project team develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
6. Analyze requirements	2.7 Analyze requirements to ensure they are verifiable by the methods available to the development effort.	* **EV-Ac2** The project's evaluation requirements are developed in conjunction with the development of the system or software technical requirements.		2. The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process.
7. Capture and baseline requirements	2.9 Capture system and other requirements, derived requirements, derivation rationale, allocations, traceability, and requirements status.	2. The project team develops and baselines software-related contractual reqmts and places them under change control early in the project, but not later than release of solicitation package.		
8. Analyze and incorporate		3. The project team appraises system	3. Changes to the allocated	

Requirements base practices	*SE-CMM* **Derive and Allocate Requirements:** ***Base Practices*** **(* Evolve System Architecture)**	*SA-CMM* **Requirements Development and Management:** ***Activities Performed*** **(* Evaluation)**	*SW-CMM* **Requirements Management:** ***Activities Performed***	*SW-CMM* **Software Product Engineering:** ***selected Activities Performed***
requirements changes		requirements change requests for their impact on software being acquired. 4. The project team appraises all changes to software-related contractual reqmts for their impact on performance, arch-itecture, support-ability, and system resource utilization and contract schedule and cost.	requirements are reviewed and incorporated into the software product.	
9. Maintain consistency and traceability	2.8 Maintain requirements traceability to ensure that lower level (derived) requirements are necessary and sufficient to meet the objectives of higher level requirements. * 3.6 Maintain requirement traceability for the architecture's requirements to ensure that lower level (derived) requirements are necessary and sufficient to meet the needs of higher level requirements or design.	5. Bi-directional traceability between the software-related contractual requirements and the contractor's software work products and services is maintained throughout the effort.	2. The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities.	10. Consistency is maintained across software work products, including the software plans, process descriptions, allocated requiremts, software requiremts, software design, code, test plans, and test procedures.
covered by generic practices		1. The project team performs its activities in accordance with its documented reqmts development and management plans.	1. The software engineering group reviews the allo-cated reqmts before they are incorp-orated into the software project.	

PA 03: Architecture

Process Area Summary

Purpose
The purpose of the Architecture process area is to provide a basis for establishing and evolving a system design.

Major points addressed
The Architecture process area involves deriving the architecture requirements, identifying key design issues, determining the functional and physical structure and interfaces, and allocating the architecture requirements to system elements. The practices described herein are expected to be performed interleaved with other systems engineering practices until the architecture is provided to the implementing or component engineering disciplines as guidance in their designs.

Goals
1. A system architecture that will meet the defined requirements is established and maintained. *(BP 03.01, BP 03.04, BP 03.05, BP 03.06).*
2. The architecture evolves to meet changing requirements. *(BP 03.02, BP 03.03)*

Notes
Architecture processes seek to achieve a match between needs and technical feasibility, to bring form to function, and to provide a basis for analysis and engineering.
System architecture comprises functional (or logical), physical (tangible), and foundation architectures. Architecture activities are applicable to all life cycle phases of a product and may be initiated either by new development, changes in requirements, or corrective actions.

Relationships between this PA and other PAs
This process area generates candidate solutions and then makes use of the Alternatives process area (PA 04) to choose an alternative that meets established criteria for the system architecture. This process area is performed iteratively with the process areas Needs (PA 01) and Requirements (PA 02). Critical architecture issues are considered in Risk Management (PA 13). Product Evolution (PA 10) considers architectural issues.

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 03.01	**Derive system architecture requirements**: Derive the requirements for the system architecture.
BP 03.02	**Identify key design issues**: Identify the key design issues that must be resolved to support successful development and maintenance of the system.
BP 03.03	**Develop architectural structure**: Generate alternative(s) and constraints for the architecture and select an appropriate solution.

BP 03.04 **Develop architectural interface requirements**: Develop the interface requirements for the selected architecture components.

BP 03.05 **Allocate architecture requirements**: Allocate the system and derived requirements to the chosen architecture components and interfaces.

BP 03.06 **Capture system architecture**: Describe the system architecture by capturing the design results and rationale.

FAA-iCMM Traceability

The Architecture process area merges the following process areas and key process areas:

- SE-CMM: Evolve System Architecture (PA 03)
- SW-CMM: selected practices from Software Product Engineering (SPE).

BP 03.01 Derive System Architecture Requirements

Derive the requirements for the system architecture.

Description
This activity makes use of and interleaves with a number of other activities, including development and evolution of system requirements, integration, and verification. Derived requirements may include requirements taken directly from the system requirements (that is, there may be existing architecture requirements), as well as requirements that are inferred from the system requirements, either directly or as constrained by the current architectures, component feasibility, etc. Types of derived requirements include performance, security, human interaction, production, maintenance, etc. Derived requirements may apply broadly or they may apply only to specific subsystems or support elements. These requirements provide a basis for the selection criteria used when analyzing architecture alternatives.

Typical Work Products
- derived maintenance requirements
- derived human interface requirements

Notes
Derived requirements for the system's architecture apply to the actual (tangible) subsystems, configuration items, or components and to the functional or notional architecture.

FAA-iCMM Traceability
1. Derive the requirements for the system architecture *(SE: BP 03.01).*

BP 03.02 Identify Key Design Issues

Identify the key design issues that must be resolved to support successful development of the system.

Description
The design activity must begin with an awareness of the many issues facing the system development. An evaluation must take place to determine the subset of the many issues that are the design drivers for the system. This subset of key design issues becomes a constraint on the system design and development. This activity also identifies analyses and trade studies that are performed to select appropriate architecture and design alternatives. Key design issues are input to or output from Risk Management (PA 13).

Typical Work Products
- list of key design issues
- analyses to be performed
- trade studies to be performed

Notes
Key design issues may include cost drivers, performance drivers, risk, or technology. In an integrated product development team environment, key design issues may identify the need for "specialty engineers" to be a part of the design team. There may be issues seemingly unrelated to the system that become key design issues. An example of such an issue is compliance with laws governing the manufacturing or disposal of a product.

FAA-iCMM Traceability
1. Identify the key design issues that must be resolved to support successful development of the system *(SE: BP 03.02)*
2. The software design is developed, maintained, documented, and verified according to the project's defined software process, to accommodate the software requirements and to form the framework for coding. *(SW: SPE-Ac3)*

BP 03.03 Develop Architectural Structure

Generate alternative(s) and constraints for the architecture and select an appropriate solution.

Description
A structure for the system architecture is developed that satisfies the system requirements, derived requirements, and architecture requirements. The system's architectural structure includes subsystems, configuration items, or components, as well as their interrelationships, which are developed to meet the requirements.

Typical Work Products
- architecture structure
- identified interfaces
- engineering drawings

Notes
The identified elements of the system's architectural structure constitute the major "pieces" of the system to be developed, upgraded, maintained, or integrated. For new development, these elements are optimally selected through the analysis of alternatives against established requirements or criteria. In the case of reuse or upgrades of existing systems, use of an existing architectural structure or its elements may be a requirement.
Selecting an architectural solution follows the practices of the Alternatives process area (PA 04).

FAA-iCMM Traceability
1. Generate alternative(s) and constraints for the architecture and select an architectural solution.*(SE: BP 03.03)*
2. The software design is developed, maintained, documented, and verified according to the project's defined software process, to accommodate the software requirements, and to form the framework for coding. *(SW: SPE-Ac3)*

BP 03.04 Develop Architecture Interface Requirements

Develop the interface requirements for the selected architecture components.

Description
External and internal interfaces are identified to develop a complete set of architecture requirements. Alternative solutions are developed and a solution is selected in accordance with the practices of Alternatives (PA 04).

Typical Work Products
- interface requirements
- user interface requirements
- environmental interface requirements
- subsystem interface requirements

Notes
The system architecture's interface requirements can be broadly classified as those interface requirements between system elements and entities external to the system, and those among elements of the selected architecture. Generally, all or part of the external interface requirements may be known before selecting the system architecture. Internal interface requirements are typically deferred until after the architectural structure is selected. Interface requirements must address security issues.

FAA-iCMM Traceability
1. Develop the interface requirements for the selected architecture components. *(SE: BP 03.04)*
2. The software design is developed, maintained, documented, and verified according to the project's defined software process, to accommodate the software requirements and to form the framework for coding. *(SW: SPE-Ac3)*

BP 03.05 Allocate Architecture Requirements

Allocate the system and derived requirements to the chosen architecture components and interfaces.

Description
Derived requirements, functions, or objects are allocated to system elements, as well as interfaces. Performance of the design is analyzed, and the system architecture is refined and modified as necessary.

Typical Work Products
- allocated architecture requirements
- requirements traceability data

Notes
Examples of activities for allocating architecture requirements include
- identify the requirements and derived requirements that apply to all system elements and allocate these requirements to all elements.
- identify the requirements and derived requirements that constitute a performance partition and allocate these requirements to the appropriate system element.

FAA-iCMM Traceability
1. Allocate the system and derived requirements to the chosen architecture components and interfaces. *(SE: BP 03.05)*
2. The software design is developed, maintained, documented, and verified according to the project's defined software process, to accommodate the software requirements and to form the framework for coding. *(SW: SPE-Ac3)*

BP 03.06 Capture System Architecture

Describe the system architecture by capturing the design results and rationale.

Description

The system architecture includes the functional and physical (tangible) architecture elements, their relationships, interfaces, allocated derived requirements, requirements traceability, and the rationale supporting the selected solution. The rationale for the design and architectural decisions draws heavily on the results of analyzing alternatives against established criteria and requirements. In developing the system, it is essential to capture, baseline, and disseminate the architecture description to verify that the system meets the customer's operational and performance expectations and to ensure the system is available for operation and maintenance purposes.

Typical Work Products

- physical architecture
- interface requirements
- requirement allocations
- design documents
- requirements traceability table

Notes

Examples of ways to capture the design results and rationale include

- design document
- specification
- interface control drawing
- engineering notebook entries
- block diagrams
- data flow or control flow diagrams

Design results and rationale may be stored in the same repository used for Requirements purposes (refer to Requirements (PA 02)).

FAA-iCMM Traceability

1. Describe the system architecture by capturing the design results and rationale. *(SE: BP 03.07)*
2. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding. *(SW: SPE-Ac3)*
3. The documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process. *(SW: SPE-Ac8)*

Table PA03-1. Merging Architecture Practices

Architecture Base Practices	***SE-CMM*** **Derive and Allocate Requirements:** ***Base Practices***	***SW-CMM*** **Software Product Engineering:** ***selected Activities Performed***
1. Derive system architecture requirements	3.1 Derive the requirements for the system architecture.	
2. Identify key design issues	3.2 Identify the key design issues that must be resolved to support successful development of the system.	3. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding.
3. Develop architectural structure	3.3 Generate alternative(s) and constraints for the architecture and select a solution in accordance with the Alternatives process area (PA 04).	3. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding.
4. Develop architecture interface requirements	3.4 Develop the interface requirements for the selected architecture components.	3. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding.
5. Allocate architecture requirements	3.5 Allocate the system and derived requirements to the chosen architecture components and interfaces.	3. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding.
6. Capture results and rationale	3.7 Describe the system architecture by capturing the design results and rationale.	3. The software design is developed, maintained, documented, and verified, according to project's defined software process, to accommodate the software requirements and to form the framework for coding. 8. The documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process.
to other PAs	3.6 Maintain requirement traceability for the architecture's requirements to ensure that lower level (derived) requirements are necessary and sufficient to meet the needs of higher level requirements or design. (PA 02) 3.8 Identify appropriate derived requirements that address the effectiveness and cost of life cycle phases following development, such as production and operation. (PA 02)	

PA 04: Alternatives

Process Area Summary

Purpose
The purpose of Alternatives is to perform studies and analyses that will result in the selection of a solution to meet the identified problem or issue and its defined constraints. Alternatives involves defining the approach and evaluation criteria for the analysis, as well as for choosing, selecting, and studying the candidate solutions. It also involves communicating the rationale and results of the analysis

Major points addressed
The process for evaluation of alternatives includes the identification of the evaluation criteria, definition of an evaluation approach, identification of alternatives to be evaluated, selection of the recommendation, and documentation of the results of the evaluation. This process area may be used for any technical decision throughout the life cycle.

Goals
1. An evaluation strategy is established and maintained. *(BP 04.01, BP 04.02)*
2. Alternatives are identified, analyzed and selected in accordance with the established strategy. *(BP 04.03, BP 04.04, BP 04.05)*
3. Results of the evaluation are recorded for each alternative. *(BP 07.05, BP 07.06).*

Notes
Alternatives should be invoked throughout the life of a project. This PA may be used for the following types of decisions, among others
- design decision
- production decisions
- life-cycle cost decisions
- human factors decisions
- risk reduction decisions
- innovation decisions

Relationships between this PA and other PAs
Alternatives may be invoked from any of the other process areas. This process area (PA) identifies the characteristics of a process for choosing a solution from several alternatives. Candidate solutions may be provided by the invoking PA, and additional solutions may be generated in this PA when needed to inform a decision.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 04.01	**Establish Evaluation Criteria:** Establish evaluation criteria based on the identified problem and its defined constraints.
BP 04.02	**Define Analysis Approach:** Define the general approach for the analysis, based on the established evaluation criteria.
BP 04.03	**Identify Alternatives:** Identify alternatives for evaluation in addition to those provided with the problem statement.
BP 04.04	**Analyze Alternatives:** Analyze the competing candidate solutions against the established evaluation criteria.
BP 04.05	**Select Solution:** Select the solution that satisfies the established evaluation criteria.
BP 04.06	**Capture the Disposition of Each Alternative:** Capture the disposition of each alternative under consideration and the rationale for the disposition.

FAA-iCMM Traceability

The Alternatives process area is adapted from the SE-CMM Analyze Candidate Solutions PA 01. No process areas from the SA-CMM or SW-CMM were applicable.

BP 04.01 Establish Evaluation Criteria
Establish evaluation criteria based on the identified problem and its defined constraints.

Description
The criteria used in the evaluation process may vary considerably, depending on the stated problem and the level and complexity of the analysis. The criteria are weighted or ranked in order of importance. For more complex analyses, there may be levels of criteria.

Typical Work Products
- captured evaluation criteria
- trade-study criteria
- defect data-related criteria

Notes
At the system level, parameters of primary importance include system performance, cost effectiveness, producibility, logistics, risk, and operational availability and maintainability.

FAA-iCMM Tracability
1. Establish evaluation criteria based on the identified problem and its defined constraints. *(SE: BP 01.01)*

BP 04.02 Define Analysis Approach
Define the general approach for the analysis based on the established evaluation criteria.

Description
The general approach, resources, and procedures for performing the analysis should be defined based on the evaluation criteria, personnel, tools, facilities, special equipment, and related resources. The general approach for the analysis should be defined and documented to ensure that the procedures can be consistently repeated.

Typical Work Products
- trade-study approach
- problem solving process

Notes
Some example approaches that could be used to analyze candidate solutions are
- prototyping
- simulation
- modeling
- trade study
- decision tree analysis
- literature search
- exploitation of prior analyses
- elicitation of expert judgment
- process quality improvement team

FAA-iCMM Tracability
1. Define the general approach for the analysis, based on the established evaluation criteria. *(SE: BP 01.02)*

BP 04.03 Identify Alternatives
Identify alternatives for evaluation in addition to those provided with the problem statement.

Description
Candidate solutions may be furnished with the need for analysis. As the analysis proceeds, other alternatives may be added to the list of candidate solutions.

Typical Work Products
- trade-study alternatives
- decision tree

Notes
Some requests for analysis may be made without supplying any candidate solutions; in these cases, the subject matter experts identify all of the alternative candidate solutions.
On the other hand, some requests for analysis may be made that already supply every useful candidate solution. In that case, this practice would not be applicable.

FAA-iCMM Tracability
1. Identify alternatives for evaluation in addition to those provided with the problem statement. *(SE: BP 01.03)*

BP 04.04 Analyze Alternatives
Analyze the competing candidate solutions against the established evaluation criteria.

Description
Analyses should be defined, conducted, and documented at the various levels of functional or physical detail to support the decision needs of the systems engineering process. The level of detail of a study should be commensurate with cost, schedule, performance, and risk impacts.

Typical Work Products
- analyses of candidate solutions

Notes
An example activity is to perform a sensitivity analysis on candidate solutions to determine how much small variations in parameters will affect the outcome.

FAA-iCMM Tracability
1. Analyze the competing candidate solutions against the established evaluation criteria. *(SE: BP 01.04)*

BP 04.05 Select Solution
Select the solution that satisfies the established evaluation criteria.

Description
Zero, one, or several solutions may be found that satisfy the evaluation criteria. The objective is to arrive at a decision where the selected approach is preferred among the alternatives, based on the evaluation criteria.

Typical Work Products
- trade study
- rationale for preferred solution
- description of the preferred solution

Notes
The following questions will usually arise when selecting among alternative solutions
- How much better is the selected approach than the next best alternative?
- Is there a significant difference between the results of the comparative evaluation?
- Have all feasible alternatives been considered?
- What are the areas of risk and uncertainty?

FAA-iCMM Tracability
1. Select the solution that satisfies the established evaluation criteria. *(SE: BP 01.05)*

BP 04.06 Capture the Disposition of Each Alternative
Capture the disposition of each alternative under consideration and the rationale for the disposition.

Description
The results from all system analysis activities should be captured and maintained in a decision database. The disposition of each alternative under consideration and the rationale for the disposition should also be documented in the decision database.

Typical Work Products
- evaluation of alternatives for the trade study
- mathematical models of appropriate solutions
- reports of prototype operation
- results of tradeoff studies
- other supporting data of all studies

Notes
Examples of ways to capture results include
- formal, deliverable documentation
- informal, internal documentation
- computer files
- a prototyped product
- an engineering log book
- change request database

FAA-iCMM Tracability
1. Capture the disposition of each alternative under consideration and the rationale for the disposition. *(SE: BP 01.06)*

Table PA04-1: Merging Alternative Practices

Alternatives base practices	***SE-CMM* Analyze Candidate Solutions: *Base Practices***
1. Establish Evaluation Criteria	1.1 Establish evaluation criteria based on the identified problem and its defined constraints.
2. Define Analysis Approach	1.2 Define the general approach for the analysis, based on the established evaluation criteria.
3. Identify Alternatives	1.3 Identify alternatives for evaluation in addition to those provided with the problem statement.
4. Analyze Alternatives	1.4 Analyze the competing candidate solutions against the established evaluation criteria.
5. Select Solution	1.5 Select the solution that satisfies the established evaluation criteria.
6. Capture the Disposition of Each Alternative	1.6 Capture the disposition of each alternative under consideration and the rationale for the disposition.

PA 05: Outsourcing

Process Area Summary

Purpose
The purpose of the Outsourcing process area is to address the needs of organizations to identify the portions of the product that are to be outsourced, identify potential sources, and select the supplier for the needed capability.

Major Points Addressed
The Outsourcing process area involves identifying services to be provided by outside organizations, preparing and issuing the solicitation package, evaluating responses, conducting negotiations, and awarding the contract.

In addition to coordination of schedules, processes, and deliveries of work products, affected organizations must have a shared vision of the working relationship. Relationships can range from integrated developer and supplier product teams, to prime-contractor and subcontractor, to vendors, and more.

Outsourcing ends at contract award.

Goals
1. Qualified suppliers are selected to provide product or process components. *(BP 05.01, BP 05.02, BP 05.03, BP 05.04)*
2. A productive communications environment is established and maintained with suppliers. *(BP 05.05)*

Notes
The general term "supplier" is used to identify an organization that develops, manufactures, tests, supports, etc., a component of the system. Suppliers may take the form of contractors, product suppliers, partners, etc., according to the acquiring organization's needs.

The acquiring organization establishes a cooperative environment between itself and potential and contracted suppliers to ensure that the suppliers understand the needs of the organization. This environment provides a sound basis for providing a set of potential suppliers that is qualified to meet the needs of the organization. This usually means that a supplier can be selected that will maximize the potential success of the delivered product or service.

Relationships between this PA and other PAs
Specific activities pertaining to managing the contract are addressed in Contract Management (PA 12). Decisions made as a part of this process area should be made in accordance with the Alternatives process area (PA 04).
Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 05.01 **Identify Needed System or Process Components**: Identify needed system or process components that may be provided by other/outside organizations.

BP 05.02 **Identify Competent Suppliers**: Identify suppliers that have shown expertise or capability in the identified areas.

BP 05.03 **Prepare for the solicitation:** Plan for the solicitation and the selection of a supplier, including objective review of estimates and inclusion of evaluation requirements in the solicitation package.

BP 5.04 **Choose Supplier**: Choose suppliers in accordance with the selection criteria.

BP 5.05 **Communicate with Suppliers**: Establish and maintain communication with suppliers emphasizing the needs, expectations, and measures of effectiveness held by the acquiring organization for the system or process components or that are to be acquired.

FAA-iCMM Traceability

The Outsourcing process area merges and extracts from the following:

- SE-CMM: Coordinate with Suppliers (PA 18)
- SA-CMM: Solicitation (SO)
- SW-CMM: Software Subcontract Management (SSM)

BP 05.01 Identify Needed System or Process Components

Identify needed system or process components that may be provided by other/outside organizations.

Description
Rarely does an organization make every component of a system. Make-versus-buy analyses and decisions determine which items will be procured. System needs that will be satisfied outside the organization are generally those in which the organization has little expertise or capability. Those needs are identified as part of a solicitation package.

Typical Work Products
- make-versus-buy trade study
- list of system components
- subset of system components for outside organizations to address
- beginnings of criteria for completion of needed work

Notes
Example practices include
- perform trade study.
- examine own organization to determine missing expertise needed to address system requirements.

FAA-iCMM Traceability
1. Identify needed systems components or services that must be provided by other/outside organizations. *(SE: BP 18.01)*
2. The work to be subcontracted is defined and planned according to a documented procedure. *(SW: SSM-Ac1)*

BP 05.02 Identify Competent Suppliers

Identify suppliers that have shown expertise and capability in the identified areas.

Description

The capabilities of the supplier should meet the needs of the organization. Issues that may be of concern include competent development processes, manufacturing processes, responsibilities for verification, on-time delivery, life cycle support processes, and ability to communicate effectively over long distances (video teleconferencing, electronic file transfers, e-mail and the like).

Typical Work Products

- qualified or preferred suppliers list
- supplier expertise and capacity or capability analysis

Notes

Example practices include

- use trade journals.
- use available library services.
- use organizational knowledge-base (perhaps an on-line system).

Identifying competent suppliers or vendors is part of pre-evaluation activities.

FAA-iCMM Traceability

1. Identify suppliers that have shown expertise in the identified areas. *(SE: BP 18.02)*
2. The software subcontractor is selected, based on an evaluation of the subcontractor's ability to perform the work, based on a documented procedure. *(SW: SSM.Ac.2)*

BP 05.03 Prepare for the solicitation

Plan for the solicitation and the selection of a supplier, including objective review of estimates and inclusion of evaluation requirements in the solicitation package.

Description
During the pre-solicitation or pre-selection period the organization prepares for the selection of a supplier through a series of actions. The principal actions are the development of an acquisition strategy and a solicitation approach. The acquisition strategy provides for the type of competition, selection, and contract type. The solicitation approach details the activities and documents necessary to perform the selection, including evaluation criteria and statement of work.

Typical Work Products
- acquisition strategy
- solicitation package
    - contract clauses
    - technical requirements
    - statement of work
    - evaluation criteria
    - evaluation plan
    - list of potential suppliers
    - contract documentation including specifications, test plans, etc.

Notes
The selection of a supplier must be planned based on a number of factors: technical requirements, cost, schedule, risks, capability of the supplier, etc. The qualified candidates list identified in BP 05.02 is an input for this phase.

The acquisition strategy is differentiated from the acquisition plan of Project Management (PA 11) in that the strategy is specific to the instant solicitation. The practices Alternatives (PA 04) are used to help prepare the evaluation plan.

FAA-iCMM Traceability
1. Cost and schedule estimates for the software products and services being sought are prepared. *(SA: SO-Ac3)*
2. Software cost and schedule estimates are independently reviewed for comprehensiveness and realism. *(SA: SO-Ac4)*
3. The evaluation requirements are incorporated into the solicitation package and resulting contract. *(SA: EV.Ac.3)*

BP 05.04   Choose Supplier

Choose suppliers in accordance with the selection criteria.

Description
Suppliers are selected in a logical and equitable manner to meet product objectives. The characteristics of a supplier which would best complement the organization's needs are determined, and qualified candidates are identified. The practices of the Alternatives process area (PA 04) are applied to select the appropriate supplier.

Typical Work Products
- selected supplier
- rationale for selecting supplier

Notes
An important consideration in the selection of the supplier is the expected working relationship. This could range from a highly integrated product team to a classical "meet the requirements" relationship. The selection criteria are likely different, depending on the desired relationship.

FAA-iCMM Traceability
1. Choose suppliers in accordance with the Analyze Candidate Solutions process areas. *(SE: BP 18.03)*
2. The software subcontractor is selected, based on an evaluation of the subcontract bidders' ability to perform the work, according to a documented procedure. (*SW: SSM-Ac2)*

BP 05.05 Communicate with Suppliers

Establish and maintain communication with suppliers, emphasizing the needs, expectations, and measures of effectiveness held by the acquiring organization for the system or process components that are to be acquired.

Description
The organization and supplier establish and maintain a mutual understanding through effective, timely, and appropriate communications. The acquiring organization must clearly identify and prioritize its needs and expectations, as well as any limitations on the part of the suppliers. The acquiring organization works closely with suppliers to achieve a mutual understanding of product requirements, responsibilities, and processes that will be applied to achieve program objectives.

Typical Work Products
- needs statement
- draft Request for Proposal
- technical performance parameters
- minutes and decisions from negotiations

Notes
Characteristics of communications include the types of information that are considered open and subject to no restrictions, the types of information subject to restrictions (e.g., policy or contractual relationships), the expected timeliness of information requests and responses, tools and methods to be used for communications, security, privacy, and distribution expectations. "Face to face" versus "at a distance" communication is important.

Expectations are ultimately documented in a contract that typically includes terms and conditions, statement of work, requirements for the products and services to be provided, list of dependencies between the supplier and the acquirer, conditions under which revisions to products are to be submitted, acceptance procedures and acceptance criteria to be used in evaluating supplier products, and procedures and evaluation criteria to be used by the acquirer to monitor and evaluate the contractor’s performance.

Examples of techniques and forums for providing needs, expectations, and measures of effectiveness to suppliers or vendors include
- trade studies
- draft contracts
- draft statements of work
- specifications
- joint meetings

FAA-iCMM Traceability
1. Provide to suppliers the needs, expectations, and measures of effectiveness held by the organization for the system components or services that are to be delivered. *(SE: BP 18.04)*
2. Maintain timely two-way communication with suppliers. *(SE: BP 18.05)*

3. The project team takes action to ensure the mutual understanding of software requirements and plans prior to contract award. *(SA: SO-Ac5)*

Table PA05-1: Merging Outsourcing Practices

Outsourcing base practices	***SE-CMM* Coordinate with Suppliers:** ***Base Practices***	***SA-CMM* Solicitation:** ***Activities Performed*** **(*Evaluation)**	***SW-CMM* Software Subcontract Management :** ***Activities Performed***
1. Identify System or Process Components	18.1. Identify needed systems components or services that must be provided by other/outside organizations.		1. The work to be subcontracted is defined and planned according to a documented procedure. (define the work)
2. Identify competent suppliers	18.2. Identify suppliers that have shown expertise in the identified areas.		2. The software subcontractor is selected, based on an evaluation of the subcontractor's ability to perform the work, based on a documented procedure.
3. Prepare for the solicitation		3. Cost and schedule estimates for the software products and services being sought are prepared. 4. Software cost and schedule estimates are independently reviewed for comprehensiveness and realism. *** EV.Ac3**. The evaluation requirements are incorporated into the solicitation package and resulting contract.	
4 Choose supplier	18.3. Choose suppliers in accordance with the Analyze Candidate Solutions process areas.		2. The software subcontractor is selected, based on an evaluation of the subcontract bidders' ability to perform the work, according to a documented procedure.
5. Communicate with Suppliers	18.4. Provide to suppliers the needs, expectations, and measures of effectiveness held by the organization for the system components or services that are to be delivered. 18.5. Maintain timely two-way communi-cation with suppliers.	5. The project team takes action to ensure the mutual understanding of software requirements and plans prior to contract award.	
covered by generic practices		1. The project team performs its activities in accordance with	1. The work to be subcontracted is defined and

Outsourcing base practices	*SE-CMM* **Coordinate with Suppliers:** ***Base Practices***	*SA-CMM* **Solicitation:** ***Activities Performed*** **(*Evaluation)**	*SW-CMM* **Software Subcontract Management :** ***Activities Performed***
		its documented solicitation plans. 2. The project team performs its activities in accordance with its documented proposal evaluation plans.	planned according to a documented procedure. 6. Changes to the software subcontractor's statement of work, subcontract terms and conditions, and other commitments are resolved according to a documented procedure.
to other PAs			3. The contractual agreement between the prime contractor and the software contractor is used as the basis for managing the subcontract. (PA 12) 4. A documented subcontractor's software development plan is reviewed and approved by prime contractor. (PA 12) 5. A documented and approved subcontractor's software development plan is used for tracking the software activities and communicating status.(PA 12) 7. The prime contractor's management conducts periodic status/coordination reviews with the software subcontractor's management.(PA 12) 8. Periodic technical reviews and interchanges are held with the software subcontractor.(PA 12) 9. Formal reviews to address the subcontractor's software engineering accomplishments and results are conducted at selected milestones according to a documented procedure.(PA 12)

Outsourcing base practices	***SE-CMM* Coordinate with Suppliers: *Base Practices***	***SA-CMM* Solicitation: *Activities Performed* (*Evaluation)**	***SW-CMM* Software Subcontract Management : *Activities Performed***
			10. The prime contractor's software quality assurance group monitors the subcontractor's software quality assurance activities according to a documented procedure. (PA 12, PA 15) 11. The prime contractor's software configuration management group monitors the subcontractor's activities for software configuration management according to a documented procedure. (PA 12) 12. The prime contractor conducts acceptance testing as part of the delivery of the subcontractor's software products according to a documented procedure.(PA 08) 13. The software subcontractor's performance is evaluated on a periodic basis, and the evaluation is reviewed with the subcontractor.(PA 12)

PA 06: Software Development and Maintenance

Process Area Summary

Purpose

The purpose of the Software Development and Maintenance process area is to produce and maintain correct, consistent software products effectively and efficiently.

Major points addressed

Software development and Maintenance involves performing the engineering tasks to build and maintain the software using a selected software process and appropriate methods and tools.

The software engineering tasks include analyzing the system requirements allocated to software (these system requirements are described in the Requirements process area), analyzing the software requirements, refining the software architecture, designing the software, implementing the software in the code, integrating the software components, and testing the software to verify that it satisfies the specified requirements (i.e., the system requirements allocated to software and the software requirements).

Documentation needed to perform the software engineering tasks (e.g., software requirements document, software design document, test plan, and test procedures) is developed and reviewed to ensure that each task addresses the results of predecessor tasks, and the results produced are appropriate for the subsequent tasks (including the tasks of operating and maintaining the software). When changes are approved, affected software work products, plans, commitments, processes, and activities are revised to reflect the approved changes.

Goals

1. The software engineering tasks are defined, integrated, and consistently performed to produce the software. (BP 06.01, BP 06.02, BP 06.03, BP 06.04, BP 06.05, BP 06.06, BP 06.07)
2. Software work products are kept consistent with each other. (BP 06.08)

Notes

This PA focuses on internal software development and maintenance. It does not focus on overseeing a contractor that is developing and/or maintaining software, although it may be useful for providing insight into the contractor’s activities.

This PA description makes reference to the “project’s selected software process.” This process is an adaptation of the Software CMM’s “standard software process.” The change was made because the idea of a standard organizational software process implies a level of maturity that a continuous model does not require for development and maintenance activities.

If the project’s organization has a standard software process, the project’s software process should be tailored from the standard software process. In the absence of an organizational standard, industry standards – such as those provided by the IEEE and other international standards bodies – should be used to provide a basis for selecting the project's software process and for integrating software engineering tasks.

Relationships between this PA and other PAs

This PA assumes that the Architecture (PA 03), Alternatives (PA 04), and Outsourcing (PA 05) PAs will consider an internal solution provider if appropriate.

The "selected software process" referenced in this process area is identified in the Project Management process area, PA 11.

The base practices of this PA begin with the analysis of the requirements allocated to software. Eliciting, deriving, and allocating requirements are addressed in the Requirements process area, PA 02.

The base practices of this PA address software unit testing and software integration testing. Additional testing, including system and acceptance testing, are addressed in the Integration process area, PA 07, and the System Evaluation process area, PA 08.

This process area does not analyze the data on defects identified in peer reviews and testing. Such analysis is performed in the Measurement process area, PA 18.

This process area makes numerous references to configuration management practices (referenced in BP 06.01, BP 06.02, BP 06.03, BP 06.04, BP 06.05). Refer to Configuration Management (PA 16) for full details.

Base practice BP 06.01 involves the selection and integration of methods and tools to support the software process. In performing this practice, the output of the Innovation process area (PA 23) should be considered and applied as appropriate.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 06.01 **Integrate Methods and Tools**: Integrate appropriate software engineering methods and tools into the project's selected software processes.

BP 06.02 **Analyze Allocated Requirements**: Systematically analyze, maintain, document, and verify the software requirements.

BP 06.03 **Design Software**: Develop, maintain, document, and verify the software design to accommodate the software requirements and to form the framework for implementation.

BP 06.04 **Implement Software**: Develop, maintain, document, and verify the software to implement the software requirements and software design.

BP 06.05 **Test Software**: Perform software testing.

BP 06.06 **Perform Integration Testing**: Plan and perform integration testing of the software.

BP 06.07 **Develop Documentation**: Develop and maintain the documentation that will be used to operate and maintain the software.

BP 06.08 **Maintain Consistency across Software Work Products**: Maintain consistency across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures.

FAA-iCMM Traceability

The Software Development and Maintenance process area is based solely on the Software Product Engineering (SPE) key process area of the Software CMM.

BP 06.01 Integrate Methods and Tools

Integrate appropriate software engineering methods and tools into the project's selected software processes.

Description
This base practice involves integrating the software engineering tasks according to the project's selected software process (refer to the Project Management process area, PA 11, for practices covering the project's selected software process), and selecting methods and tools appropriate for use on the software project. Document the rationale for selecting each tool or method, and place the tools used to develop and maintain the software products under configuration management.

Typical Work Products
- description of selected software process
- selected methods and tools
- rationale for selecting tools and methods

Notes
Candidate methods and tools are selected based upon their applicability to the organization's standards, the project's selected software process, the existing skill base, availability of training, contractual requirements, capability, ease of use, and support services.

Configuration management methods and tools should be used that integrate well with other selected methods and tools. (Refer to the Configuration Management (PA 16)).

FAA-iCMM Traceability
1. Appropriate software engineering methods and tools are integrated into the project's defined software process. *(SW: SPE-Ac1)*

BP 06.02 Analyze Allocated Requirements

Systematically analyze, maintain, document, and verify the software requirements.

Description
The individuals who will be involved in analyzing the software requirements must review the allocated requirements to ensure that issues affecting the software requirements analysis are identified and resolved. This base practice also involves using effective methods for requirements analysis to derive the software requirements, and documenting the results and rationale of the requirements analysis. Analyze the software requirements to ensure they are feasible and appropriate to implement in software, clearly stated, consistent with each other, testable, and complete (when considered as a set). Identify and review software requirements problems with the group responsible for the system requirements, and make appropriate changes to the allocated and to the software requirements. (Refer to the Requirements (PA 02).) Document all the software requirements.

The group responsible for system and acceptance testing of the software must analyze each software requirement to verify that it can be tested. Identify and document the methods for verifying that each software requirement is satisfied.

Peer review the software requirements. (Refer to the Peer Review process area, PA 17.) Review and approve the software requirements document. As appropriate, review the software requirements document with the customer and end users.

Place the software requirements document under configuration management (refer to the Configuration Management process area, PA 16), and make appropriate changes to the software requirements whenever the allocated requirements change (refer to the Requirements process area, PA 02).

Typical Work Products
- analyzed software requirements and rationale in a database or document
- software requirements document
- peer review results

Notes
Software requirements cover the software functions and performance, the interfaces to both hardware and software, and other system components (e.g., humans).

Examples of methods for requirements analysis include
- functional decomposition
- object-oriented requirements analysis (“Use Case” technique)
- tradeoff studies
- simulations
- modeling
- prototyping

- scenario generation
- flow diagrams
- state-events

Examples of verification and validation methods include
- demonstration
- testing
- analysis
- inspection

Examples of individuals who review and approve the software requirements document include
- the project manager
- the system engineering manager
- the project software manager
- the software test manager

The “end users” referred to in these practices are the customer-designated end users or representatives of the end users.

FAA-iCMM Traceability
1. The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process. *(SW: SPE-Ac2)*

BP 06.03 Design Software

Develop, maintain, document, and verify the software design to accommodate the software requirements and to form the framework for implementation.

Description

The software design consists of the software architecture and the detailed software design. This base practice involves developing and reviewing design criteria. The individuals involved in the software design must review the software requirements to ensure that issues affecting the software design are identified and resolved. Use application standards where appropriate, and use effective methods to design the software.

Develop the software architecture early, within the constraints of the software life cycle and technology being used. The software architecture establishes the top-level software framework with well-defined internal and external interfaces. Review the software architecture to ensure that architecture issues affecting the software detailed design are identified and resolved. Develop the software detailed design based on the software architecture.

Document the software design (i.e., the software architecture and detailed design). The documentation of the software design covers the software components; the internal interfaces between software components; and the software interfaces to other software systems, to hardware, and to other system components (e.g., humans).

Peer review the software design document before considering the design complete. (Refer to Peer Review (PA 17).) Place the software design document under configuration management (refer to Configuration Management (PA 16)), and make appropriate changes to the software design document whenever the software requirements change.

Typical Work Products

- software architecture
- software detailed design
- software design document
- peer review results

Notes

Examples of design criteria include

- verifiability
- adherence to design standards
- ease of construction
- simplicity
- ease of planning

Examples of application standards include

- standards for operating system interfaces
- standards for computer-human interfaces

- standards for networking interfaces

Examples of software design methods include
- design reuse
- structured analysis (e.g., Yourdon-DeMarco)
- object-oriented design

FAA-iCMM Traceability

1. The software design is developed, maintained, documented, and verified, according to the project's defined software process, to accommodate the software requirements and to form the framework for coding. *(SW: SPE-Ac3)*

BP 06.04 Implement Software

Develop, maintain, document, and verify the software to implement the software requirements and software design.

Description
The individuals involved in implementation must review the software requirements and software design to ensure that issues affecting the implementation are identified and resolved. Use effective methods to implement the software. The sequence in which units are developed must account for factors such as criticality, difficulty, integration and test issues, and needs of the customer and end users, as appropriate. Each software unit must meet the exit criteria of the chosen implementation methodology before it is considered complete.

Place the software under configuration management (refer to Configuration Management (PA 16)), and make appropriate changes to the software whenever the software requirements or software design changes.

Typical Work Products
- software units
- peer review results

Notes
Examples of implementation methods include:
- structured programming
- code reuse

FAA-iCMM Traceability
1. The software code is developed, maintained, documented, and verified, according to the project's defined software process, to implement the software requirements and software design. *(SW: SPE-Ac4)*

BP 06.05 Test Software

Perform software testing.

Description
Develop testing criteria and, as appropriate, review the criteria with the customer and the end users. Use effective methods to test the software. The adequacy of testing must be determined based on:

- the level of testing performed
- the test strategy selected
- the test coverage to be achieved

Establish and use test readiness criteria for each level of software testing. Perform regression testing, as appropriate, at each test level whenever the software being tested or its environment changes.

Peer review the test plan, test procedures, and test cases before considering them ready for use. (Refer to Peer Review (PA 17).) Manage and control the test plans, test procedures, and test cases (refer to Configuration Management (PA 16)), and make appropriate changes to the test plans, test procedures, and test cases whenever the allocated requirements, software requirements, software design, or software units being tested change.

Typical Work Products

- test results
- action items or recommendations for changes

Notes
Examples of levels of testing include

- unit or component testing
- integration testing
- system testing
- acceptance testing

Examples of test strategies include

- functional (black-box)
- structural (white-box)
- statistical

Examples of test coverage approaches include

- statement coverage
- path coverage
- branch coverage
- usage profile

Examples of criteria to determine test readiness include

- software units have successfully completed a code peer review and unit testing before they enter integration testing
- the software has successfully completed integration testing before it enters system testing
- a test readiness review is held before the software enters acceptance testing

FAA-iCMM Traceability

1. Software testing is performed according to the project's defined software process. *(SW: SPE-Ac5)*

BP 06.06 Perform Integration Testing

Perform integration testing of the software.

Description
Develop and document the approach to integration testing. Review the integration test cases and test procedures with the individuals responsible for the software requirements, software design, and system and acceptance testing. Perform integration testing of the software against the designated version of the software requirements document and the software design document.

Typical Work Products
- integration test results

Notes
None

FAA-iCMM Traceability
1. Integration testing of the software is planned and performed according to the project's defined software process. *(SW: SPE-Ac6)*

BP 06.07 Develop Documentation

Develop and maintain the documentation that will be used to operate and maintain the software.

Description
Use appropriate methods and tools to develop the documentation. Documentation specialists must actively participate in planning, developing, and maintaining documentation. Develop and make available preliminary versions of the documentation early in the software life cycle for the customer, end users, and software maintainers to review and provide feedback. Verify final versions of the documentation against the software baselined for software acceptance testing. Peer review the documentation. (Refer to Peer Review (PA 17).)

Manage and control the documentation. The final documentation must be reviewed and approved by the customer, end users, and software maintainers, as appropriate.

Typical Work Products
- training documentation
- on-line documentation
- user's manual
- operator's manual
- maintenance manual
- peer review results

Notes
Examples of methods and tools include
- word processing
- case studies
- documentation reuse

Examples of documentation include
- training documentation
- on-line documentation
- user's manual
- operator's manual
- maintenance manual

FAA-iCMM Traceability
1. The documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process. *(SW: SPE-Ac8)*

BP 06.08 Maintain Consistency across Software Work Products

Maintain consistency across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, software units, test plans, and test procedures.

Description
Document software work products. Trace the software requirements, design, units, and test cases to the source from which they were derived and to the products of the subsequent software engineering activities.

Manage and control the documentation, tracing the allocated requirements through the software requirements, design, units/components, and test cases. As understanding of the software improves, propose, analyze, and incorporate changes to the software work products, plans, process descriptions, and activities as appropriate.

Adequate project staff determine the impact of a change before it is made. When changes to the allocated requirements are needed, they are approved before any software work products or activities are changed to incorporate them. Changes are tracked to completion.

Typical Work Products
- traceability matrix(ces)
- change requests
- change reports

FAA-iCMM Traceability
1. Consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures. *(SW: SPE-Ac10)*

Table PA06-1. Merging Software Development and Maintenance Practices

Software development & Maintenance Base Practices	***SW-CMM*** **Software Product Engineering:** ***Activities Performed***
1. Integrate methods and tools	**1.** Appropriate software engineering methods and tools are integrated into the project's defined software process.
2. Analyze allocated requirements	**2.** The software requirements are developed, maintained, documented, and verified by systematically analyzing the allocated requirements according to the project's defined software process.
3. Design software	**3.** The software design is developed, maintained, documented, and verified, according to the project's defined software process, to accommodate the software requirements and to form the framework for coding.
4. Implement software	**4.** The software code is developed, maintained, documented, and verified, according to the project's defined software process, to implement the software requirements and software design.
5. Test software	**5.** Software testing is performed according to the project's defined software process.
6. Perform integration testing	**6.** Integration testing of the software is planned and performed according to the project's defined software process.
7. Develop documentation	**8.** The documentation that will be used to operate and maintain the software is developed and maintained according to the project's defined software process.
8. Maintain consistency across software work products	**10.** Consistency is maintained across software work products, including the software plans, process descriptions, allocated requirements, software requirements, software design, code, test plans, and test procedures.
to other PAs	**7.** System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. (to PA 08) **9.** Data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process (to PA 17)

PA 07: Integration

Process Area Summary

Purpose
The purpose of Integration is to ensure that system elements will function as a whole.

Major points addressed
This primarily involves identifying, defining, and controlling interfaces, as well as verifying system functions that require multiple system elements.

The Integration activities begin early in the development effort, when interface requirements can be influenced by all engineering disciplines and applicable interface standards can be invoked. Interface definition continues through design and checkout. During design, emphasis is on ensuring that interface specifications are documented and communicated. During system element checkout, both prior to assembly and in the assembled configuration, emphasis is on verifying the implemented interfaces. Throughout the integration activities, interface baselines are controlled to ensure that changes in the design of system elements have minimal impact on other elements to which they interface. During testing, or other validation and verification activities, multiple system elements are checked out as integrated subsystems or systems.

Goals
1. A strategy for integrating the system elements is defined. *(BP 7.07)*
2. Interfaces are defined in accordance with the system architecture. *(BP 7.01)*
3. System elements are verified. *(BP 7.02, BP 7.03, BP 7.04)*
4. The system is integrated in accordance with the integration strategy. *(BP 7.04, BP 07.05, BP 07.06).*

Notes
None

Relationships between this PA and other PAs
There is some redundancy between the process characteristics captured in this process area and some of those in the Architecture process area (PA 03). However, the emphasis in the Architecture process area is to generate alternatives and select a solution, whereas the related emphasis in this process area is to develop a detailed description of interfaces and their verification. The importance of interfaces is also emphasized in this process area.

The interfaces must be coordinated with all affected groups as defined in Coordination (PA 14).

This PA is performed after the configuration item integration testing performed in Software Development and Maintenance (PA 06), and prior to the System Test and Evaluation (PA 08).

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 07.01 **Define Interfaces:** Develop detailed specifications of the interfaces implied by the system architecture.

BP 07.02 **Verify Receipt of System Elements:** Verify the receipt of each system element required to assemble the system in accordance with the physical architecture.

BP 07.03 **Verify System Element Correctness:** Verify the implemented design features of developed or purchased system elements against their requirements.

BP 07.04 **Verify System Element Interfaces:** Verify that the system element interfaces comply with the interface specifications prior to assembly.

BP 07.05 **Assemble Aggregates of System Elements:** Assemble aggregates of system elements in accordance with the established integration strategy.

BP 07.06 **Test System Level Integration:** Check the integrated system interfaces in accordance with the established integration strategy.

BP 07.07 **Develop Integration Strategy:** Develop an integration strategy and supporting documentation that identify the optimal sequence for receipt, assembly, and activation of the various components that make up the system.

FAA-iCMM Traceability

The Integration process area is adapted from the SE-CMM Integrate System (PA 05). Two activities of Software Product Engineering (SPE) from the SW-CMM are applicable to this PA. No process areas from the SA-CMM were applicable.

BP 07.01 Define Interfaces

Develop detailed specifications of the interfaces implied by the system architecture.

Description

The bulk of integration problems arise from unknown or uncontrolled aspects of interfaces. Therefore, system and subsystem interfaces are specified as early as possible in the development effort. Interface specifications address logical, physical, electrical, mechanical, human, and environmental parameters as appropriate. Intra-system interfaces are the first design consideration for developers of the system's subsystems. Interfaces may be used from previous development efforts (for example, Non-Developmental Items (NDI) and Commercial-off-the-shelf (COTS)) or are developed in accordance with interface standards for the given discipline or technology. Novel interfaces are constructed only for compelling reasons. Interface specifications are verified against interface requirements.

Typical Work Products

- interface descriptions
- interface control documents (i.e., an ICD)
- interface requirements documents (i.e., an IRD)

Notes

Examples of components of data interface specifications include data element description, direction, and frequency. Mechanical and environmental interface requirements may also be appropriate at the architecture phase, especially for interfaces to existing systems or subsystems.

FAA-iCMM Traceability

1. Develop detailed specifications of the interfaces implied by the system architecture. *(SE: BP 05.01)*

BP 07.02 Verify Receipt of System Elements

Verify the receipt of each system element required to assemble the system in accordance with the architecture.

Description
This practice is intended to ensure that each element of the system or subsystem is received. The elements are checked for quantity, obvious damage, and consistency between the element description and a list of element requirements. In addition, there needs to be some method to assess the timeliness of receipt of system elements.

Typical Work Products
- acceptance documents
- supplier quality assurance documents
- delivery receipts
- checked packing list

Notes
The supplier should provide a quality assurance document, for example, a quality system acceptance report, describing the quality assurance acceptance criteria, for example, vendor testing and evaluation method, metrics, assessment criteria, and instrumentation with environmental conditions, that were adhered to during acceptance and delivery of the product or system.

It is vital for safety-critical products, particularly those that are, or include, COTS/NDI items that a means be provided to ensure that system/subsystem elements, and their component parts, are produced by the appropriate manufacturer(s) or supplier(s).

An example activity is to check the list of required items to verify delivery of the expected items.

FAA-iCMM Traceability
1. Verify the receipt of each system element required to assemble the system in accordance with the physical architecture. *(SE: BP 05.03)*

BP 07.03 Verify System Element Correctness

Verify the implemented design features of developed or purchased system elements against their requirements.

Description
This practice is intended to ensure that each element of the system or subsystem functions in its intended environment. Such verification may be by test, inspection, analysis, etc., and may be executed either by the organization that will assemble the system or subsystem or by the producing organization. Some method of discerning the elements that passed verification from those elements that failed will need to be in place.

Typical Work Products
- verified system features
- exception reports

Notes
Examples of verification activities include
- inspect and/or test elements
- prepare deficiency or compliance reports
- verify that elements meet requirements before shipping by manufacturer/supplier

FAA-iCMM Traceability
1. Verify the implemented design features of developed or purchased system elements against their requirements. *(SE: BP 05.04)*
2. Integration testing of the software is planned and performed according to the project's defined software process. *(SW: SPE-Ac6)*
3. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *(SW: SPE-Ac7)*

BP 07.04 Verify System Element Interfaces

Verify that the system element interfaces comply with the interface specifications prior to assembly.

Description
This practice ensures that the interface of each element of the system or subsystem is verified against its corresponding interface specification. Such verification may be by test, inspection, analysis, etc., and may be executed either by the organization that will assemble the system or subsystem or by another organization. Some method of discerning the elements that "passed" verification from those elements that "failed" will need to be in place.

Typical Work Products
- test reports
- problem trouble reports
- acceptance reports addressing system element interfaces

Notes
Examples of verification activities include
- inspect and/or test elements to verify that the interfaces were implemented in accordance with the defined interface specifications
- prepare compliance or deficiency reports

FAA-iCMM Traceability
1. Verify that the system element interfaces comply with the interface specifications prior to assembly. *(SE: BP 05.05)*
2. Integration testing of the software is planned and performed according to the project's defined software process. *(SW: SPE-Ac6)*
3. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *(SW: SPE-Ac7)*

BP 07.05 Assemble Aggregates of System Elements

Assemble aggregates of system elements in accordance with the established integration strategy.

Description
This practice ensures that the assembly of the system elements into larger or more complex assemblies is conducted in accordance with the planned strategy. Testing of the aggregates is explicitly addressed in System Test and Evaluation (PA 08).

Typical Work Products
- integration reports
- exception reports

Notes
Examples of system element assembly include
- subsystem build
- subsystem test

FAA-iCMM Traceability
1. Assemble aggregates of system elements in accordance with the established integration strategy. *(SE: BP 05.06)*

BP 07.06 Test System Level Integration

Check the integrated system interfaces in accordance with the established integration strategy.

Description
This practice ensures that a planned strategy is followed to assemble the system elements into the final system and test the assembled system. This practice includes the installation and integration of the system at operational facilities. System testing is explicitly addressed in System Test and Evaluation (PA 08).

Typical Work Products
- installation and integration checklist/reports
- integrated system
- installation integration test reports

Notes
An example activity is integration testing, which includes assembling the system according to the integration plan or strategy. This may include the practice of system verification procedures, for example, using a checklist in system verification procedures.

FAA-iCMM Traceability
1. Check the integrated system interfaces in accordance with the established integration strategy. *(SE: BP 05.07)*
2. Integration testing of the software is planned and performed according to the project's defined software process. *(SW: SPE-Ac6)*
3. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *(SW: SPE-Ac7)*

BP 07.07 Develop Integration Strategy

Develop an integration strategy and supporting documentation that identify the optimal sequence for receipt, assembly, and activation of the various components and elements that make up the system.

Description
Using business as well as technical factors, an integration strategy is developed for receipt, assembly, activation, and loading sequence that minimizes cost and assembly difficulties. The larger or more complex the system or the more delicate its elements, the more critical the proper sequence becomes, as small changes can cause large impacts on project results.

This practice also encompasses site preparation and the installation and integration (I&I) activities conducted at system development/test sites and operational field facilities. For these activities, the integration strategy must address the proper preparation of each implementation site to ensure readiness for installation and integration, assurance that all system elements and associated interfaces function correctly, assurance that the integrated system can be connected to external systems without causing degradation, and verification of the correct operation of the installed system when operating in conjunction with other interconnecting systems.

The integration strategy should include contingency plans to minimize the impact on subsequent project schedules/costs in the event of delays in availability of various subsystems.

The typical sequence of assembly is built from the bottom up as components become subelements, elements, and subsystems, each of which must be checked prior to fitting into the next higher assembly. The sequence will encompass any effort needed to establish and equip the assembly facilities (e.g., raised floor, hoists, jigs, test equipment, I/O, and power connections). Once established, the sequence must be periodically reviewed to ensure that variations in production and delivery schedules have not had an adverse effect on the sequence or compromised the factors on which earlier decisions were made.

Typical Work Products
- integration strategy document
- assembly/check area drawings
- system/component documentation
- sequence and rationale for selected assembly

Notes
Example contents of a strategy document include
- personnel requirements
- assembly area drawings
- special handling
- system documentation for systems engineering users
- shipping schedule
- assembly sequence and rationale

- test equipment and drivers

FAA-iCMM Traceability

1. Develop an integration strategy and supporting documentation that identify the optimal sequence for receipt, assembly, and activation of the various components that make up the system. *(SE: BP 05.08)*
2. Integration testing of the software is planned and performed according to the project's defined software process. *(SW: SPE-Ac6)*

Table PA07-1: Merging Integration Practices

Integration base practices	***SE-CMM*** **Integrate System:** ***Base Practices***	***SW-CMM*** **Software Product Engineering:** ***Activities Performed***
1. Define Interfaces	5.1.Develop detailed specifications of the interfaces implied by the system architecture.	
2. Verify Receipt of System Elements	5.3.Verify the receipt of each system element required to assemble the system in accordance with the physical architecture.	
3. Verify System Element Correctness	5.4.Verify the implemented design features of developed or purchased system elements against their requirements.	6. Integration testing of the software is planned and performed according to the project's defined software process. 7. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
4. Verify System Element Interfaces	5.5 Verify that the system element interfaces comply with the interface specifications prior to assembly.	6. Integration testing of the software is planned and performed according to the project's defined software process. 7. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
5. Assemble Aggregates of System Elements	5.6.Assemble aggregates of system elements in accordance with the established integration strategy.	
6. Test System Level Integration	5.7.Check the integrated system interfaces in accordance with the established integration strategy.	6. Integration testing of the software is planned and performed according to the project's defined software process. 7. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
7. Develop Integration Strategy	5.8.Develop an integration strategy and supporting documentation that identify the optimal sequence for receipt, assembly, and activation of the various components that make up the system.	6. Integration testing of the software is planned and performed according to the project's defined software process.
to other PAs	5.2 Coordinate Interfaces. (PA 14)	

PA 08: System Test and Evaluation

Process Area Summary

Purpose
The purpose of System Test and Evaluation is to determine that the system products and services satisfy specified requirements.

Major points addressed
System Test and Evaluation involves development of the evaluation approach or strategy and the development of technical and non-technical evaluation requirements, including acceptance criteria. Evaluations (i.e., verification and validation) continue throughout the development period and results are analyzed to determine acceptability of the system products and services as they are evolving. Evaluation activities are designed to reduce duplication of effort. Evaluation begins with development of the system requirements and ends when the system is retired.

Goals
1. The evaluation approach, requirements and methods are defined to provide an objective basis to support the decision for acceptance of the system products and services. *(BP 08.01, BP 08.02, BP 08.03)*
2. Evaluations are performed as planned. *(BP 08.05)*
3. Analyses are conducted on results of evaluations and developer performance. *(BP 08.04, BP 08.06)*

Notes
Evaluation includes verification and validation.

Evaluation requirements are both technical and non-technical. An example of a non-technical requirement would include test schedules.

Specified requirements for evaluations are documented.

The term “developer” includes all organizations involved in development and maintenance of the system, including both contractors and in the case of in-house development the FAA.

Acceptance pertains to both contractor requirements and user requirements being satisfied.

Relationships between this PA and other PAs
Evaluation activities primarily address the work products of the process areas Architecture (PA 03), Software Development and Maintenance (PA 06), Integration (PA 07), Quality Assurance and Management (PA 15), and Peer Reviews (PA 17). The evaluation requirements mentioned in this process area are defined in Requirements (PA 02) and Outsourcing (PA 05). Corrective actions resulting from evaluations are monitored in the Project Management (PA 11), and Contract Management (PA 12).

Base Practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 08.01 Develop Evaluation Strategy and Requirements: Develop evaluation strategy and requirements in conjunction with the development of the system technical requirements and acquisition/development strategy.

BP 08.02 Define Evaluation Procedures: Define the detailed procedures, methods and processes to be used in evaluating system products and services.

BP 08.03 Incorporate Evaluation Requirements into the Solicitation and Contract: Identify those evaluation requirements that the developer or contractor will be responsible for performing.

BP 08.04 Monitor Developer Performance: Monitor developer performance for compliance with developer's evaluation requirements.

BP 08.05 Perform Planned Evaluations: Perform planned evaluations on the acquired products and services prior to acceptance for operational use.

BP 08.06 Analyze Evaluation Results: Analyze results of evaluations and compare them to the requirements (which include user and contract requirements) to establish an objective basis to support the decision to accept the system products and services or to take further action.

FAA-iCMM Traceability

System Test and Evaluation merges practices from:

- SE-CMM: Verification and Validation (PA 07)
- SA-CMM: Evaluation (EV)
- SW-CMM: Software Product Engineering (SPE)

BP 08.01 Develop Evaluation Strategy and Requirements

Develop evaluation strategy and requirements in conjunction with the development of the system technical requirements and acquisition/development strategy.

Description
Evaluation requirements are both technical and non-technical, and include identification of products and services to be evaluated. For each identified product or service, the overall objectives of the evaluation, acceptance criteria, responsibility for each evaluation (within the acquirer/developer team), resources, facilities, special equipment, and schedule applicable to the system products must be documented. Evaluation requirements are closely related with technical and non-technical requirements that they test. Interleaving evaluation (testability, verifiability) considerations with requirements and design saves time and effort later. Any applicable evaluation requirements should be incorporated into appropriate contracting documents as addressed in Outsourcing (PA 05).

Typical Work Products
- Acquisition Strategy Paper
- Acquisition Program Baseline
- Test Section of the Integrated Program Plan (IPP)
- strategy for the evaluation of products and services.

Notes
Example activities include
- develop test strategy
- perform test engineering research/study
- identify the system or software requirements to be evaluated
- identify architectural compliance issues to be evaluated
- establish objective evaluation and acceptance criteria
- develop test cases
- design detailed activities to perform the evaluations
- identify methods to evaluate the quality of acquired software products and services
- identify requisite resources and ensuring that these resources will be in place
- develop a detailed schedule of activities
- develop test environments
- ensure traceability of evaluation requirements to system requirements
- provide inputs to acquisition documents

FAA-iCMM Traceability
1. Establish plans for verification and validation that identify the overall requirements, objectives, resources, facilities, special equipment, and schedule applicable to the system development. *(SE: BP 07.01)*
2. The project's evaluation requirements are developed in conjunction with the development of the system or software technical requirements. *(SA: Eval-Ac2)*

BP 08.02 Define Evaluation Procedures

Define the detailed procedures, methods, and processes to be used in evaluating system products and services.

Description

Defined system evaluation consists of

- identifying operational requirements to be evaluated,
- identifying methods to evaluate the quality of acquired products and services
- defining the test environment, operational scenarios, test procedures, inputs, outputs, expected results, and evaluation acceptance criteria for evaluation of the developed system and its integration, including interoperability, with existing systems.

System evaluation (verification and validation) includes the customer as user/operator of the system during testing. Evaluation includes both structured and unstructured operation of the system or product by the user, and defines the type of data to be collected, analyzed, and reported. Evaluation also includes the definition of methods, process, reviews, inspections, and tests by which incremental products are evaluated against established criteria or requirements.

Typical Work Products

- test environment definition
- system verification procedures and test cases
- simulation requirements
- system validation procedures and test cases
- operational scenarios
- detailed work schedules.

Notes

These procedures are used for evaluating products and services through the full lifecycle.

Examples include

- identify requirements for the realistic operational environment
- define and maintain traceability between system requirements and validation activities.

FAA-iCMM Traceability

1. Define the methods, processes, and evaluation criteria by which the system or product is verified against the system or product requirements. *(SE: BP 07.03)*
2. Define the methods, process, and evaluation criteria by which the system or product will be validated against the customer's needs and expectations. *(SE: BP 07.04)*
3. Define the methods, process, reviews, inspections, and tests by which incremental products are verified against established criteria or requirements that were established in a previous phase. *(SE: BP 07.02)*
4. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *(SW: SPE-Ac.7)*

BP 08.03 Incorporate Evaluation Requirements into the Solicitation and Contract

Identify those evaluation requirements that the developer or contractor will be responsible for performing.

Description
Contract provisions typically include

- requirements for the contractor to document a plan for an evaluation of the products and services prior to delivery
- measurements that demonstrate to the project team the contractor's evaluation program and results
- mechanisms and deliverables that provide the project team sufficient data to allow evaluation and analysis of acquired products and services
- requirements for the contractor to establish a corrective action system which includes a change control process for rework and re-evaluation
- requirements to ensure that the contractor supports each of the project's evaluation activities.

Typical Work Products

- contract deliverables list
- non-technical requirements
- solicitation package, including Statement of Work

Notes
none.

FAA-iCMM Traceability

1. The evaluation requirements are incorporated into the solicitation package and resulting contract. *(SA: Eval-Ac3)*

BP 08.04 Monitor Developer Performance

Monitor developer performance for compliance with developer's evaluation requirements.

Description

Monitor the developer's performance throughout the project lifecycle. This includes attending reviews (both technical and non-technical), reviewing interim work products, and preparing for the delivery of the final work product.

Typical Work Products

- system test procedures
- minutes of reviews
- traceability of evaluation requirements to test documents (e.g. a Verification Requirements Traceability Matrix)

Notes

Developer performance includes development and maintenance of both products and services.

Examples include

- define the test environment, test cases, inputs, expected results, and evaluation criteria for system test
- define and maintain traceability between system requirements and verification activities
- develop a detailed schedule of activities
- Perform formal and informal technical reviews

FAA-iCMM Traceability

1. The project team assesses contractor's performance for compliance with evaluation requirements *(SA: Eval-Ac4)*

BP 08.05 Perform Planned Evaluations

Perform planned evaluations on the acquired products and services prior to acceptance for operational use.

Description
Incremental and final deliverable work products, subsystems, components, and systems are evaluated (verified and validated). Evaluations start early in the project and are performed according to defined procedures. The results are recorded to support analysis and comparison with expected results defined in the verification procedures. Verification of requirements, design, and as-built components involves both comparison with established standards and criteria and comparison with the parent work product from a prior phase (e.g., comparison of the requirements with the design). The project team may assess supplier's performance for compliance with evaluation requirements. Validation is performed to ensure the customer's expectations have been understood and incorporated in the work product or system. The evaluation environment is carefully controlled to provide for replication, analysis of results, and reverification of problem areas. Planned evaluations are performed on the acquired system and services prior to acceptance for operational use. The end user will periodically participate in the evaluation of evolving products and services to determine the satisfaction of operational requirements.

Typical Work Products
- system verification data/results
- system validation data/results
- validation exception reports
- trouble reports
- test reports (data)

Notes
Examples include
- perform receiving inspection of procured components
- perform verification/system test
- perform validation/operational test and evaluation.
- perform final acceptance testing

FAA-iCMM Traceability
1. Perform the verification and validation activities that are specified by the verification and validation plans and procedures, and record the results. *(SE: BP 07.05)*
2. Planned evaluations are performed on the acquired software products and services prior to acceptance for operational use. *(SA: Eval-Ac5)*
3. The end user periodically participates in the evaluation of evolving software products and services to determine the satisfaction of operational requirements. *(SA: CPM-Ac6)*
4. The prime contractor conducts acceptance testing as part of the delivery of the subcontractors software products according to a documented procedure. *(SW: SSM-Ac12)*
5. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *(SW: SPE-Ac7)*

BP 08.06 Analyze Evaluation Results

Analyze results of evaluations and compare them to the requirements (which include user and contract requirements) to establish an objective basis to support the decision to accept the system products and services or to take further action.

Description
Evaluation activities are executed and the resulting data are collected according to established plans and procedures. The data resulting from evaluation are then analyzed against the defined evaluation criteria. Analysis reports are prepared to indicate whether or not requirements were met and, in the case of deficiencies, assess the degree of success or failure, categorize the probable cause of failure, and support decisions to accept/decline products.

Typical Work Products
- test deficiency reports
- test incident reports
- test reports (analysis)

Notes
Examples include:
- document assessments
- assess inspection results for root causes
- document test results
- assess test results for root causes
- analyze test anomalies
- prepare quick -look reports.

FAA-iCMM Traceability
1. Compare the collected test, inspection, or review results with established evaluation criteria to assess the degree of success. *(SE: BP 07.06)*
2. The project team assesses contractor's performance for compliance with evaluation requirements. *(SA: Eval-Ac4)*
3. Results of the evaluation are analyzed and compared to the contract's requirements to establish a basis for acceptance. *(SA: Eval-Ac6)*

Table PA 08 - 1: Merging System Test and Evaluation Practices

System Test and Evaluation base practices	***SE-CMM*** **Verification and Validation:** ***Base Practices***	***SA-CMM*** **Evaluation: (*Contract Performance Management)** ***Activities Performed***	***SW-CMM*** **Software Product Engineering: (*Software Subcontract Management)** ***Activities Performed***
1. Develop Evaluation Strategy and Req nts	7.1. Establish plans for verification and validation that identify the overall requirements, objectives, resources, facilities, special equipment, and schedule applicable to the system development.	2. The project's evaluation requirements are developed in conjunction with the development of the system or software technical requirements.	
2. Define Evaluation Procedures	7.2.Define the methods, process, reviews, inspections, and tests by which incremental products are verified against established criteria or requirements that were established in a previous phase. 7.3.Define the methods, processes, and evaluation criteria by which the system or product is verified against the system or product requirements. 7.4.Define the methods, process, and evaluation criteria by which the system or product will be validated against the customer's needs and expectations.		7. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements.
3. Incorporate Evaluation Requirements into the Solicitation and Contract		3. The evaluation requirements are incorporated into the solicitation package and resulting contract.	

System Test and Evaluation base practices	***SE-CMM*** **Verification and Validation:** ***Base Practices***	***SA-CMM*** **Evaluation: (*Contract Performance Management)** ***Activities Performed***	***SW-CMM*** **Software Product Engineering: (*Software Subcontract Management)** ***Activities Performed***
4. Monitor Contractor Performance		4. The project team assesses contractor's performance for compliance with evaluation requirements.	
5. Perform Planned Evaluations	7.5.Perform the verification and validation activities that are specified by the verification and validation plans, procedures, and capture results.	5. Planned evaluations are performed on the acquired S/W products and services prior to acceptance for operational use. *6. The end user periodically participates in the evaluation of evolving software products and services to determine the satisfaction of operational requirements.	7. System and acceptance testing of the software are planned and performed to demonstrate that the software satisfies its requirements. *12. The prime contractor conducts acceptance testing as part of the delivery of the subcontractors software products according to a documented procedure.
6. Analyze Evaluation Results	7.6.Compare the collected test, inspection, or review results with established evaluation criteria to assess the degree of success.	4. The project team assesses contractor's performance for compliance with evaluation requirements. 6. Results of the evaluations are analyzed and compared to the contract's requirements to establish an objective basis to support the decision to accept the products and services or to take further action.	

System Test and Evaluation base practices	***SE-CMM*** **Verification and Validation:** ***Base Practices***	***SA-CMM*** **Evaluation: (*Contract Performance Management)** ***Activities Performed***	***SW-CMM*** **Software Product Engineering: (*Software Subcontract Management)** ***Activities Performed***
covered by generic practices		1. The project team performs its activities in accordance with its documented evaluation plans.	5. Software testing is performed according to the project's defined software process 6. Integration testing of SW is planned and performed according to the project's defined software process.

PA 09: Transition

Process Area Summary

Purpose
The purpose of Transition is to provide for the transition of the system being acquired to the eventual support organization.

Major points addressed
Transition involves developing and implementing the plans for transitioning the acquired system. The necessary resources are identified, budgeted for, and available when needed. Issues and risks are analyzed and mitigation plans are prepared. The developer and the support organization are informed on the contents of the engineering and support environments.

The project team provides for an orderly, smooth transition of the system from the developer to the system support organization. The designated system support organization is fully prepared to accept responsibility for the system in time to ensure uninterrupted support.

Transition begins with the definition of stable system requirements and ends when the responsibility for the system is turned over to the system support organization.

Goals
1. The system support organization demonstrates its capacity to provide the required support upon assumption of responsibility for the system. *(BP 09.01, BP 09.02, BP 09.03)*
2. Continuity of configuration and requirements management is maintained during the transition. *(BP 09.04, BP 09.05, BP 09.06)*

Notes
Effective communication between the developer and the support organization is important for a smooth transition, so it is important to gain the cooperation of both groups.

Relationships between this PA and other PAs
Some practices in the Transition process area operate in conjunction with the practices in the Project Management (PA 11).

Base Practice List
The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 09.01 **Conduct inventory:** Develop, prior to transition, a complete inventory of all subsystems and related items that are to be transitioned.

BP 09.02 **Develop and follow transition to support strategy:** Develop a strategy for the transition process and perform activities in accordance with this strategy.

BP 09.03 **Demonstrate support capability:** Prior to transition, demonstrate the support organization's capability to modify and support the system.

BP 09.04 **Oversee the configuration management of the system:** Oversee the system configuration throughout the transition.

BP 09.05 **Oversee the requirements management of the system:** Oversee the system requirements and their traceability throughout the transition.

BP 09.06 **Transfer and tailor developer's processes to the support organization:** Transfer and tailor the development processes used by the developer to the adaptation and support needs of the support organization.

FAA-iCMM Traceability:

The Transition Process Area is adapted from the following:

- SA-CMM: Transition to Support (TTS)

Some modifications have been applied to assume a system, rather than software perspective, and to incorporate some of the transition requirements identified by the support organization practitioners.

BP 09.01 Conduct Inventory

Develop, prior to transition, complete inventory of all subsystems and related items that are to be transitioned.

Description
The transition team must develop a list of all software, hardware, firmware, communication subsystems and related items that will be transitioned. Some examples of related items include system descriptive documentation (e.g., user manuals, administration manuals, troubleshooting manuals), necessary support software and hardware, pertinent data from the corrective action and configuration management systems, requirements management information, and maintenance documentation. Prior to transition, the system support organization must have this inventory.

Typical Work Products
- list of subsystems
- list of related items
- list of support tools
- list of data sources

Notes
If the developer has reliable information about defects and other quality related issues (e.g., error logs, trouble reports, reliability data), transfer this information to the support organization and make sure these quality tracking activities can be continued without interruption.

FAA-iCMM Traceability
1. The software support organization, prior to transition, has a complete inventory of all software and related items that are to be transitioned. *(SA: TTS-Ab4)*

BP 09.02 Develop and Follow a Transition to Support Strategy

Develop a strategy for the transition process and perform activities in accordance with the strategy.

Description
The project team performs its activities in accordance with its documented transition to support strategy. The transition strategy typically covers

- objectives and scope of the transition to support activities
- allocation of transition responsibilities
- definition and schedule of transition activities
- resource requirements
- transition risk analysis and risk mitigation activities
- warranty and data rights provisions
- readiness to support checklist

Typical Work Products
- transition plan
- list of risks
- support checklist

Notes
Typically the transition plan will estimate resource requirements in a different way from the developer's plans (e.g., by using a different estimation model). It is important to explain the differences and to identify transition risks associated with such differences.

FAA-iCMM Traceability
1. The project team performs its activities in accordance with its documented transition to support plans. *(SA: TTS-Ac1)*

BP 09.03 Demonstrate Support Capability

Prior to transition, demonstrates the support organization its capability to modify and support the system.

Description
Responsibility for the system is transferred only after the support organization demonstrates it capability to modify and enhance the system. This capability typically includes the availability of

- hardware, software, physical, fiscal, and personnel resources
- plans, processes, procedures, and documentation
- an established configuration management system
- an established requirements management system
- appropriate training of all personnel involved.
- software and firmware replication, test, and distribution capabilities

The “readiness to support” checklist, developed within the transition-to-support plan, is used to assess the support capability, and to prepare a “readiness to support” report.

Typical Work Products
- readiness to support report

Notes
The demonstration of the support capability involves an independent organization, such as a Quality Assurance group, and/or a Program Team representative.

FAA-iCMM Traceability
2. Responsibility for the software products is transferred only after the software support organization demonstrates its capability to modify and support the software products *(SA: TTS-Ac2)*.

BP 09.04 Oversee the Configuration Management of the System

Oversee the system configuration throughout the transition.

Description
The support organization develops a plan that typically describes how the system configuration is going to be transferred and how is going to be managed after the transfer. There are two issues to be addressed

- The support organization learns about the system configuration enough to be able to build, maintain, and distribute the system independent of the developer's assistance
- The configuration management approach is adapted to the needs of a support and enhancement organization

If the developer was using a configuration management tool, the support organization must evaluate the suitability of the tool to its needs and the necessary learning process. The choice of a configuration management tool must be documented whether a different tool is chosen or not. The configuration management transition plan contains a plan for tool migration and conversion.

Typical Work Products
- configuration management transition plan
- configuration management tool selection rationale

Notes
It is very difficult, and often not necessary, for the support organization to distinguish between configuration and requirements management. The requirements represent another system baseline that is part of the configuration. There may be no practical need to distinguish this base practice from BP 09.05.

FAA-iCMM Traceability
1. The project team oversees the configuration control of the software products throughout the transition. *(SA: TTS-Ac3)*

BP 09.05 Oversee the Requirements Management of the System

Oversee the system requirements and their traceability throughout the transition.

Description
The support organization develops a plan that typically describes how the system requirements tracking and management systems used by the developer (if any) is going to be transferred. The support organization learns about the requirements traceability system enough to be able to use it or to transfer the information to its own system. This applies to both automated and manual requirements tracking systems.

If the developer was using a requirements management tool, the support organization must evaluate the suitability of the tool to its needs and the necessary learning process. The choice of a requirements management tool must be documented whether a different tool is chosen or not. The requirements management transition plan contains a plan for tool migration and conversion.

Typical Work Products
- requirements management transition plan
- requirements management tool selection rationale

Notes
It is very difficult, and often not necessary, for the support organization to distinguish between configuration and requirements management. The requirements represent another system baseline that is part of the configuration. There may be no practical need to distinguish this base practice from BP 09.04.

FAA-iCMM Traceability
This base practice is not derived from any of the CMMs.

BP 09.06 Transfer and Tailor Developer's Processes to the Support Organization

Transfer and tailor the development processes used by the developer to the adaptation and support needs of the support organization

Description
The transfer and tailoring activities typically include

- review and analysis of developer's documentation
- mapping developer's processes to current practices and intended processes of the support organization
- conversion of the scope from development to maintenance
- conversion of the viewpoint from developer to support organization if from different organizations (e.g., if the developer is a contractor).

The support organization develops a plan to perform the transfer and tailoring activities. This plan typically describes in detail the activities to be performed and estimates resources needed for those activities.

The support organization should develop a checklist of the information to be found in the developer's process documentation, and identify possible action items to deal with the issues found in the documentation.

Typical Work Products
- process transfer and tailoring plan
- process action item list

Notes
This practice is dependent on cooperation between the developer and the support organization, and in particular their SEPGs. If such cooperation is lacking, the transfer and tailoring plan should reflect this problem and deal with the risks associated with it.

FAA-iCMM Traceability
This base practice is not derived from any of the CMMs.

Table PA09-1: Merging Transition Practices

Transition base practices	***SA-CMM* Transition to Support: *Abilities to Perform***	***SA-CMM* Transition to Support: *Activities Performed***
1. Conduct inventory	4. The software support organization, prior to transition, has a complete inventory of all software related items that are to be transitioned.	
2. Develop and follow transition to support strategy		1. The project team performs its activities in accordance with its documented transition to support plans.
3. Demonstrate support capability		2. Responsibility for the software products is transferred only after the software support organization demonstrates its capability to modify and support the software products.
4. Oversee the configuration management of the system		3. The project team oversees the configuration control of the software products throughout the transition.
5. Oversee the requirements management of the system		
6. Transfer and tailor developer's processes to support organization		

PA 10: Product Evolution

Process Area Summary

Purpose
The purpose of Product Evolution is to introduce services, equipment, and new technology to achieve the optimal benefits in product evolution, cost, schedule, and performance over time as the product line evolves throughout its life cycle toward its ultimate objectives.

Major points addressed
An organization must first determine the evolution of a product. Then the organization has to decide how it will design and build those products including critical components, cost-effective tools, and efficient and effective processes.

Goals
1. Strategies that support disciplined product evolution are established and maintained. *(BP 10.01, BP 10.02, BP 10.03, BP 10.04, BP 10.05)*

Notes
This process area focuses on the evolution of a product line, but not the engineering of the products themselves.

Relationships between this PA and other PAs
The Product Evolution process area addresses technology insertion to evolve products whereas the Innovation process area (PA 23) addresses technology insertion to improve the support environment. Organization Process Improvement (PA 21) addresses improvement of any processes used by the organization.

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 10.01 **Define product evolution**: Define the types of products to be offered.
BP 10.02 **Identify new product technologies**: Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.
BP 10.03 **Adapt development processes:** Make the necessary changes in the product development cycle to support the development of new products.
BP 10.04 **Ensure critical component availability:** Ensure critical components are available to support planned product evolution.
BP 10.05 **Insert Product Technology:** Insert new technology into product development, marketing, and manufacturing.

FAA-iCMM Traceability

The Product Evolution process area is adapted from:

- SE-CMM: Manage Product Line Evolution (PA 15)

BP 10.01   Define Product Evolution

Define the types of products to be offered.

Description
Define the product lines that support the organization’s strategic vision.
Consider the organization's strengths and weaknesses, the competition, potential market size, and available technologies.

Typical Work Products

- product line definition

Notes
Defined product lines enable a more effective reuse approach and allow investments with high potential payoff.

FAA-iCMM Traceability
1. Define the types of products to be offered. *(SE:BP 15.01)*

BP 10.02 Identify New Product Technologies

Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.

Description
Identify new product technologies for potential introduction into the product line. Establish and maintain sources and methods for identifying new technology and infrastructure improvements, such as facilities or maintenance services. Managers and technical staff are kept informed of new technologies.

Typical Work Products
- reviews of product-line technology
- improvements recommended by process teams

Notes
This practice involves identifying, selecting, evaluating, and pilot testing new technologies. By maintaining an awareness of technology innovations and systematically evaluating and experimenting with them, the organization selects appropriate technologies to improve the quality of its product lines and the productivity of its engineering and manufacturing activities. Pilot efforts are performed to assess new and unproven technologies before they are incorporated into the product line. Infrastructure improvements such as facilities upgrades or enhancements to the service of the distribution chain may also provide opportunities for evolving a product line toward its future objectives.

FAA-iCMM Traceability
1. Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage. *(SE: BP 15.02)*

BP 10.03 Adapt Development Processes

Make the necessary changes in the product development cycle to support the development of new products.

Description
Adapt the organization's product development or other processes to take advantage of components intended for future use.

Typical Work Products
- adapted development processes
- other adapted processes

Notes
This practice can establish a library of reusable components that includes the mechanisms for identifying and retrieving components.

The Innovation process area (PA 23) addresses technology insertion to improve the acquisition support environment, and Organization Process Improvement (PA 21) addresses improvement of any process used by the organization. This base practice pertains to process changes for the purpose of product evolution.

FAA-iCMM Traceability
1. Make the necessary changes in the product development cycle to support the development of new products. *(SE: BP 15.03)*

BP 10.04 Ensure Critical Component Availability

Ensure critical components are available to support planned product evolution.

Description
The organization must determine the critical components of the product line and plan for their availability.

Typical Work Products
- product-line components

Notes
The availability of critical components can be ensured by incorporating considerations for the future use of these components into the product line requirements. Appropriate resources must be allocated by the organization to maintain the components continually.

FAA-iCMM Traceability
1. Ensure critical components are available to support planned product evolution. *(SE:* BP *15.04)*

BP 10.05 Insert Product Technology

Insert new technology into product development, marketing, and manufacturing.

Description
Manage the introduction of new technology into the product lines, including both modifications of existing product-line components and the introduction of new components. Identify and manage risks associated with product design changes.

Typical Work Products
- new product-line definition

Notes
The objective of this practice is to improve product quality, increase productivity, decrease life cycle cost, and decrease the cycle time for product development.

FAA-iCMM Traceability:
1. Insert new technology into product development, marketing, and manufacturing. *(SE: BP 15.05)*

Table PA10-1. Merging Product Evolution Practices

Product Evolution Base Practices	***SE-CMM*** **Manage Product Line Evolution:** ***Base Practices***
1. Define Product Evolution	**15.1.** Define the types of products to be offered.
2. Identify New Product Technologies	**15.2.** Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.
3. Adapt development processes	**15.3.** Make the necessary changes in the product development cycle to support the development of new products.
4. Ensure critical component availability	**15.4.** Ensure critical components are available to support planned product evolution.
5. Insert Product Technology	**15.5.** Insert new technology into product development, marketing, and manufacturing.

PA11: Project Management

Process Area Summary

Purpose

The purpose of Project Management is to ensure that the project achieves its objectives. This is done by planning, scheduling, costing, controlling, tracking, and negotiating the nature and scope of the work involved in system development, production, usage, and retirement, and by providing adequate visibility into actual progress and risks.

Major points addressed

The Project Management process area involves

- developing and maintaining project and technical plans throughout the project life cycle
- estimating cost, schedule, size of work products, and critical technical parameters.
- obtaining commitments from the affected groups
- monitoring and tracking the project and technical effort in accordance with the plans.
- taking appropriate action as needed

Goals

1. Plans for managing the project are established early in the project lifecycle and maintained. *(BP 11.01, BP 11.02, BP 11.03, and BP 11.05)*
2. Estimates of the project's planning parameters are established and maintained. *(BP 11.04)*
3. Commitments related to the project are established and maintained. *(BP 11.06)*
4. Progress of the project is evaluated against the project's established plans. *(BP 11.07, BP 11.08, BP 11.09)*
5. Corrective actions are taken appropriately and managed to closure. *(BP 11.10)*

Notes

All management, acquisition, and engineering activities must be integrated by comprehensive planning and tracking for the entire project.

Adequate visibility of actual progress and risk encourages timely corrective action when performance deviates significantly from plans.

Relationships between this PA and other PAs

The Project Management PA interacts with almost all of the other FAA-iCMM PAs. The project gathers data or passes data to all the Life Cycle or Engineering Processes (PAs 1-10). The Project Manager will actually manage by the Management or Project Processes (PAs 12-14), and will coordinate and work with the Support Processes (PAs 15-19) throughout the project's life cycle.

Base Practice List

The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 11.01	**Identify the Activities:** Identify project management and technical activities that form the basis for planning the system.
BP 11.02	**Identify the Life Cycle Approach:** Identify the life cycle approach that will be used to develop and support the system.
BP 11.03	**Establish Estimates:** Develop project life cycle estimates for cost, schedule, size of work products, effort, and critical technical parameters.
BP 11.04	**Establish Schedules:** Develop management and technical schedules for the project.
BP 11.05	**Establish and Maintain Plans:** Establish and maintain a plan for the project life cycle.
BP 11.06	**Establish Commitment:** Obtain commitment of all affected groups and individuals to plans, procedures, and activities.
BP 11.07	**Monitor the Project according to Established Plans:** Monitor project activities, product size, effort and costs, resources, schedule, and equipment capacity, and track them against project plans.
BP 11.08	**Track Technical Process:** Direct the technical effort, and track it against technical plans and parameters.
BP 11.09	**Review Performance Against Established Plans:** Conduct periodic, formal and informal internal reviews of the project in accordance with the plans.
BP 11.10	**Take Corrective Action:** Take corrective actions as problems or potential problems are identified.

FAA-iCMM Traceability

The Project Management process area merges the following process areas and key process areas:

- SE-CMM: Monitor and Control Technical Effort (PA 11) and Plan Technical Effort (PA 12)
- SA-CMM: Software Acquisition Planning (SAP), Project Management (PM), and Project Performance Management (PPM)
- SW-CMM: Software Project Planning (SPP), Software Project Tracking and Oversight (PTO), and Integrated Software Management (ISM).

BP 11.01 Identify the Activities

Identify project management and technical activities that form the basis for planning the system.

Description
This practice involves identifying all of the activities that are to be included in the project plan including planning and tracking the project throughout its life cycle. Management and technical activities are considered. Management activities include organizational structure, life cycle support, funding and scheduling, potential contract types and terms, end user considerations, risk management including identifying cost and schedule risks, available and projected technologies, and system testing. Technical activities include requirements analysis, system decomposition, technical risk identification, system development and testing, and work product identification. Activities related to facilities and support tools are identified.

The result of identifying the management and technical activities provides the basis for management and technical plans for the project and for a schedule of project activities.

Typical Work Products
- lists of risks
- lists of identified technical activities
- system test concept
- life cycle support concept
- technologies that will be used

Notes
Management and technical activities are related. For example, developing a risk management approach is related to the identification of risks. All of the activities that will be necessary for the project must be identified including those necessary for the successful support of the system.

Use historical records from similar projects, where possible, to develop a list of activities and gain confidence that the list is complete. Expand the list through a method such as the Delphi method ,whereby peer level experts are used to add activities and refine the list.

In Establish and Maintain Plans (BP 11.05), activities may be assigned according to different acquisition approaches that are being considered. Tradeoffs of the alternatives will in part be based on risks, need, and resources required for the activities.

FAA-iCMM Traceability
1. Identify technical activities for the entire life cycle of the project. *(SE: BP 12.05)*
2. Life cycle support of the software is included in software acquisition planning documentation. *(SA: SAP-Ac4)*
3. Software project planning is initiated in the early stages of, and in parallel with, the overall project planning. *(SW: SPP-Ac2)*
4. Software work products that are needed to establish and maintain control of the software project are identified. *(SW: SPP-Ac8)*

5. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. *(SW: SPP-Ac13)*
6. Plans for the project's software engineering facilities and support tools are prepared. *(SW: SPP-Ac14)*

BP 11.02   Identify the Life Cycle Approach

Identify the life cycle approach that will be used to develop and support the system.

Description

This practice identifies the life cycle approach that is used in the acquisition of the system. It considers management issues such as the use of multiple contracts, the need for competitive efforts, and the development life cycle that will be employed. The life cycle approach supports the development of an acquisition strategy.

At the highest level, the technical process should follow a life cycle model based on the characteristics of the project and the characteristics of the organization. Typical life cycle models include waterfall, evolutionary spiral, and incremental

Typical Work Products

- selected technical process

Notes

The technical plan developed in Establish and Maintain Plans (BP 11.05) will include process activities , inputs, outputs, sequences, and quality measures that are tied to the increments in the identified lifecycle model.

FAA-iCMM Traceability

1. Determine the technical process to be used on the project. *(SE: BP 12.04)*
2. The software acquisition strategy for the project is developed and documented. *(SA: SAP-Ac2)*
3. A software life cycle with predefined stages of manageable size is identified or defined. *(SW: SPP-Ac5)*

BP 11.03 Establish Estimates

Develop project life cycle estimates for cost, schedule, size of work products, effort, and critical technical parameters.

Description
The project's scope and size can be estimated by decomposing the conceptual system into component elements that are similar to those of other projects. The size estimate can then be adjusted for factors such as differences in complexity or other parameters throughout the life cycle of the project.

Historical sources often provide the best available information to use for initial size estimates. These estimates will be refined as more information on the current system becomes available.

A detailed estimate of project costs, including life cycle support costs is essential to good project management. Estimates of project costs are made by determining the labor costs, material costs, and subcontractor costs expected for the project's planned activities and the identified scope of the system to be built. Both direct costs and indirect costs (such as the cost of tools, training, special test and support items) are included. Historical parameters or cost models are employed to estimate labor costs based on job complexity, tools, available skills and experience, schedules, and direct and overhead rates. Appropriate reserves are established, based on identified risks.

Historical data and lessons learned are used in the estimation process. Estimates are independently reviewed.

Typical Work Products
- estimates of the scope of the system
  - number of source lines of code or function points
  - computer resources
  - number of cards of electronics
  - number of cubic yards of material to be moved
- total labor cost by skill level and schedule
- cost of material by item, vendor, and schedule
- cost of subcontracts by vendor and schedule
- feasibility cost analysis
- historical data
- lessons learned
- cost of acquisition
- cost of tools
- cost of training
- life cycle support costs
- supporting rationale

Notes

A considerable amount of project data such as scope, schedule, and material items must be collected prior to estimating costs. Checklists and historical data from other projects can be used to identify cost items that may otherwise be overlooked. Variance reports and "lessons-learned" documents are typically good sources of this type of information.

Estimates are incorporated into the plans and are maintained throughout the full life cycle.

FAA-iCMM Traceability

1. Develop estimates for the factors that affect the magnitude and technical feasibility of the project. (*SE: BP 12.02)*
2. Develop cost estimates for all technical resources required by the project. *(SE: BP 12.03)*
3. Life cycle cost and schedule estimates for the software products and services being acquired are prepared and independently reviewed. *(SA: SAP-Ac5)*
4. Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure. *(SW: SPP-Ac9)*
5. Estimates for the software project's effort and costs are derived according to a documented procedure. *(SW: SPP-Ac10)*
6. Estimates for the project's critical computer resources are derived according to a documented procedure. *(SW: SPP-Ac11)*
7. The project’s software schedule is derived according to a documented procedure. *(SW: SPP-Ac12)*
8. Actual measurement data and replanning data for the software project are recorded. *(SW: PTO-Ac11)*
9. The organization’s software process database is used for software planning and estimating. *(SW: ISM-Ac5)*

BP 11.04 Establish Schedules

Develop management and technical schedules for the project.

Description
Project schedules include system and component development, obtaining procured items, training, and preparing the engineering support environment. Schedules are based on verifiable effort models or data for identified tasks, and they must allow for task interdependencies and the availability of procured items. Schedules should also include slack time appropriate for identified risks. All affected parties must review and commit to the schedule.

Typical Work Products
- activity charts
- PERT diagrams
- project schedules
- milestone charts
- technical schedules

Notes
Activities are scheduled according to their criticality and time-frame. The basic concept is to define near-term activities more precisely than activities that start later in the project.

Derive detailed schedules for technical activities within each increment by sequencing the activities from the start of the increment, taking into account dependencies between activities.

Example: Within project constraints (e.g., contractual, market timing, customer-provided inputs), define system increments consistent with the overall technical approach. Estimate the resource hours required to develop each increment. In noncritical-paths, it may be necessary to adjust activity duration, activity sequencing, or activity start dates to avoid unacceptable resource peaking. Identify which aspects of the system that are primary drivers of project performance. Develop a metric for each aspect that can be tracked over time while the system is being developed.

Schedules typically include both customer and technical milestones. For the non-systems-engineering technical activities, use this same method while working with other disciplines according to the Coordination process area (PA 14).

FAA-iCMM Traceability:
1. Develop technical schedules for the entire project life cycle. *(SE: BP 12.07)*
2. A software life cycle with predefined stages of manageable size is identified or defined. *(SW: SPP-Ac5)*
3. The project's software schedule is derived according to a documented procedure. *(SW: SPP-Ac12)*

BP 11.05 Establish and Maintain Plans

Establish and maintain a plan for the project life cycle.

Description
Establish and maintain plans that define the project, management of the project, and interaction with internal and external organizations

The project plan is policy-driven, documented, lists activities, schedule, and resources estimates, has assigned responsibilities, has adequate resources allocated, has work products under configuration management, has activities verified for adherence to the plan and procedures or standards, has work products verified for compliance with requirements or standards, has progress measured and reported, and has corrective action taken appropriately when deviations occur.

Planning should be started early within the project life cycle and must be maintained throughout the life cycle. Software project planning is integrated into the planning process. Included in the planning process is the development of an acquisition strategy (both systems and software as appropriate). The strategy defines the overall approach of the acquisition. Included in this strategy are the life cycle support requirements for acquisition.

Resources essential to the success of the project should be identified. Resources include personnel with special skills, tools, facilities, and data. Essential resources can be identified by analyzing project tasks and schedules, and by comparing this project with similar projects.

Engineering activities in the various life cycle increments may be selected from applicable standards , known best practices within the business segment, reference models, or the organization’s historical experience.

Establish key technical parameters that can be traced over the life of the project and that will serve as in-progress indicators for meeting the technical objectives. Key technical parameters can be identified through interaction with the customer, customer requirements, market research, prototypes, identified risks, or historical experience on similar projects. Each technical parameter to be tracked should have a threshold or tolerance beyond which some corrective action would be expected. Key technical parameters should have pre-planned assessments scheduled at useful points in the project schedule.

Typical Work Products
- project management plan
- system/software acquisition plan

- software development plan
- test plan
- technical management plan
- System Engineering Management Plan (SEMP)
- Risk Management Plan
- identified critical resources
- project schedule
- selected systems engineering process for the project
- reuse plan
- technical parameters
- technical parameter thresholds

Notes
Planning of the technical activities for the full life cycle is identified in the project plans. Engineering activities should be integrated into technical planning for the entire project. These activities include the planning of engineering support facilities and tools.

Technical management plans typically include
- plans for developing the system
- plans for interacting with other organizations (e.g., subcontractors) performing the technical effort

Examples of technical parameters include:
- payload capacity of cargo aircraft
- sensor resolution
- video monitor distortion
- computer capacity, thruput, response time

Example practice: Examine the project schedule and identify the types of resources required at each point in time. List resources that are not easily obtainable. Cross check and augment this list by identifying skills that are required to synthesize the system and work products.

Establish and maintain an management plan that defines the project's interaction with all internal and external organizations (e.g., the subcontractor) performing the technical effort. Include the planned project life cycle model for the project and specific project activities. This is coordinated with Outsourcing (PA 05).

If COTS/NDI are going to be used on the project, a strategy and plan for their use should be developed that includes how they will be selected, procured, integrated, and maintained.

For the project, identify the groups internal and external to your organization that the project needs to interact with to be successful. For each group, perform the base practices of Coordination (PA 14) to define and implement each interface in terms of interaction mechanisms, interaction frequency, and problem resolution mechanisms. Risk Management (PA

13) calls for development of a risk management plan. This will be coordinated with overall planning of this PA.

FAA-iCMM Traceability:

1. Identify resources that are critical to the technical success of the project. *(SE: BP 12.01)*
2. Define project processes to support effective interaction with customer(s) and supplier(s). *(SE: BP 12.06)*
3. Establish technical parameters with thresholds for the project and the system. *(SE: BP 12.08)*
4. Use the information gathered in planning activities to develop technical management plans that will serve as the basis for tracking the salient aspects of the project and the systems engineering effort. *(SE: BP 12.09)*
12. The software acquisition strategy for the project is developed and documented. *(SA: SAP-Ac2)*
13. The software acquisition planning is documented and the planning documentation is maintained over the life of the project. *(SA: SAP-Ac3)*
14. Life cycle support of the software is included in software acquisition planning documentation. *(SA: SAP-Ac4)*
15. The organization of the project provides for the management of all project functions. *(SA: PM-Ac2)*
1. The software acquisition management activities of the project team are directed to accomplish the project directives. *(SA: PM-Ac3)*
2. The project’s software development plan is developed according to a documented procedure. *(SW: SPP-Ac6)*
6. The plan for the software product is documented. *(SW: SPP-Ac7)*
7. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. *(SW: SPP-Ac13)*
8. Plan for the project's software engineering facilities and support tools are prepared. *(SW: SPP-Ac14)*
9. Software planning data are recorded. *(SW: SPP-Ac15)*
10. A documented software development plan is used for tracking the software activities and communicating status. *(SW: PTO-Ac1)*
11. The project's software development plan is revised according to a documented procedure. *(SW: PTO-Ac2)*

BP 11.06 Establish Commitment

Obtain commitment of all affected groups and individuals to plans, procedures, and activities.

Description
This practice provides for negotiation and obtaining commitment of the affected groups and individuals that interface with the project.

The objective of project plan reviews is to ensure a bottom-up, common understanding of the process, resources, schedule, and information requirements by affected groups and individuals throughout the project. Inputs on the project plan are solicited from all affected organizational elements and project staff. Whenever possible, these inputs are incorporated to build team ownership of the plans. If an input is rejected or modified, feedback is provided to the originator. Interim and completed project plans are distributed for review. A commitment to the project plans is obtained from all groups comprising the project team.

Project interfaces include any interface with organizations and individuals that are necessary to successful project execution, whether they are inside or outside the project group. Types of interaction include information exchange, tasking, and deliveries. Methods and processes (including controls) for interaction are established as appropriate for the parties that are interacting.

Typical Work Products
- defined processes for project interfaces
- interface issues between disciplines/groups
- memoranda of understandings
- risks
- project plan inputs
- project plan comments
- project plan issues and resolutions

Notes
Affected groups and individuals typically include
- software engineering
- hardware engineering
- manufacturing
- management
- customers
- users
- partners
- subcontractors

Example activity: Identify questions that each group should answer as part of their review for commitment. (The questions may be different for different groups.) Communicate to the groups how the review will be conducted. Provide the technical management plans to the groups and, at a pre-arranged time, meet with them to discuss their comments. Produce a list of issues from the reviewers' comments and work on each issue until it is resolved.

FAA-iCMM Traceability:

1. Review the technical management plans with all affected groups and individuals, and obtain group commitment. *(SE: BP 12.10)*
2. Software acquisition planning personnel are involved in system acquisition planning. *(SW: SAP-Ac1)*
3. The software engineering group participates on the project proposal team. *(SW: SPP-Ac1)*
4. The software engineering group participates with other affected groups in the overall project planning throughout the project's life. *(SW: SPP-Ac3)*
5. Software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure. *(SW: SPP-Ac4)*
6. Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure. *(SW: PTO-Ac3)*
7. Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups. *(SW: PTO-Ac4)*

BP 11.07 Monitor the Project According to Established Plans

Monitor project activities, product size, effort and costs, resources, schedule, and equipment capacity, and track them against project plans.

Description
This practice involves directing, tracking, and controlling all phases of the project. It provides visibility of progress and insight into the risks of the project. Visibility encourages timely corrective action when performance significantly deviates from plans.

The results of analyzing the measurements of project performance are reviewed, along with other indicators of project performance, and corrective action plans are approved.

Typical Work Products
- resource usage data
- change requests for the project management plan
- analysis of project performance issues
- approved corrective actions

Notes
Monitoring the project involves tracking planned events, activities, and resources detailed in the planning documentation against actual occurrences/expenditures. The principle tracking indicators are schedule and cost related. Earned value is a typical method used to determine cost and schedule variance. Earned value is used with other indicators to provide more accurate insight into issues and problem areas.

Examples of reviewing performance include
- Meetings of the stakeholders of the project to present analyses of performance and suggested corrective actions.
- Status reports which document a particular issue or occurrence (technical meeting)
- Analysis of project management indicators
- Review of contractor prepared management reports

New project issues surface frequently throughout the project life cycle. Timely identification, analysis, and tracking of issues is crucial to controlling project performance (refer to Risk Management (PA 13)).

The project effort is continuously adjusted as project status information is acquired.
New information is integrated with historical project data. Trends that are adversely affecting the project are identified, with issues that may indicate new risks to the project. It is usually necessary to obtain more detailed data to determine the cause and extent of impact of an adverse trend or new issue before deciding whether a remedial action and a specific action plan are required. Analysis is frequently used to aid this process (e.g., modeling and simulation, expert opinion).

FAA-iCMM Traceability

1. Direct technical effort in accordance with technical management plans. *(SE: BP 11.01)*
2. Review performance against the technical management plans. *(SE: BP 11.05)*
3. The project team performs its activities in accordance with its documented software acquisition management plans. *(SA: PM-Ac1)*
4. The software acquisition management activities of the project team are directed to accomplish the project directives. *(SA: PM-Ac3)*
5. The software acquisition management activities of the project team are controlled. *(SA: PM-Ac4)*
6. The project team's software acquisition management activities are performed in accordance with the Project Management Plan. *(SA: PPM-Ac3)*
7. The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan. *(SW: PTO-Ac12)*
8. The project team performs its activities in accordance with its documented solicitation plans. *(SA: SOL-Ac1)*

BP 11.08 Track Technical Process

Direct the technical effort, and track it against technical plans and parameters.

Description
This practice involves tracking the technical effort according to technical management plans. It provides visibility into technical progress through tracking of actual progress against planned progress. Visibility encourages timely corrective action when performance significantly deviates from plans.

The actual performance of the project and its products is tracked by measuring the technical parameters established in the technical management plan. These measurements are compared to the thresholds established in the technical management plan so that warnings of problems can be communicated to management.

The performance of the project activities and its products is reviewed periodically and when technical parameter thresholds are exceeded. The results of analyzing the measurements of technical performance are reviewed, along with other indicators of technical performance, and corrective action plans are approved.

Typical Work Products
- technical parameter trend data
- resource usage
- profile of technical performance management
- change requests for the technical management plan
- analysis of technical performance issues
- approved corrective actions

Notes
Effective technical direction includes the use of appropriate communication mechanisms and timely distribution of technical information to all affected parties. All technical direction must be captured to preserve the basis for decisions and actions.

An example of a performance tracking scenario follows. For each technical parameter, define a benchmarking activity that will be used to obtain the measurement. Use persons outside of the control of the project manager to perform the benchmarking activities to ensure objective measurements. Periodically perform the benchmarking activity and compare the actual measurement with the planned values of the parameters.

New information is integrated with historical project data. Trends that are hurting the activities and with new issues that indicate risks to the activity's success are identified. Obtain more detailed data, as needed, for issues and trends that are inconclusive. Analysis frequently requires modeling and simulation tools as well as expert opinions (refer to Measurement (PA 18)).

FAA-iCMM Traceability

1. Track actual use of resources against technical management plans. *(SE: BP 11.02)*
2. Track performance against the established technical parameters*. (SE: BP 11.03)*
3. The project team tracks project status, execution, funding, and expenditures and takes action. *(SA: PM-Ac6)*
4. The acquisition organization's software acquisition process repository is used for project planning, estimating, and management. *(SA: PPM-Ac6)*
5. A documented software development plan is used for tracking the software activities and communicating status. *(SW: PTO-Ac1)*
6. The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac5)*
7. The project's software effort and costs are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac6)*
8. The project's critical computer resources are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac7)*
9. The project's software schedule is tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac8)*
10. Software engineering technical activities are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac9)*
11. The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked. *(SW: PTO-Ac10)*
12. The software engineering group conducts periodic internal reviews to track technical progress, plans, performance and issues against the software development plan. *(SW: PTO-Ac12)*

BP 11.09 Review Performance Against Established Plans

Conduct periodic, formal and informal internal reviews of the project in accordance with the plans.

Description
This practice requires the affected groups to review the progress of the project efforts, including technical progress, plans, performance, and issues. Also, issues resulting from the tracking and review of technical parameters must be analyzed to determine corrective action.

Typical Work Products
- agenda
- minutes/slides
- formal reviews (system requirements, design, and subsequent reviews, preliminary and critical design reviews and test readiness reviews)
- management reviews (MAR)
- quality assurance reviews and audits (functional configuration audit, preliminary configuration audit, process audits, product audits)
- technical reviews
- status reports
- action item list

Notes
Reviews are scheduled with agendas provided. Artifacts of the meeting are kept and action items recorded and tracked to closure. Reviews include all affected groups and individuals including for example: senior management, project management, task management, system engineering (hardware and software), test, maintenance, operations, quality assurance, end user, customer, subcontractors, external system representatives, and the business office.

FAA-iCMM Traceability
1. Review performance against the technical management plans. *(SE: BP 11.04)*
2. Analyze issues resulting from the tracking and review of technical parameters to determine corrective actions. *(SE: BP 11.05)*
3. The project team performs periodic reviews to ensure current and projected needs of the end user will be satisfied. *(SA: PPM-Ac8)*
4. The software engineering conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan. *(SW: PTO-Ac12)*
5. Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure. *(SW: PTO-Ac13)*
6. Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate. *(SW: ISM-Ac11)*

BP 11.10. Take Corrective Action

Take corrective actions as problems or potential problems are identified.

Description
When problems or potential problems are identified, take corrective actions as needed. These corrective actions may take the form, for example, of reallocating resources, changing methods and procedures, or increasing adherence to the existing plans. When changes to the management plans are necessary, revise the plan.

The project team implements a corrective action system to identify, record, track and correct problems discovered during the project.

Typical Work Products
- resource reallocations
- changes to methods and procedures
- change orders
- action items

Notes
This base practice covers whatever actions are needed to prevent anticipated problems or to correct the problems discovered. The possible actions taken under this base practice are varied and numerous.

FAA-iCMM Traceability
1. Analyze issues resulting from tracking and review of technical parameters to determine corrective actions. *(SE: BP 11.05)*
2. Take corrective actions when technical parameters indicate future problems or when actual results deviate from plans. *(SE: BP 11.06)*
3. The project team implements a corrective action system for the identification, recording, tracking, and correction of problems discovered during software acquisition. *(SA: PM-Ac5)*
4. The project team tracks project status, execution, funding, and expenditures and takes action. *(SA: PM-Ac6)*
5. The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac5)*
6. The project's software effort and costs are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac6)*
7. The project's critical computer resources are tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac7)*
8. The project's software schedule is tracked, and corrective actions are taken as necessary. *(SW: PTO-Ac8)*
9. Software engineering technical activities are tracked, and corrective actions are taken as necessary. *(SW: PTO.Ac.9)*

Table PA11-1a: Merging Project Management Practices

Project Management base practices	***SE-CMM* Monitor and Control Technical Effort: *Base Practices***	***SE-CMM* Plan Technical Effort: *Base Practices***	***SA- CMM* Software Acquisition Planning: *Activities Performed***	***SA- CMM* Project Management: *Activities Performed***
1. Identify the Activities		12.5 Identify technical activities for the entire life cycle of the project.	4. Life cycle support of the software is included in software acquisition planning documentation.	
2. Identify the Life Cycle Approach		12.4 Determine the technical process to be used on the project.	2. The software acquisition strategy for the project is developed and documented.	
3. Establish Estimates		12.2 Develop estimates for the factors that affect the magnitude and technical feasibility of the project. 12.3 Develop cost estimates for all technical resources required by the project.	5. Life cycle cost and schedule estimates for the software products and services being acquired are prepared and independently reviewed.	
4. Develop Schedules for the Project		12.7 Develop technical schedules for the entire project life cycle.		
5. Establish and Maintain Plans		12.1 Identify resources that are critical to the technical success of the project. 12.6 Define project processes to support effective interaction with customer(s) and supplier(s). 12.8 Establish technical parameters with thresholds for the project and the system. 12.9 Use the information gathered in planning activities to develop technical management plans that will serve as the basis for tracking the salient aspects of the project and the systems engineering effort.	2. The software acquisition strategy for the project is developed and documented. 3. The software acquisition planning is documented and the planning documentation is maintained over the life of the project. 4. Life cycle support of the software is included in software acquisition planning documentation.	2. The organization of the project provides for the management of all project functions. 3. The software acquisition management activities of the project team are directed to accomplish the project directives.
6. Establish Commitment		12.10 Review the technical management plans with all affected groups and individuals, and obtain group commitment.	1. Planning personnel are involved in system acquisition planning.	
7. Monitor the Project according to Established Plans	11.1 Direct technical effort in accordance with technical management plans. 11.5 Review performance			1. The project team performs its activities in accordance with its documented software acquisition management plans.

Project Management base practices	***SE-CMM*** **Monitor and Control Technical Effort:** ***Base Practices***	***SE-CMM*** **Plan Technical Effort:** ***Base Practices***	***SA- CMM*** **Software Acquisition Planning:** ***Activities Performed***	***SA- CMM*** **Project Management:** ***Activities Performed***
	against the technical management plans.			3. The software acquisition management activities of the project team are directed to accomplish the project directives. 4. The software acquisition management activities of the project team are controlled.
8. Track Project to Established Plans	11.2 Track actual use of resources against technical management plans. 11.3 Track performance against the established technical parameters.			6. The project team tracks project status, execution, funding, and expenditures and takes action.
9. Review Performance against Established Plans	11.4 Review performance against the technical management plans. 11.5 Analyze Issues resulting from the tracking and review of technical parameters to determine corrective actions.			
10. Take Corrective Action	11.5 Analyze issues resulting from tracking and review of technical parameters to determine corrective actions. 11.6 Take corrective actions when technical parameters indicate future problems or when actual results deviate from plans.			5. The project team implements a corrective action system for the identification, recording, tracking, and correction of problems discovered during software acquisition. 6. The project team tracks project status, execution, funding, and expenditures and takes action.

Table PA 11-1b: Merging Project Management Practices

Project Management base practices	***SA-CMM*** **Project Performance Management:** ***Activities Performed***	***SW CMM*** **Project Planning:** ***Activities Performed***	***SW-CMM*** **Project Tracking and Oversight:** ***Activities Performed***	***SW-CMM*** **Integrated Software Management:** ***Activities Performed***	Other CMM References
1. Identify the Activities		2. Software project planning is initiated in the early stages of, and in parallel with, the overall project planning. 8. Software work products that are needed to establish and maintain control of the software project are identified. 13. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. 14. Plan for the project's software engineering facilities and support tools are prepared.			
2. Identify the Life Cycle Approach		5. A software life cycle with predefined stages of manageable size is identified or defined.			
3. Establish Estimates		9. Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure. 10. Estimates for the software project's effort and costs are derived according to a documented procedure. 11. Estimates for the project's critical computer resources are derived according to a documented procedure.	11. Actual measurement data and replanning data for the software project are recorded.	5. The organization's software process database is used for software planning and estimating.	

Project Management base practices	***SA-CMM* Project Performance Management: *Activities Performed***	***SW CMM* Project Planning: *Activities Performed***	***SW-CMM* Project Tracking and Oversight: *Activities Performed***	***SW-CMM* Integrated Software Management: *Activities Performed***	Other CMM References
		12. The project's software schedule is derived according to a documented procedure.			
4. Develop Schedules for the Project		5. A software life cycle with predefined stages of manageable size is identified or defined. 12. The project's software schedule is derived according to a documented procedure.			
5. Establish and Maintain Plans		6. The project's software development plan is developed according to a documented procedure. 7. The plan for the software product is documented, 13. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. 14. Plans for the project's software engineering facilities and support tools are prepared. 15. Software planning data are recorded.	1. A documented software development plan is used for tracking the software activities and communicating status. 2. The project's software development plan is revised according to a documented procedure.		
6. Establish Commitment		1. The software engineering group participates on the project proposal team. 3. The software engineering group participates with other affected groups in the overall project planning throughout the project's life. 4. Software project commitments made	3. Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure. 4. Approved changes to commitments that affect the software project are		

Project Management base practices	***SA-CMM*** **Project Performance Management:** ***Activities Performed***	***SW CMM*** **Project Planning:** ***Activities Performed***	***SW-CMM*** **Project Tracking and Oversight:** ***Activities Performed***	***SW-CMM*** **Integrated Software Management:** ***Activities Performed***	Other CMM References
		to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.	communicated to the members of the software engineering group and other software-related groups.		
7. Monitor the Project according to Established Plans			12. The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.		*SA- SOL - Ac 1:* The project team performs its activities in accordance with its documented solicitation plans.
8.Track Project to established Plans	6. The acquisition organization's software acquisition process repository is used for project planning, estimating, and management.		1. A documented software development plan is used for tracking the software activities and communicating status. 5. The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary. 6. The project's software effort and costs are tracked, and corrective actions are taken as necessary. 7. The project's critical computer resources are tracked, and corrective actions are taken as necessary. 8. The project's software schedule is tracked, and corrective actions are taken as necessary. 9. Software engineering technical activities are tracked, and corrective actions are taken as necessary. 10. The software risks associated with cost, resource, schedule, and		

Project Management base practices	***SA-CMM* Project Performance Management: *Activities Performed***	***SW CMM* Project Planning: *Activities Performed***	***SW-CMM* Project Tracking and Oversight: *Activities Performed***	***SW-CMM* Integrated Software Management: *Activities Performed***	Other CMM References
			technical aspects of the project are tracked. 12. The software engineering group conducts periodic internal reviews to track technical progress, plans, performance and issues against the software development plan.		
9. Review Performance against Established Plans	8. The project team performs periodic reviews to ensure current and projected needs of the end user will be satisfied.		12. The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan. 13. Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.	11. Reviews of the software project are periodically performed to determine actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate.	
10. Take Corrective Action			5. The size of the software work products (or size of the changes to the software work products) are tracked, and corrective actions are taken as necessary. 6. The project's software effort and costs are tracked, and corrective actions are taken as necessary. 7. The project's critical computer resources are tracked, and corrective actions are taken as necessary. 8. The project's software schedule is tracked, and corrective actions are taken as necessary. 9. Software engineering technical activities are tracked,		*SA-QAM - Ac 7:* Changes are implemented to correct project's acquired products and services that are out of expected or acceptable bounds *SA - QPM Ac 7:* Changes are implemented to correct the project's defined software acquisition process where it is out of expected or acceptable bounds.

Project Management base practices	***SA-CMM*** **Project Performance Management:** ***Activities Performed***	***SW CMM*** **Project Planning:** ***Activities Performed***	***SW-CMM*** **Project Tracking and Oversight:** ***Activities Performed***	***SW-CMM*** **Integrated Software Management:** ***Activities Performed***	Other CMM References
			and corrective actions are taken as necessary.		
covered by generic practices [* or other PAs]	1. The project’s defined software acquisition process is developed and documented by tailoring the acquisition organization’s standard software acquisition process according to the organization’s tailoring guidelines. 2. The project team develops and maintains the Project Management Plan in accordance with the acquisition organization’s standard software acquisition process. 3. The project team’s software acquisition management activities are performed in accordance with the Project Management Plan. 4. The projects defined software acquisition process is revised as required to remain consistent with current project objectives. *5. [also to **PA 14**] The project team coordinates its activities with other organizations and activities supporting the project. 6. The acquisition organization’s software acquisition process repository is used for project planning, estimating, and management. 7. Critical dependencies are identified,	12. The project's software schedule is derived according to a documented procedure. 6. The project's software development plan is developed according to a documented procedure. 7. The plan for the software project is documented.		1. The projects defined software process is developed by tailoring the organization’s standard software process according to a documented procedure. 2. Each projects defined software process is revised according to a documented procedure. 3. The projects software development plan, which describes the use of the projects defined software process, is developed and revised according to a documented procedure. 4. The software project is managed in accordance with the projects defined software process. 5. The organization's software process database is used for software planning and estimating. 6. The size of the software products (or size of changes to the software work products) is managed according to a documented procedure. 7. The project's software effort and costs are managed according to a documented procedure. 8. The project's critical computer resources are managed according to a documented procedure 9. The critical dependencies and critical paths of the project's software	*SA-CPM - Ac 5*: As understanding of the software engineering process, products, and services improves, the project team may propose changes to the software products, or services, process plans, and activities. SA-QAM - Ac. 2: The acquisition organization utilizes quantitative measures as a normal part of management review and oversight of acquired products and services. *SA-QPM - Ac 5*: Reports documenting the results of the project team’s quantitative process management activities are prepared and distributed. *SA-QAM - Ac 7*: Changes are implemented to correct project’s acquired products and services that are out of expected or acceptable bounds.

Project Management base practices	***SA-CMM*** **Project Performance Management:** ***Activities Performed***	***SW CMM*** **Project Planning:** ***Activities Performed***	***SW-CMM*** **Project Tracking and Oversight:** ***Activities Performed***	***SW-CMM*** **Integrated Software Management:** ***Activities Performed***	Other CMM References
	negotiated, and managed. 8. The project team performs periodic reviews to ensure current and projected needs of the end user will be satisfied. 9. Measurements are used to determine project team performance and trends analyzed. 11. The project team's software acquisition lessons learned are identified, documented, and entered into acquisition organization's software acquisition process repository.			schedule. are managed according to a documented schedule 11. Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate. 12. The organization's software process database is used for software planning and estimating.	

PA12: Contract Management

Process Area Summary

Purpose:
The purpose of Contract Management is to ensure that the activities under contract are being performed in accordance with contractual requirements and that evolving products and services will satisfy contractual requirements.

Major Points Addressed:
Contract Management begins with the award of the contract and ends at the conclusion of the contract's period of performance. Contract Management involves providing ongoing inputs and guidance to the contractor's effort to meet contracted requirements. It includes maintaining visibility into, and ongoing communications with, the supplier. Visibility helps to identify risks and problems in the contracted effort. Activities include evaluating the contractor's performance, and the quality of evolving deliverables, including both products and services. Based on the results of those evaluations, the acquisition may be modified.

Contract Management contributes to the project's risk management activities, fostering an environment of mutual cooperation with the contractor, maintaining communication with the supplier after the contract has been awarded, and evaluation of the final products and services to determine satisfaction of contractual requirements.   In addition to coordination of schedules, processes, and deliveries of work products, the supplier and acquiring organizations are more likely to succeed if they share a vision of the working relationship. Suppliers may relate to acquirers as vendors, subcontractors, partners, or other business units of the acquiring organization's enterprise. A successful relationship between an acquiring organization and a supplier depends on the capability of both organizations, and on a mutual understanding of the relationship and each others' expectations.

Goals
1. The contract is kept consistent with the requirements of the acquisition project and relevant laws, policies, regulations, and guidance. *(BP 12.03)*
2. Contractor performance, products, and services are reviewed throughout the project to identify risks, problems, and appropriate corrective actions. *(BP 12.01*, *BP 12.02)*
3. Measurements are used to track the contractor's performance. *(BP 12.01, BP 12.02, BP 12.04)*
4. Communications between the acquirer's project team and the contractor are established and maintained. *(BP 12.02, BP 12.05)*

Notes
The contract is the binding agreement that establishes the requirements for the products and services to be acquired. The contract establishes the mechanism to allow the project team to oversee the contractor's activities and evolving products and to evaluate products and services being acquired. The contract also provides the vehicle for mutual understanding of the contract's requirements between the project team and the contractor.

The general term “supplier” is used to identify an organization that develops, manufactures, tests, supports, etc., a component of the system or product. In the SW-CMM the term “prime contractor” refers to the software organization within the producing enterprise, whereas “subcontractor” refers to those contracted with by the project or enterprise to provide software components or elements. In the SA-CMM and the FAA-iCMM, the “contractor” is the outsource organization providing software or other component(s) to the project (equivalent to the “subcontractor” of the SW-CMM). See also the glossary in Appendix B.

When suppliers deliver products that do not meet an organization's needs, the organization has the option to change to another supplier, lower its standards and accept the delivered products, or help the supplier or vendor meet the organization's needs.

Relationships between this PA and other PAs:
Specific activities pertaining to selecting the contractor are addressed in Outsourcing (PA05). Contracts are established by activities in the Outsourcing process area.

Some System Test and Evaluation (PA08) practices are related to Contract Management practices. Contract Management provides input to Risk Management (PA13. Measures are identified and standardized to evaluate contractor performance in Measurement (PA18).

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP.12.01 Review and Use Planning documents: Review required contractor planning documents and, when satisfactory, ensure that the contractor uses them to oversee the development or maintenance effort.

BP.12.02 Conduct Periodic Reviews: Conduct periodic, formal reviews and informal, technical issue interchanges with the contractor, including feedback on the development processes and support environment.

BP.12.03 Maintain Contract Integrity: Maintain the integrity of the contract throughout the contract performance period.

BP.12.04 Monitor Contractor’s Support Processes: Monitor contractor’s quality assurance and configuration management activities.

BP.12.05 Foster Cooperative Environment: Perform activities to foster a cooperative environment between the acquiring organization and the contractor**.**

FAA-iCMM Traceability
The Contract Management process area merges and extracts from the following:

SA-CMM: Contract Tracking and Oversight (CTO)
SA-CMM: Contract Performance Management (CPM)
SW-CMM: Software Subcontract Management (SSM)
SE-CMM: Coordinate With Suppliers (PA18)

BP 12.01 Review and Use Planning Documents

Review required contractor planning documents and, when satisfactory, ensure that the contractor uses them to oversee the development or maintenance effort.

Description
Review planning documents for compliance with contractual requirements and ensure that the contractor's processes, practices, methodologies, and procedures are satisfactory. These are then used by the contractor to oversee the contractor's efforts.

Typical Work Products
- reviews of the following typical planning documents
    - project management plan
    - risk management plan(s) (including programmatic, system, software, etc)
    - software engineering plan
    - software development plan
    - configuration management plan
    - subcontractor management plan
    - quality assurance plan
    - corrective action system
    - systems engineering management plan (SEMP)
- changes to the plans

Notes
Coordinate changes to these plans with the project team before the contractor implements them. The contract and typical contract contents are identified or developed in Outsourcing (PA 05).

FAA-iCMM Traceability
1. The project team reviews required contractor software planning documents which, when satisfactory, are used to oversee the contractor's software engineering effort *(SA: CTO-Ac2)*
2. The contractual agreement between the prime contractor and the software contractor is used as the basis for managing the subcontract. *(SW: SSM-Ac3)*
3. A documented subcontractor's software development plan is reviewed and approved by prime contractor *(SW: SSM-Ac4)*
4. A documented and approved subcontractor's software development plan is used for tracking the software activities and communicating status. *(SW: SSM-Ac5)*

BP 12.02 Conduct Periodic Reviews

Conduct periodic, formal reviews and informal, technical issue interchanges with the contractor, including feedback on development processes and the support environment.

Description
Continually review the contractor's engineering processes, practices, methodologies, and procedures for effectiveness and compliance with contractual requirements. Also review the contractor's corrective action, and risk management systems and processes for compliance with standards and plans to ensure that associated results support and promote attainment of contract objectives and compliance with contractual requirements. Perform trend analysis of the results of reviews of the contractor's engineering process to detect issues in satisfying contractual requirements as early as possible.

Formal reviews include agendas with decisions related to the completion of milestones or achievement of technical and programmatic objectives. Typically these reviews include work product inspection, analysis, or test results summaries, analyses, and recommended actions or decisions. Those participating in the reviews have the authority to assign, accept, and close actioons or make and approve decisions based on the reviews.

Technical issue interchanges are meetings between technical or support groups to learn about each others' expertise, approach, or progress; identify, analyze, and select alternative actions for issues crossing group or element boundaries, plan inter-related activities, or solve problems within the technical or support domain. These group meetings may be informal get-togethers or formal conflict resolution sessions to prioritize the use of scarce resources.

Typical Work Products
- review records
- action items
- plan revisions
- agendas

Notes
Ensure that products are being developed, documented, maintained, and verified according to the contractual requirements. Ensure that the architecture is feasible and will satisfy future system growth and reuse needs. Ensure that the contractor follows the planned process for design, development, documentation, and integration (e.g. COTS), as appropriate.

Review and track the development of the engineering environment required to provide life cycle support for the acquired products and services.

Review the contractor's technical, cost, staffing, and schedule performance against the contractor's plan. Ensure that critical resources, dependencies, commitments, nonconformance, risks, contractor conflicts and unresolvable issues are addressed.

Perform periodic technical reviews and interchanges to ensure contractor visibility of needs and desires.

Ensure that the contractor’s plan is refined as appropriate

FAA-iCMM Traceability

1. The project team conducts periodic reviews and interchanges with the contractor. *(SA: CTO-Ac3)*
2. The project team reviews and tracks the development of the software engineering environment required to provide life cycle support for the acquired software. *(SA: CTO-Ac4)*
3. The prime contractor’s management conducts periodic status/coordination reviews with the software subcontractor’s management.*(SW: SSM-Ac7)*
4. Periodic technical reviews and interchanges are held with the software subcontractor. *(SW: SSM-Ac8)*
5. Formal reviews to address the subcontractor’s software engineering accomplishments and results are conducted at selected milestones according to a documented procedure. *(SW: SSM-Ac9)*
6. The software subcontractor’s performance is evaluated on a periodic basis, and the evaluation is reviewed with the subcontractor. *(SW: SSM-Ac13)*

BP.12.03 Maintain Contract Integrity

Maintain the integrity of the contract throughout the contract performance period.

Description
This practice may involve changing the contract terms and conditions as appropriate. In such a case, ensure that changes to the contractual requirements are coordinated with all affected groups and individuals, such as the contracting official, contractor, and end user.

Typical Work Products
- integral contract

Notes
Contract integrity is the adherence and compliance to relevant laws, policies, regulations, and other planned guidance.

FAA-iCMM Traceability
1. The project team maintains the integrity of the contract throughout the contract performance period. *(SA: CTO-Ac6)*

BP 12.04 Monitor contractor's support processes

Monitor contractor's quality assurance and configuration management activities.

Description
This practice typically specifies that the contractor's procedures and standards for quality assurance and configuration management are periodically reviewed to ensure that they are adequate to monitor the contractor's performance. Regular reviews of the contractor are conducted to ensure that approved procedures and standards are being followed. Contractor records of QA and CM activity are periodically audited to assess how well the plans, standards, and procedures are being followed. CM groups coordinate their activities on matters relating to CM to ensure that the contractor's products or components can be readily incorporated into the project's product.

Typical Work Products
- Audit reports
- Coordination meeting minutes
- Change requests on QA and CM topics between contractor and acquiring project

Notes
Coordination between contractor and acquiring organization support groups reduces redundancy and builds trust in a stable project environment. In particular the QA and CM functions permit more trust of the contractor or internal supplier (such as a software or hardware developer for a systems integration unit).

FAA-iCMM Traceability
1. The prime contractor's software quality assurance group monitors the subcontractor's software quality assurance activities according to a documented procedure. *(SW: SSM.Ac.10)*
2. The prime contractor's software configuration management group monitors the subcontractor's activities for software configuration management according to a documented procedure *(SW: SSM.Ac.11)*

BP 12.05 Foster cooperative environment

Perform activities to foster a cooperative environment between the acquiring organization and the contractor**.**

Description
Typical activities might include:
- supporting a mutual understanding of the contract's requirements between the project team and the contractor
- maintaining ongoing communication at appropriate levels
- facilitating access to information regarding the status of the contractor's performance and accomplishments
- allowing the contractor to manage the engineering efforts, including engineering evaluation, with minimal interference
- promoting the joint development of solutions to issues by the project team and the contractor
- requiring that the project team satisfies its commitments to the contractor, such as review of contractor-generated documentation and timely feedback of the results of project team evaluations of contractor performance, products, and services.

Typical Work Products
- communications plan
- procedures for handling issues and concerns not resolvable at lower levels
- methods of identifying and mitigating risks
- technical exchange meeting minutes

Notes
Process and product measurements may be used as a common basis of communication to understand the requirements and the status of the project.

FAA-iCMM Traceability
1. Contract performance mgmt activities are performed to foster a cooperative environment between the project team and the contractor. *(SA: CPM-Ac7)*
2. Maintain timely two-way communication with suppliers. *(SE: PA18.5)*

Table 1: Merging Practices

Combined practice name	*SA- CMM* **Contract Tracking and Oversight (CTO) and Contract Performance Management (CPM)** *Activities Performed*	*SE-CMM* **Coordinate With Suppliers (PA18) (Mostly covered in PA05, Outsourcing)** *Base Practices*	*SW-CMM* **Software Subcontract Management (SSM)** *Activities Performed*
covered by generic practices	CTO.Ac1. The project team performs its activities in accordance with its documented contract tracking and oversight plans. CTO.Ac5. Any problems or issues found by the project team during tracking and oversight are recorded in the appropriate corrective action system and tracked to closure. CPM.Ac1. The project team performas its activities in accordance with its documented contract performance management plans. . CPM.Ac2 The contractor's software engineering process is appraised according to the project's defined software acquisition process. (Note: "appraised" in SA-CMM indicates review and comparison against requirements or standards) CPM.Ac3. Results of the contractor's engineering activities are appraised according to the projects defined sw acquisition process. CPM.Ac4. Measurements from appraisals are used to evaluate the contractor's performance, and trends are analyzed.		1. The work to be subcontracted is defined and planned according to a documented procedure 6. Changes to the software subcontractor's statement of work, subcontract terms and conditions, and other commitments are resolved according to a documented procedure. .
1.Review and use	CTO.Ac2. The project team		3. The contractual agreement

Combined practice name	*SA- CMM* **Contract Tracking and Oversight (CTO) and Contract Performance Management (CPM)** *Activities Performed*	*SE-CMM* **Coordinate With Suppliers (PA18) (Mostly covered in PA05, Outsourcing)** *Base Practices*	*SW-CMM* **Software Subcontract Management (SSM)** *Activities Performed*
planning documents	reviews required contractor software planning documents which, when satisfactory, are used to oversee the contractor's software engineering effort		between the prime contractor and the software contractor is used as the basis for managing the subcontract. 4. A documented subcontractor's software development plan is reviewed and approved by prime contractor 5. A documented and approved subcontractor's software development plan is used for tracking the software activities and communicating status.
2 Conduct Periodic reviews	CTO.Ac3. The project team conducts periodic reviews and interchanges with the contractor. CTO.Ac4. The project team reviews and tracks the development of the software engineering environment required to provide life cycle support for the acquired software. .		7. The prime contractor's management conducts periodic status/coordination reviews with the software subcontractor's management. 8. Periodic technical reviews and interchanges are held with the software subcontractor. 9. Formal reviews to address the subcontractor's software engineering accomplishments and results are conducted at selected milestones according to a documented procedure. 13. The software subcontractor's performance is evaluated on a periodic basis, and the evaluation is reviewed with the subcontractor.
3. Maintain contract integrity	CTO.Ac6. The project team maintains the integrity of the contract throughout the contract performance period		
4. Monitor contractor's			10. The prime contractor's software quality assurance

Combined practice name	***SA- CMM*** **Contract Tracking and Oversight (CTO) and Contract Performance Management (CPM)** ***Activities Performed***	***SE-CMM*** **Coordinate With Suppliers (PA18) (Mostly covered in PA05, Outsourcing)** ***Base Practices***	***SW-CMM*** **Software Subcontract Management (SSM)** ***Activities Performed***
support processes			group monitors the subcontractor's software quality assurance activities according to a documented procedure.) 11. The prime contractor's software configuration management group monitors the subcontractor's activities for software configuration management according to a documented procedure
5. Foster cooperative environment	CPM.Ac7. Contract performance mgmt activities are performed to foster a cooperative environment between the project team and the contractor.	PA18.5 Maintain timely two-way communication with suppliers.	
to other PAs	CPM.Ac5. As understanding of the software engineering process, products, and services improves, the project team may propose changes to the software products or services, process descriptions, plans, and activities. (Org Process Improvement, PA21) CPM.Ac6. The end user periodically participates in the evaluation of evolving sw products and services to determine the satisfaction of operational requirements. (GP3.5 applied to PA08, System Evaluation, and PA07, Integration).		2. The software subcontractor is selected, based on an evaluation of the subcontract bidders' ability to perform the work, according to a documented procedure (in Outsourcing, PA05) 12. The prime contractor conducts acceptance testing as part of the delivery of the subcontractor's software products according to a documented procedure.(GP2.4 for System Evaluation, PA08)

PA 13: Risk Management

Process Area Summary

Purpose
The purpose of Risk Management is to identify, assess, monitor, and mitigate risks to help ensure that the project meets its objectives.

Major points addressed
The Risk Management process area involves:
- Developing life cycle risk management plans that specify the processes and methods that will be used to identify, assess, monitor, and mitigate project risks.
- Examining project issues that can result in a project risk
- Analyzing project issues to determine their likelihood of occurrence and severity of impact to quantify the risk
- Implementing risk control actions including risk mitigation plans in order to manage project risk
- Monitoring and assessing the effectiveness of the risk controlling actions and mitigation plans

Goals
1. Risk Management is an integral part of project management and engineering activities. *(BP 13.01)*
2. Risks are identified and assessed for their likelihood and impact. *(BP 13.02, BP 13.03)*
3. Risk mitigation is performed when analysis indicates action. *(BP 13.04, BP 13.05)*

Notes
The scope of this process area includes both the overall project effort and the systems engineering activities. This process area continues throughout the life of the project.

All system development efforts have inherent risks, some of which are not easily recognized. The likelihood of risks should be sought out throughout the life cycle of the project as risks can occur in any phase including maintenance. Poor risk management is often cited as a primary reason for unsatisfied customers, and cost or schedule overruns. Early detection and reduction of risks avoid the increased costs of reducing risks at a more advanced state of system development or dealing with problems should the risk materialize.

There is a distinction among risk types and sources, analysis, and management approach. Good risk management operates on all three dimensions. For example, analyzing developer risk primarily deals with the management approach, or profit and market building; whereas analyzing user risk primarily is concerned with types and analysis, or mission and goal satisfaction.

Relationships between this PA and other PAs
This PA is closely related to Project Management (PA 11) and is also related to Coordination (PA 14) and Measurement (PA 18).

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 13.01 **Develop Risk Management Approach**: Develop an approach for risk management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project.

BP 13.02 **Identify Risks**: Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong.

BP 13.03 **Assess Risks**: Assess risks to determine their probability and consequence or impact of occurrence.

BP 13.04 **Review and Validate Risk Assessment**: Review and approve the risk assessment as a basis for risk mitigation and handling actions.

BP 13.05 **Execute Risk Mitigation Plans**: Implement the risk mitigation activities.

FAA-iCMM Traceability
The Risk Management process area merges related practices from the following process areas and key process areas:

- SE: CMM: Manage Risk (PA 10)
- SA: CMM, Project Performance Management (SPM), and Acquisition Risk Management (ARM)
- SW: CMM: Software Project Planning (SPP), Software Project Tracking and Oversight (PT&O), and Integrated Software Management (ISM).

BP 13.01 Develop Risk Management Approach

Develop an approach for risk management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project.

Description

The purpose of this base practice is to develop an effective approach to guide the risk management activities of the project. The approach is developed early in the project and is typically documented in a risk management plan. The risk management approach is developed by all elements of the program including the project management team and the developing and maintaining organization. It becomes an integral part of project performance management, solicitation and contract performance management.

Elements of the approach should include identification of members of the risk management team including software acquisition management planning personnel; identification of team and individual responsibilities; a schedule of regular risk management activities, methods, and tools to be employed in risk identification, assessment, and mitigation; and methods of tracking and controlling risk mitigation activities. The approach should also provide for the assessment of risk management results.

Typical Work Products

- risk management plan

Notes

Examples of risk management approaches include

- Use of phased development approaches such as the incremental or spiral management development models where the objectives for the next cycle and the objectives for the overall project are clarified and documented periodically.
- Formally identify and review risks at the beginning of each cycle and develop mitigation approaches.
- At the end of each cycle, review progress made in reducing each risk.

FAA-iCMM Traceability

1. Develop a plan for risk-management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project. *(SE: BP 10.01)*
2. Software acquisition risk management activities are integrated into software acquisition planning. *(SA: ARM-Ac1)*
3. The Software Acquisition Risk Management Plan is developed in accordance with the project's defined software acquisition process. *(SA: ARM-Ac2)*
4. Risk Management is conducted as an integral part of the solicitation, project performance management, and contract performance management processes. *(SA: ARM-Ac4)*

BP 13.02 Identify Risks

Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong.

Description
Examine the project objectives, the project plans (including activity or event dependencies), and the system requirements in an orderly way to identify probable areas of difficulties and what can go wrong in these areas. Sources of risk based on past experience should be considered to identify potential risks.

Typical Work Products
list of identified risks
risk taxonomy

Notes
Risks that have been identified as a part of the risk management plan are reviewed and additional risks are identified. Typical risk lists are used as possible sources for common risk issues found in similar projects.

Examples of activities to identify risks include

- Develop a common risk classification scheme or risk taxonomy to categorize risks. This taxonomy contains the history of risks for each category and the area of impact of the risk, i.e., performance, cost, schedule, and technical.

Collect all the information specifying project and systems engineering objectives, alternative technical strategies, constraints, and success criteria. Ensure that the objectives for the project and the systems engineering effort are clearly defined.

Interview technical and management personnel to uncover assumptions and decisions leading to risk. Use historical data from similar projects to find out where problems have arisen in similar contexts.

FAA-iCMM Traceability

1. Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong. *(SE: BP 10.02)*
2. The project's software risks are identified, assessed, documented and managed according to a documented procedure. *(SW: ISM-Ac10)*
3. The project team identifies and analyzes risks and identifies specific risk handling actions for those risks. *(SA: PPM-Ac10)*
4. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. *(SW: SPP-Ac13)*

BP 13.03 Assess Risks

Assess risks to determine their probability and consequence or impact of occurrence.

Description
Estimate the probability of the risk occurring and the potential loss (or gain) of the risk if it occurs. Analyze the risks independently of one another and understand the relationships between different individual risks. The analysis methodology should take into account factors such as the probability of failure due to the maturity and complexity of the technology. Develop a risk strategy that includes risk handling options such as avoidance and control. For those options that may require resource allocation (e.g., control, research and development) develop draft risk mitigation plans.

Typical Work Products
risk assessment
risk strategy
draft risk mitigation plans

Notes
Examples of activities to assess risks include

- Develop standards for estimating the probability and impact of risk occurrence. Possible standards range from a simple high-moderate-low qualitative scale to quantitative scales (e.g., in dollars to indicate consequence, probability percent to indicate probability of occurrence). A criteria table may be developed to provide guidance on the project's assessment of the criticality of impact areas. For example, performance may have a higher criticality than cost.

Establish a practical risk assessment standard based on the project's size, duration, overall risk exposure, system domain, and customer environment.
Focus mitigation resources and controls on system elements that contribute most to risk.
For each identified risk propose a risk handling option (i.e., control, assumption, research and development, avoidance, and control).
For those risks that will require resources develop a risk mitigation strategy.

Examples of activities to mitigate risks include the following:

- To address the risk that the delivered system will not meet a specific performance requirement, build a prototype of the system or a model that can be tested against this requirement. This type of mitigation strategy lowers the probability of risk occurrence.

To address the risk that the delivery schedule will slip due to a subsystem not being available for integration, develop alternative integration plans with different integration times for the risky subsystem. If the risk occurs (i.e., the subsystem is not ready on time), the impact of the risk on the overall schedule will be less. This type of mitigation strategy lowers the consequence of risk occurrence.

FAA-iCMM Traceability

1. Assess risks and determine the probability of occurrence and consequence of realization. *(SE: BP 10.03)*
2. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented. *(SW: SPP-Ac13)*
3. The project team identifies and analyzes risks and identifies specific risk handling actions for those risks. *(SA: PPM-Ac10)*
4. The project's software risks are identified, assessed, documented and managed according to a documented procedure. *(SW ISM-Ac 10)*

BP 13.04 Review and Validate Risk Assessment

Review and approve the risk assessment as a basis for risk mitigation and handling actions.

Description

Review adequacy of the risk assessment and obtain a decision to proceed, modify, or cancel the effort based on risks. The review should confirm the assessment in terms of likelihood of occurrence and the impact of the risk. This review should consider the resources required to implement risk mitigation plans and the priority of risk actions. The review should confirm those risks that will be handled by other options such as transfer or assumption. Validating the assessment results in an approved project risk management strategy that includes risk handling options and mitigation plans.

Typical Work Products

risk mitigation strategy
risk mitigation plans

Notes

Examples of activities to review the risk assessment include:

- Hold a meeting of all stakeholders of the project internal to the company to present the risk assessment. To help communicate a sense of control over the risks, present possible mitigation strategies and handling actions with each risk.
- Obtain agreement from the attendees that the risk estimates are reasonable and that no obvious mitigation strategies are being overlooked.

FAA-iCMM Traceability

1. Obtain formal recognition of the project risk assessment. *(SE: BP 10.04)*

BP 13.05 Execute Risk Mitigation Plans.

Implement the risk mitigation activities in accordance with risk management plans.

Description
Risk mitigation activities are implemented in accordance with the risk strategy and risk mitigation plans. Risk mitigation and handling activities are monitored to ensure that the desired results are being obtained. By monitoring the risk mitigation plans predetermined baselines may be used to trigger corrective actions. Control actions may address either lowering the probability that the risk will occur or lowering the extent of the damage (impact) the risk causes if it does occur.

Regularly, examine the results of the risk mitigations that have been put into effect, to determine whether the mitigations have been successful.

Typical Work Products
risk mitigation plan
risk status

Notes
Risk mitigation actions are implemented in accordance with the specific risk mitigation plan. These plans detail the resources required to mitigate the risk, assignment of responsibility for mitigation actions, a schedule for those actions, the review procedure that will be used, measures that will be applied to assessment mitigation, and the reporting procedure that will be used. Examples of activities to review the risk assessment include: given a project with a development schedule of about six months, re-assess risks about every two weeks. Re-estimate the probability and consequence of each risk occurrence.

FAA-iCMM Traceability:
1. Implement the risk-mitigation activities. *(SE: BP 10.05)*
2. Monitor risk-mitigation activities to ensure that the desired results are being obtained. *(SE: BP 10.06)*
3. The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked. *(SW: PTO-Ac10)*
4. The project team performs its software acquisition risk management activities in accordance with its documented plans. *(SA: ARM-Ac3)*
5. Software acquisition risk handling actions are tracked and controlled until risks are mitigated. *(SA: ARM-Ac5)*
6. The project's software risks are identified, assessed, documented and managed according to a documented procedure . *(SW ISM-Ac 10)*
7. Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate. (SW: ISM-Ac11)

Table PA 13-1: Merging Risk Management Practices

Risk Management base practices	***SE- CMM* Manage Risk: *Base Practices***	***SW-CMM* Integrated Software Management*: Activities performed***	***SA-CMM* Acquisition Risk Management: *Activities Performed***	***SA -CMM* Project Performance Management: *Activities Performed***	***SW: CMM* Software Project Planning & Tracking & Oversight *Activities Performed***
1. Develop Risk Management Approach	1. Develop a plan for risk-management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project.		1. Software acquisition risk management activities are integrated into software acquisition planning. 2. The Software Acquisition Risk Management Plan is developed in accordance with the project's defined software acquisition process. 4. Risk Management is conducted as an integral part of the solicitation, project performance management, and contract performance management processes.		
2. Identify Risks	3. Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong.	10. The project's software risks are identified, assessed, documented and managed according to a documented procedure.		10. The project team identifies and analyzes risks and identifies specific risk handling actions for those risks.	13. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.

Risk Management base practices	***SE- CMM*** **Manage Risk:** ***Base Practices***	***SW-CMM*** **Integrated Software Management*:*** ***Activities performed***	***SA-CMM*** **Acquisition Risk Management:** ***Activities Performed***	***SA -CMM*** **Project Performance Management:** ***Activities Performed***	***SW: CMM*** **Software Project Planning & Tracking & Oversight** ***Activities Performed***
3. Assess Risks	3. Assess risks and determine the probability of occurrence and consequence of realization.	10. The project's software risks are identified, assessed, documented and managed according to a documented procedure.		10. The project team identifies and analyzes risks and identifies specific risk handling actions for those risks.	13. The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.
4. Review and Validate Risk Assessment	4. Obtain formal recognition of the project risk assessment.				
5. Execute Risk Mitigation Plans	5. Implement the risk-mitigation activities. 6. Monitor risk-mitigation activities to ensure that the desired results are being obtained.	10. The project's software risks are identified, assessed, documented and managed according to a documented procedure. 11. Reviews of the software project are periodically performed to determine the actions needed to bring the software project's performance and results in line with the current and projected needs of the business, customer, and end users, as appropriate.	3. The project team performs its software acquisition risk management activities in accordance with its documented plans. 5. Software acquisition risk handling actions are tracked and controlled until risks are mitigated.		10. The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.

PA 14: Coordination

Process Area Summary

Purpose

The purpose of Coordination is to identify those disciplines necessary for effective system development and create an environment in which they jointly and effectively work together toward a common agenda.

Major points addressed

Each discipline's unique expertise and concerns are brought forward and considered, but the focus on total system development is maintained. These disciplines may include, but are not limited to the user or problem-to-be-solved domain, manufacturing, component design, development, test, reliability, maintainability, operations, quality, supportability, human factors, logistics, safety, and security.. This cooperative environment must be supported throughout the system life cycle.

Goals

1. The project goals, processes and interfaces between the disciplines necessary to the system life cycle are coordinated. *(BP 14.01, BP 14.02)*
2. Methods are established and maintained for interdisciplinary communication, coordination, and conflict resolution. *(BP 14.03, BP 14.04, BP 14.05, BP 14.06)*

Notes

It is essential to sustain a focus on the human interaction activities and issues related to cooperation via group dynamics during the development, synthesis, and integration efforts. The goal is to minimize nonessential information flows while providing essential and timely information to members of the system or life cycle staff.

Relationships between this PA and other PAs

"Coordination" defines the base practices required for effective coordination between groups and individuals active during the system or product life cycle or a project within that life cycle. This builds on project (PA 11, Project Management) and supplier (PA 05, Outsourcing, and PA 12, Contract Management)) management. It begins the extension of the definition of organization to others outside the enterprise including customers and suppliers.

Base Practice List

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 14.01 **Involve Disciplines:** Involve the disciplines that are essential to the system or product life cycle in a timely manner.

BP 14.02 **Promote Cross-Discipline Understanding:** Promote cross-discipline understanding among the developers.

BP 14.03 **Establish Coordination Methods:** Establish methods for interdisciplinary coordination, including technical exchanges and reviews of inputs from each other.

BP 14.04 **Establish Resolution Methods:** Establish and use methods for identifying and resolving interdisciplinary issues, and creating integrated solutions, including critical dependencies and paths.

BP 14.05 **Communicate Interdisciplinary Activity Results:** Communicate results of interdisciplinary activities to affected groups and individuals.

BP 14.06 **Develop and Communicate Project Goals:** Develop project goals and ensure that all affected groups and individuals are fully aware of them.

FAA-iCMM Traceability

The Coordination process area merges the following process areas and key process areas:

- SE: CMM: Integrate Disciplines (PA 04)
- SW: CMM: Intergroup Coordination (IC)

BP 14.01 Involve Disciplines

Involve the disciplines that are essential to the system or product life cycle in a timely manner.

Description
In large or complex projects, efficient and effective results come from a blending of the efforts of people. Those people who contribute to project or product results during the product or system life cycle can prevent waste and inefficiency by being involved from conception through the life cycle appropriately: when their input or feedback can affect decisions that affect their performance.

Typical Work Products
- roster of essential disciplines (work breakdown structure)
- list of representatives from each discipline
- agendas and schedules of collaborative activities
- process deployment chart

Notes
As the development effort proceeds through its life cycle, the activity levels of critical disciplines vary. The initial focus should be on attaining complete coverage, not limiting participants. The managers, developers, and maintainers must be cognizant enough of the concerns of all disciplines so that he or she can recall specialists when needed throughout the product life cycle.

The customer, end user, external interfaces, suppliers, contractors, process improvement groups, and other stakeholders should be included in the identification of those to be coordinated.

FAA-iCMM Traceability
1. Involve the disciplines that are essential to system development in a timely manner. *(SE: BP 04.01)*
2. The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements. *(SW: IC-Ac1)*
3. Software acquisition planning personnel are involved in system acquisition planning. *(SA: SAP-Ac1)*
4. The project team coordinates its activities with other organizations and activities supporting the project. *(SA: PPM-Ac5)*
5. The software engineering group reviews the allocated requirements before they are incorporated into the software project. *(SW: RM-Ac1)*
6. The software engineering group participates on the project proposal team. *(SW: SPP-Ac1)*
7. The software engineering group participates with other affected groups in the overall project planning throughout the project's life. *(SW: SPP-Ac3)*

BP 14.02 Promote Cross-Discipline Understanding

Promote cross-discipline understanding among the developers.

Description
Developers need to become familiar with the issues that are important to those disciplines essential to the use and development of the system and the effect that each discipline has on the quality of the product.

Typical Work Products
- roles and responsibilities of participants
- process deployment chart

Notes
The systems engineer is a natural avenue to provide the technical overview of the product and project focus of and the issues of concern to each discipline involved with the product or project life cycle.

This is often one of the most overlooked areas in the list of engineering tasks; yet it often produces the highest return on investment in terms of cost-effective solutions to project problems. Understanding the other individuals' concerns is the first step to achieving a cooperative, harmonious work environment, so it is difficult to focus too much effort in this area. However, the objective is not to create a group who are experts in all the disciplines; rather, it is to create a group of individuals who are aware of each others' technical concerns and understand how proper consideration of each concern has a positive impact on the quality of the group's product.

To illustrate that consideration of the specialty disciplines is key to product success, it may help to show the time-critical nature of some of the decisions made early in the project life cycle and how they can produce positive or negative customer impressions when the system is introduced to its intended environment.

Example activities include
- a kickoff meeting with technical or architectural overview presentations, discipline issues, and action item lists
- "lunch and learn" technical seminars.

FAA-iCMM Traceability
1. Promote cross-discipline understanding among the developers. *(SE: BP 04.02)*

BP 14.03 Establish Coordination Methods

Establish methods for interdisciplinary coordination, including technical exchanges and reviews of inputs from each other.

Description

In addition to understanding the roles and what information to share, the product personnel must know how to share knowledge: the particular methods of getting information from an individual or group to others who need it. In addition, they recognize that specialties may have their own processes that should be integrated with the engineering process.

Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs.

Typical Work Products

- methods for coordinating integrated development

Notes

Knowledge sharing may center around an automation strategy in which individuals would share knowledge through the automation tool suite.

Alternatively, knowledge sharing may center around a teaming strategy in which individuals would share knowledge in accordance with the particular teaming structures used.

FAA-iCMM Traceability

1. Establish methods for interdisciplinary coordination. *(SE: BP 04.03)*
2. Coordinate interface specifications and changes with all affected groups and individuals. *(SE: BP 05.02)*
3. Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues. *(SW: IC-Ac2)*
4. Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs. *(SW: IC-Ac5)*
5. Representatives of the project engineering groups conduct periodic technical reviews and interchanges. *(SW: IC-Ac7)*
6. Intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure. *(SW: IC.Ac6)*
7. The project team performs periodic reviews to ensure current and projected needs of the end user will be satisfied. *(SA: PPM-Ac8)*

BP 14.04 Establish Resolution Methods

Establish and use methods for identifying and resolving interdisciplinary issues, and creating integrated solutions, including critical dependencies and paths.

Description
Issues will arise between the disciplines during product development. Thus, the project personnel must have available several predetermined techniques for resolving these issues. The technique used would depend on several factors, including the time available to come to resolution, the severity of the issue, and the related consequences of the issue. Prevention activities include having representatives of the disciplines and later life cycle groups review and coordinate early life cycle outputs on which they depend as inputs. Issues are documented and tracked to closure.

Typical Work Products
- issue resolution methods
- integrated solutions

Notes
Examples of methods for resolving interdisciplinary issues include
- Pugh's Controlled Convergence technique
- consensus building technique
- negotiation techniques
- Quality Function Deployment technique
- autocratic edict
- arbitration rules
- consensus

FAA-iCMM Traceability
1. Establish and use methods for identifying and resolving interdisciplinary issues, and creating integrated solutions. *(SE: BP 04.04)*
2. The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements. *(SW: IC-Ac1)*
3. Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues. *(SW: IC-Ac2)*
4. Critical dependencies between engineering groups are identified, negotiated, and tracked according to a documented procedure. *(SW: IC-Ac4)*
5. Critical dependencies are identified, negotiated, and managed. *(SA: PPM-Ac7)*
6. Critical dependencies and critical paths of the project’s software schedule are managed according to a documented procedure. *(SW: ISM-Ac9)*
7. Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs. *(SW: IC-Ac5)*

BP 14.05 Communicate Interdisciplinary Activity Results

Communicate results of interdisciplinary activities to affected groups and individuals.

Description
The results of interdisciplinary activities will include the alternatives considered, the decisions made, and the rationale for the decisions. Communicate these results promptly to affected groups and individuals.

Typical Work Products
- results of interdisciplinary activities
- meeting minutes
- decision database
- commitments
- technical reviews

Notes
Examples of methods to communicate results include
- electronic mail decisions with rationale
- use of the project's selected automation tool set

FAA-iCMM Traceability
1. Communicate results of interdisciplinary activities to affected groups. *(SE: BP 04.05)*
2. Representatives of the project engineering groups conduct periodic technical reviews and interchanges. *(SW: IC-Ac7)*

BP 14.06 Develop and Communicate Project Goals

Develop project goals and ensure that all affected groups and individuals are fully aware of them.

Description
For the project to proceed with reasonable smoothness, each project member and the direct support staff must know and work toward the same goals. These goals must be clearly developed and communicated to every member of the staff and other affected groups and individuals.

Typical Work Products
- project objectives
- excerpts from the technical management plan

Notes
Examples of project goals include
- a cost/schedule goal
- a quality/cost goal
- a quality/schedule goal

FAA-iCMM Traceability
1. Develop project goals and ensure that all affected groups and individuals are fully aware of them. *(SE: BP 04.06)*

Table PA 14-1: Merging Coordination Practices

Coordination base practices	***SE-CMM*** **Integrate Disciplines: (*Integrate Systems)** ***Base Practices***	***SW-CMM*** **Intergroup Coordination (* Requirements Management, * Software Project Planning, *Integrated Software Management):** ***Activities Performed***	***SA-CMM*** **Project Performance Management (* Software Acquisition Planning):** ***Activities Performed***
1. Involve Disciplines	1. Involve the disciplines that are essential to system development in a timely manner.	1. The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements. ***RM**-Ac1. The software engineering group reviews the allocated requirements before they are incorporated into the software project. ***SPP.**Ac1. The software engineering group participates on the project proposal team. ***SPP.**Ac3. The software engineering group participates with other affected groups in the overall project planning throughout the project's life.	5. The project team coordinates its activities with other organizations and activities supporting the project. ***SAP**-Ac1. Software acquisition planning personnel are involved in system acquisition planning.
2. Promote Cross-Discipline Understanding	4.2. Promote cross-discipline understanding among the developers.		
3. Establish Coordination Methods	4.3. Establish methods for interdisciplinary coordination. * **5.2**. Coordinate interface specifications and changes with all affected groups and individuals.	2. Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues. 5. Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs. 6. Intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure. 7. Representatives of the project engineering groups conduct	8. The project team performs periodic reviews to ensure current and projected needs of the end user will be satisfied.

Coordination base practices	***SE-CMM*** **Integrate Disciplines: (*Integrate Systems)** ***Base Practices***	***SW-CMM*** **Intergroup Coordination (* Requirements Management, * Software Project Planning, *Integrated Software Management):** ***Activities Performed***	***SA-CMM*** **Project Performance Management (* Software Acquisition Planning):** ***Activities Performed***
		periodic technical reviews and interchanges.	
4. Establish Resolution Methods	4.4. Establish and use methods for identifying and resolving interdisciplinary issues, and creating integrated solutions.	1. The software engineering group and the other engineering groups participate with the customer and end users, as appropriate, to establish the system requirements. 2. Representatives of the project's software engineering group work with representatives of the other engineering groups to monitor and coordinate technical activities and resolve technical issues. 4. Critical dependencies between engineering groups are identified, negotiated, and tracked according to a documented procedure. 5. Work products produced as input to other engineering groups are reviewed by representatives of the receiving groups to ensure that the work products meet their needs. 6. Intergroup issues not resolvable by the individual representatives of the project engineering groups are handled according to a documented procedure. ***ISM**-Ac9. Critical dependencies and critical paths of the project’s software schedule are managed according to a documented procedure.	7. Critical dependencies are identified, negotiated, and managed.
5. Communicate Interdisciplinary Activity Results	4.5. Communicate results of interdisciplinary activities to affected groups.	7. Representatives of the project engineering groups conduct periodic technical reviews and interchanges.	
6. Develop and Communicate Project Goals	4.6. Develop project goals and ensure that all affected groups and individuals are fully aware of them.		
covered by generic		3. A documented plan is used	

Coordination base practices	***SE-CMM*** **Integrate Disciplines: (*Integrate Systems)** ***Base Practices***	***SW-CMM*** **Intergroup Coordination (* Requirements Management, * Software Project Planning, *Integrated Software Management):** ***Activities Performed***	***SA-CMM*** **Project Performance Management (* Software Acquisition Planning):** ***Activities Performed***
practice		to communicate intergroup commitments and to coordinate and track the work performed.	

PA 15: Quality Assurance and Management

Process Area Summary

Purpose
The purpose of Quality Assurance and Management is to address the quality of the system, and the quality of the process being used to create the system, and to provide management with appropriate visibility into the process and product.

Major Points Addressed
The underlying concept of this process area is that high-quality systems are consistently produced when a process exists to continuously measure and improve quality. In addition, this process must be adhered to rigorously and throughout the system life cycle. Key aspects of the process required to develop high-quality systems are measurement, analysis, and corrective action.

Goals
1. Adherence of work products and activities to the applicable standards, procedures, and requirements is verified objectively. *(BP 15.01, BP 15.02)*
2. Noncompliance issues that cannot be resolved within the software project are addressed by senior management. *(BP 15.03)*
3. Affected groups and individuals are informed of quality assurance activities, results. and quality improvement opportunities. *(BP 15.04, BP 15.05, BP 15.06)*

Notes
A successful quality program requires integration of the quality efforts throughout the project team and support elements. Effective processes provide mechanisms for building in quality and reducing dependence on end-item inspections and rework.

This is not meant to imply that those managing and/or assuring the quality of work products and processes are solely responsible for the quality of the work product outputs. On the contrary, the primary responsibility for "building in" quality lies with the builders. A quality management process helps to ensure that all aspects of quality management are seriously considered and acted upon by the organization and reflected in its products. This increases the confidence of developers, management, and customers in the system's quality.

The kinds of quality variances that may be addressed by this process area include:
- technical content, such as the particular values of derived or allocated requirements;
- form issues, such as whether the customer prefers instructions on product use to be in paper or electronic form

Cost and schedule variances can also be considered defects and would be dealt with as are other defects. Organizations may wish to determine the variances, based on periodic increments. For example, if the organization has committed to deliver or roll-out a product during a given week, then it would be wise to measure or determine its progress, by measuring variances, on a weekly basis. If the commitment is monthly, then monthly measurements would likely be appropriate.

Relationships between the PA and other PAs

Most practices in the Quality Assurance process area operate in parallel with the practices in all the other FAA-iCMM process areas. Of specific relevance is the Project Management (PA 11) and Measurement (PA 18) process areas. Project management must act upon the quality assurance results (PA 11) and the measurement of quality is part of PA 18. Coordination (PA 14) discusses customer interface and communication of quality related information. In addition, these other PA's provide quality information on products and processes: System Test and Evaluation (PA 08), Peer Review (PA 17), Prevention (PA 19), and Organizational Process Improvement (PA 21).

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 15.01	**Monitor Process Compliance -** Monitor compliance to the documented processes throughout the project/product life cycle.
BP 15.02	**Evaluate Product and Process** - Measure work products and processes against the requirements and standards that define them.
BP 15.03	**Detect Need for Corrective Actions -** Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products.
BP 15.04	**Record and Report Results -** Record and report the results of QA activities to the applicable groups.
BP 15.05	**Analyze Quality** - Analyze the quality of the system products and processes.
BP 15.06	**Initiate Quality Improvement Opportunities** - Initiate activities that address identified quality issues or quality improvement opportunities.

FAA-iCMM Traceability

The Quality Assurance process area merges the following process areas and key process areas:

- SE-CMM: Ensure Quality (PA 08)
- SW-CMM: Software Quality Assurance (QA)

The references to quality in the SA-CMM were minimal at best and covered in the generic practices. Therefore no attempt was made to merge the SA-CMM into the Quality Assurance process area.

BP 15.01 Monitor Process Compliance

Monitor compliance with the established processes throughout the project/product life cycle.

Description
Ensure that the project's execution follows the documented processes. Compliance should be checked at useful intervals. Deviations from the documented processes and the impact of the deviations should be recorded. This base practice includes the monitoring of compliance of the people assigned QA responsibilities. The QA personnel should also conduct periodic reviews of their activities and findings with the customer’s QA personnel, as appropriate. The inverse of this situation also applies to subcontractors. The people assigned QA responsibilities should monitor any subcontractor's quality assurance activities. To insure that the QA personnel are familiar with the processes, the QA personnel should participate in the preparation and review of the project’s plans, standards, and procedures. This will ensure that the QA personnel have the opportunity to plan their monitoring activities to have the greatest impact on the processes.

Typical Work Products
- recorded deviations from documented processes for the acquisition of software intensive systems
- recorded impact of deviations from documented processes for the acquisition of software intensive systems
- quality handbook (paper or on-line).

Notes
The processes can be monitored in a number of ways. For example, a designated auditor/reviewer can participate in or observe all (or a sample percentage of) process activities, or an auditor/reviewer may inspect all (or a sample percentage of) in-process work products. Also, an independent channel for reporting process quality issues should be established.

FAA-iCMM Traceability
1. Ensure the defined system engineering process is adhered to during the system life cycle. *(SE: BP 08.01)*
2. The SQA group reviews the software engineering activities to verify compliance. *(SW: SQA-Ac4)*
3. The SQA group conducts periodic reviews of its activities and findings with the customer’s SQA personnel, as appropriate. *(SW: SQA-Ac8)*
4. The SQA group participates in the preparation and review of the project’s software development plan, standards, and procedures. *(SW: SQA-Ac3)*
5. The prime contractor’s software quality assurance group monitors the subcontractor’s software quality assurance activities according to a documented procedure. *(SW: SSM-Ac10)*

BP 15.02 Evaluate Product and Process

Measure work products and processes against the requirements and standards that define them.

Description
The work products are evaluated against the designated standards, procedures, and contractual requirements. Measuring the characteristics of the work products provides an indication of the quality of the system. Measurements should be designed to assess whether the work product will meet customer, engineering, and contractual requirements. Product measurements should also be designed to help isolate problems with system processes. Deviations are identified, documented, and tracked to closure. Corrections are verified. The deliverable work products are evaluated before they are delivered to the customer.

The process that is used to create a quality product is as important as the quality of the product. It is important to have a system and acquisition process that is checked by measurement so that degrading conditions are caught early, before the final work product is produced and found to not meet requirements. Thus, having a process that is measured may lead to less waste and higher productivity.

Typical Work Products
- assessment of the quality of the product/process (e.g. audit report)
- product quality certification
- process quality certification

Notes
Examples of measurements used to track product compliance are
- Defect Rate
  - ⇒ by life cycle stage or activity (i.e., design, test)
  - ⇒ by product
  - ⇒ by severity
  - ⇒ by type (i.e., hardware, software, documentation)
  - ⇒ by source (i.e., standard, requirements document)

Examples of tools to use in measuring the process include
- process flow chart: can be used to determine which characteristics should be measured and to identify potential sources of variation, in addition to defining process
- statistical process control on process parameters
- design of experiments

FAA-iCMM Traceability
1. The SQA group audits designated software work products to verify compliance. *(SW: SQA-Ac5)*
2. Evaluate work product measures against the requirements for work product quality. *(SE: BP 08.02)*
3. Measure the quality of the systems engineering process used by the project. *(SE: BP 08.03)*

BP 15.03 Detect Need for Corrective Actions

Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products.

Description
Such a mechanism must be available throughout the life cycle of the product (development through manufacturing through customer use). Mechanisms may include procedures, on-line reporting systems, workshops, periodic reviews, peer reviews, customer focus groups, and individuals. Mechanisms must be available to all affected groups, including design, manufacturing, customers, customer support, etc.

Deviations, improvements, or other corrective actions to the project's plans, standards, procedures, and processes are documented and identified to the appropriate task leader, manager, or project manager. Issues of noncompliance that are not resolved by the project are addressed by senior management. Noncompliance issues presented to senior management are periodically reviewed until they are resolved. Noncompliance issues are managed and controlled.

Typical Work Products
- ongoing database or repository containing deviations, identified needs, process improvements, and product improvements
- clearly described processes, methods, and avenues for getting identified needs into a database or repository
- identified needs for process improvement
- identified needs for product improvement
- trouble reports

Notes
This base practice is critical to the effective use of systems and software engineering and for acquisition of software intensive systems in the production, operations, and maintenance life cycle phases.

Needs for corrective action are detected in this base practice. Corrective actions taken are addressed in the Project Management process area (PA 11). Additionally, any corrective actions affecting baselined items are tracked and controlled in the Configuration Management process area (PA 16).

FAA-iCMM Traceability
1. Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products. *(SE: BP 08.07)*
2. Deviations identified in the software activities and software work products are documented and handled according to a documented procedure. *(SW: SQA-Ac7)*

BP 15.04 Record and Report Results

Record and report the results of QA activities to the applicable groups.

Description
To improve quality, the participation of all affected parties is required. For the affected parties to be cognizant of their contribution to a problem, they are informed when quality issues are discovered. The results of QA activities in identifying quality issues are reported to the affected groups. Close the feedback loop in the process of identifying and reporting quality issues.

Not only is it important to enable the formal QA group to report results of its activities but it is equally important to encourage ideas for improving quality from anyone in the organization. Ideas for improving quality are encouraged, and a forum exists that allows each employee to raise process and quality issues freely.

Typical Work Products
- environment that promotes quality
- captured inputs and resolutions from workers
- quality issue reports

Notes
A quality environment can be fostered by
- process action teams
- a quality assurance group with a reporting chain of command that is independent of the project

Record and report the results of QA activities. If verbal reporting is all that is done, then there is a risk of not taking action for some critical items. If reporting is merely writing down and posting somewhere, then there is a risk of the proper people not being informed in a timely manner.

FAA-iCMM Traceability:
1. Obtain employee participation in identifying and reporting quality issues. *(SE: BP 08.05)*
2. The SQA group periodically reports the results of its activities to the software engineering group. *(SW: QA-Ac6)*

BP 15.05 Analyze Quality

Analyze the quality measurements to develop recommendations for quality improvement or corrective actions, as appropriate.

Description
Careful examination of all the available data on product, process, and project performance can reveal causes of problems. This information will then enable improvement of the process and product quality.

Typical Work Products
- analysis of deviations
- failure analysis
- defect reports (i.e., peer reviews, test, etc.)
- system quality trends
- corrective action recommendations
- cause and effect diagrams

Notes
Examples of measurements that support quality improvement include
- trend analysis, such as the identification of equipment calibration issues causing a slow creep in the product parameters
- standards evaluation, such as determining if specific standards are still applicable due to technology or process changes

FAA-iCMM Traceability
1. Analyze quality measurements to develop recommendations for quality improvement or corrective action, as appropriate. *(SE: BP 08.04)*

BP 15.06 Initiate Quality Improvement Opportunities

Initiate activities that address identified quality issues or quality improvement opportunities.

Description
To continuously improve quality, specific actions are planned and executed. Specific aspects of the system development process that jeopardize product or process quality are identified and corrected. This includes minimizing cumbersome or bureaucratic systems.

Typical Work Products
- recommendations for improving the systems engineering process
- quality improvement plan
- process revisions

Notes
Effective implementation of quality improvement activities requires input and buy-in by the work product team.

The intent of this BP is to take the ideas, suggestions, deviations, etc., identified previously and incorporate them into an action plan for implementation.

FAA-iCMM Traceability
1. Initiate activities that address identified quality issues or quality improvement opportunities. *(SE: BP 08.06)*

Table PA 15-1: Merging Quality Assurance and Management Practices

Quality Assurance and Management base practices	***SE-CMM*** **Ensure Quality:** ***Base Practices***	***SW-CMM*** **Software Quality Assurance (SQA):** ***(* Software Subcontract Management) Activities Performed***
1. Monitor Process Compliance	8.1 Ensure the defined system engineering process is adhered to during the system life cycle.	4. The SQA group reviews the software engineering activities to verify compliance. 8. The SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate. 3. The SQA group participates in the preparation and review of the project's software development plan, standards, and procedures. ***SSM**-Ac 10. The prime contractor's software quality assurance group monitors the subcontractor's software quality assurance activities according to a documented procedure.
2. Evaluate product and process quality	8.2 Evaluate work product measures against the requirements for work product quality. 8.3 Measure the quality of the systems engineering process used by the project*)*	5. The SQA group audits designated software work products to verify compliance.
3. Detect need for corrective action	8.7 Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products.	7. Deviations identified in the software activities and software work products are documented and handled according to a documented procedure.
4. Record and report results	8.5 Obtain employee participation in identifying and reporting quality issues.	6. The SQA group periodically reports the results of its activities to the software engineering group.
5. Analyze quality	8.4 Analyze quality measurements to develop recommendations for quality improvement or corrective action, as appropriate.	
6. Initiate quality improvement opportunities.	8.6 Initiate activities that address identified quality issues or quality improvement opportunities.	
covered by generic practices		1. A SQA plan is prepared for the software project according to a documented procedure. 2. The SQA group's activities are performed in accordance with the SQA plan.

PA16: Configuration Management

Process Area Summary

Purpose
The purpose of the Configuration Management process area is to establish and maintain data on and status of identified configuration units/items, analyze and control changes to the system and its configuration units, and establish and maintain the integrity of the work products of the project throughout the project's life cycle.

Major Points Addressed
This process area is applicable to all work products that are placed under configuration management. An example set of work products that may be placed under configuration management could include hardware and software configuration units/items, design rationale, requirements, product data files, and trade studies. The work products placed under configuration management could also include those products delivered to the customer (e.g., software requirements documents and the code) and the units/items that are identified with or required to create these products (e.g., compiler).

Managing the system configuration involves providing accurate and current configuration data and status to developers and customers.

Goals
1. Configuration items that constitute baselines are identified. *(BP 16.01, BP 16.02)*
2. Configuration items are controlled to support the disciplined evolution of the product baseline. *(BP 16.01, BP 16.03, BP 16.04)*
3. Configuration status is communicated to affected groups. *(BP 16.05)*
4. Configuration baselines are audited to verify the product baseline integrity. *(BP 16.06)*

Notes
The Configuration Management process area supports traceability by allowing the configuration to be traced through the hierarchy of system requirements at any point in the configuration life cycle.

Relationships between this PA and other PAs
Traceability is established as part of the practices in the Requirements process area (PA 02).

When the practices of this process area are used to manage requirements, changes to those requirements need to be iterated through the Needs process area (PA 01) to communicate the impact of changes to the customer or their surrogate.

Base Practice List

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 16.01	**Establish Configuration Management Methodology**: Decide among candidate methods for configuration management.
BP 16.02	**Identify Configuration Units/Items:** Identify configuration units or items that constitute identified baselines and work products that will be placed under configuration management.
BP 16.03	**Establish and Maintain a Repository for Work Product Baselines:** Establish and maintain a repository to house work product baselines.
BP 16.04	**Control and Track Changes:** Control changes to established configuration units/items/work plans and products throughout the life cycle.
BP 16.05	**Communicate Configuration Status:** Communicate and generate reports on CM activities, status of proposed changes, and baseline and configuration data; and access information to affected groups or individuals.
BP 16.06	**Conduct Configuration Audits:** Conduct configuration baseline audits.

FAA-iCMM Traceability

The Configuration Management process area merges the following process areas and key process areas:

- SE-CMM: Manage Configurations (PA 09)
- SW-CMM: Software Configuration Management (SCM).

In addition, activity 4 of the SA-CMM Transition to Support process area was used.

BP 16.01 Establish Configuration Management Methodology

Decide among candidate methods for configuration management.

Description
Establish a mechanism, with appropriate authority, for managing the project's baselines. This mechanism shall authorize the establishment of baselines and the identification of configuration items/units, represent the interests of the program/project manager and all affected groups, review and authorize changes to the baselines, and authorize the creation of products from the baseline library.

Three primary trade-off considerations will have an impact on the structure and cost of configuration management, including
- the level of detail at which the configuration units/items are identified
- when the configuration units/items are placed under configuration management
- the level of formalization required for the configuration management process

The Alternatives process area (PA 04) should be used as guidance to perform the trade studies.

Typical Work Products
- guidelines for identifying configuration units/items
- timeline for placing units under configuration management
- selected configuration management process
- selected configuration management process description
- control board charter

Notes
Example criteria for selecting configuration units/items at the appropriate work product level include
- need to maintain interfaces at a manageable level
- unique user requirements such as field replaceable units
- new versus modified design
- expected rate of change

These criteria will affect the level of visibility into the effort.

Example criteria for determining when to place work products under configuration management include
- portion of the development life cycle that the project is in
- if system element is ready for test
- degree of formalization selected
- cost and schedule limitations
- customer requirements

Example criteria for selecting a configuration management process include

- portion of the development life cycle
- impact of change in system on other work products
- impact of change in system on procured or subcontracted work products including COTS/NDI
- impact system changes on program schedule and funding
- requirements management process

FAA-iCMM Traceability

1. Decide among candidate methods for configuration management. *(SE: BP 09.01)*
2. A board having authority for managing the project's software baseline (i.e., a software configuration control board -- SCCB) exists or is established. *(SW: SCM-Ab1)*
3. The software work products to be placed under configuration management are identified. *(SW: SCM-Ac4)*

BP 16.02 Identify Configuration Units/Items

Identify configuration units or items that constitute identified baselines and work products that will be placed under configuration management.

Description
A configuration unit/item is one or more work products that are baselined together. The selection of work products for configuration management should be based on criteria established in the selected configuration management methodology. Configuration units/items should be selected at a level that benefits the developers and customers, but that does not place an unreasonable administrative burden on the developers. The baselines for each configuration unit/item should be identified, as well as, when in its development/acquisition the configuration unit/item is placed under configuration control.

Typical Work Products
- baselined work product configuration
- identified configuration units/items such as
    - process-related documentation (e.g., plans, standards, or procedures)
    - system requirements
    - system design
    - software requirements
    - software code units
    - test procedures
    - software/system build for the software/system test activity
    - software/system build for delivery to customer or end user
    - compilers
    - support tools

Notes
Configuration units/items in the area of requirements management could vary from individual requirements to groupings of requirements documents.

Configuration units/items for a system that has requirements on field replacement should have an identified configuration unit/item at the field-replaceable unit/item level.
The person responsible for each configuration unit/item is identified.

FAA-iCMM Traceability
1. Identify configuration units that constitute identified baselines. *(SE: BP 09.02)*
2. The software work products to be placed under configuration management are identified. *(SW: CM-Ac4)*

BP 16.03 Establish and Maintain a Repository for Work Product Baselines

Establish and maintain a repository to house work product baselines.

Description
This practice involves establishing and maintaining a repository of information comprised of work product baselines as they are developed. The repository provides for storage and retrieval of configuration items/records, sharing and transfer of configuration items/records between affected groups and individuals, and the production and dissemination of CM reports. The release of configuration items/records from the repository is controlled. Product builds and releases are authorized by the controlling mechanism and are created only from the configuration items/records in the approved baseline library.

Typical Work Products
- specifications
- drawings
- source code
- test reports
- CM reports
- associated tools

Notes
For software, the baseline repository also allows multiple control levels of software configuration management. One example of a situation requiring multiple levels of control, is the differences in the levels of control needed at different times in the life cycle (e.g., tighter control as the product matures).

FAA-iCMM Traceability
1. Maintain a repository of work product baselines. *(SE: BP 09.03)*
2. A configuration management system library system is established as a repository for the software baselines. *(SW: SCM-Ac3)*
3. Products from the software baseline library are created and their release is controlled according to a documented procedure. *(SW: SCM-Ac7)*

BP 16.04 Control and Track Changes

Control changes to established configuration units/items/work plans and products throughout the life cycle, including transitions to operations, support, and retirement.

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

Change requests and problem reports for all configuration items/units should be initiated, recorded, reviewed, approved, and tracked. Identified problems with the work product or requests to change the work product are analyzed to determine the impact that the change will have on the work product, program schedule and cost, and other work products. If, based upon analysis, the proposed change to the work product is accepted, a schedule is identified for incorporating the change into the work product and other affected areas.

Changed configuration units/items are released after review and formal approval of configuration changes by the controlling mechanism. Changes are not official until they are released.

Typical Work Products
- new work-product baselines
- change requests
- problem reports

Notes
Change control mechanisms can be tailored to categories of changes.

FAA-iCMM Traceability
1. Control changes to established configuration units. *(SE: BP 09.04)*
2. The project team oversees the configuration control of the software products throughout the transition. *(SA: TTS-Ac3)*
3. Change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a documented procedure. *(SW: SCM-Ac5)*
4. Changes to baselines are controlled according to a documented procedure. *(SW: SCM-Ac6)*
5. Status of configuration data is recorded according to a documented procedure. *(SW: SCM-Ac8)*

BP 16.05 Communicate Configuration Status

Communicate status of proposed changes, and baseline and configuration data, and access information to affected groups and individuals.

Description
Inform affected groups and individuals of the status of configuration data whenever there are any status changes. The status reports should include information on when accepted changes to configuration units/items will be processed, and the associated work products that are affected by the change. Access to configuration data and status should be provided to developers, customers, and other affected groups and individuals.

Typical Work Products
- status reports

Notes
Examples of activities for communicating configuration status include
- provide access to authorized users
- make baseline copies readily available to authorized users

Examples of reports includes
- configuration control board meeting minutes
- change request summary and status
- trouble report summary and status (including fixes)
- summary of changes made to baselines
- revision history of configuration units/items
- baseline status
- baseline audit results

FAA-iCMM Traceability
1. Communicate status of configuration data, proposed changes, and access information to affected groups. *(SE: BP 09.05)*
2. Standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals. *(SW: SCM-Ac9)*

BP 16.06   Conduct Configuration Audits

Conduct configuration baseline audits.

Description
Configuration audits are conducted to verify that a configuration item/unit/work product or set thereof has achieved its specified performance level (functional), and that the design documentation matches the as built work product (physical). Configuration audits also serve as a prerequisite for establishing the product baseline configuration to be used for production and acceptance purposes.

Typical Work Products
- baseline documentation
- audit procedures
- audit results

Notes
Audit, as used in this PA, is an examination of a work product or set of work products to assess compliance with specifications, standards contractual agreements, or other criteria.

FAA-iCMM Traceability
1. Software baseline audits are conducted according to a documented procedure. *(SW: SCM-Ac10)*

Table PA 16-1: Merging Configuration Management Practices

Configuration Management base practices	***SE-CMM*** **Manage Configurations:** ***Base Practices***	***SA-CMM*** **Transition to Support:** ***Activities Performed***	***SW-CMM*** **Configuration Management:** ***Activities Performed***
1. Establish configuration management methodology	9.1 Decide among candidate methods for configuration management.		1. (ability) A board having authority for managing the project's software baseline (i.e., a software configuration control board -- SCCB) exists or is established. 4. The software work products to be placed under configuration management are identified.
2. Identify configuration units/items	9.2 Identify configuration units that constitute identified baselines.		4. The software work products to be placed under configuration management are identified.
3. Establish and maintain a repository for work product baselines	9.3 Maintain a repository of work product baselines.		3. A configuration management library system is established as a repository for the software baselines. 7. Products from the software baseline library are created and their release is controlled according to a documented procedure.
4. Control and track changes	9.4 Control changes to established configuration units.	3. The project team oversees the configuration control of the software products throughout the transition.	5. Change requests and problem reports for all configuration items/units are initiated, recorded, reviewed, approved, and tracked according to a

Configuration Management base practices	***SE-CMM*** **Manage Configurations:** ***Base Practices***	***SA-CMM*** **Transition to Support:** ***Activities Performed***	***SW-CMM*** **Configuration Management:** ***Activities Performed***
			documented procedure. 6. Changes to baselines are controlled according to a documented procedure. 8. Status of configuration data is recorded according to a documented procedure.
5. Communicate configuration status	9.5 Communicate status of configuration data, proposed changes, and access information to affected groups.		9. Standard reports documenting the SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.
6. Conduct configuration audits.			10. Software baseline audits are conducted according to a documented procedure.
covered by generic practices			1. A SCM plan is prepared for each software project according to a documented procedure. 2. A documented and approved SCM plan is used as the basis for performing the SCM activities.

PA 17: Peer Review

Process Area Summary

Purpose
The purpose of Peer Review is to remove defects from work products early and efficiently..

Major Points Address
Peer Review involves a methodical examination of work products by the producers' peers to identify defects and areas where changes are needed. An important corollary effect is to develop a better understanding of work products and of defects that might be prevented

Goals
1. Defects in work products are identified and removed. *(BP 17.01, BP 17.02)*

Notes
Peer reviews are useful for removing defects from all work products. Peer reviews are most effective when the climate for conducting reviews is nonthreatening and when it is understood that the defect data are to be used for process and product improvement, not personnel performance appraisal. Peer reviews focus on the product being reviewed, not the producer. Care needs to be taken if any reports concerning peer reviews are provided to management. The information must be presented at the summary level evaluating the effectiveness of the peer review process itself or identifying overall program/system deficiencies and not to evaluate individual performance.

Relationships between this PA and other PAs
The specific products that will undergo a peer review are identified in the project's process and scheduled as part of the project planning activities, as described in Project Management (PA 11). Results of peer reviews are used to prevent defects (see Prevention PA 19). Reviewers should represent appropriate disciplines (see Coordination PA 14).

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 17.01 **Conduct Peer Reviews**. Conduct peer reviews to identify defects in work products and areas needing change.

BP 17.02 **Record and Analyze Peer Review Data.** Collect, record and analyze data on the conduct and results of peer reviews.

FAA-iCMM Traceability
The Peer Review process area is adapted from the following:
- SW-CMM: Peer Reviews (PR)

One activity from SW-CMM Software Product Engineering is also included.

BP 17.01 Conduct Peer Reviews.

Conduct peer reviews to identify defects in work products and areas needing change.

Description
Peer reviews are conducted to examine work products and identify defects and areas needing change. Peer review actions are tracked to closure.

Typical Work Products
- checklists of review criteria
- actions resulting from the review
- revised work products.

Notes
The following are typical peer review activities
- Identify peers who will be the reviewers. They may include for example subject matter experts, stakeholders, etc.
- Ensure that the peer review leader and other participants are aware of their roles
- Distribute review materials to reviewers in advance so they can adequately prepare for the peer review.
- Specify and enforce readiness and completion criteria for peer reviews
- Use checklists to identify criteria for the review of the work products in a consistent manner
- Track actions identified in peer reviews until they are resolved
- Use successful completion of peer reviews, including the rework to address the items identified in the peer reviews, as a completion criterion for the associated task

FAA-iCMM Traceability
1. Peer reviews are performed according to a documented procedure. *(SW: PR-Ac2)*

BP 17.02 Record and Analyze Peer Review Data.

Collect, record and analyze data on the conduct and results of peer reviews.

Description
After peer reviews are conducted, collect, record and analyze data about the reviews.

Typical Work Products

- identification of the work product
- size of the work product
- size and composition of the review team
- preparation time per reviewer
- length of the review meeting
- types and number of defects found and fixed
- rework effort

Notes
Data from peer reviews are used in Prevention (PA 19).

Examples of kinds of data to be collected and analyzed:

- defect description
- defect category
- severity of the defect
- units containing the defect
- units affected by the defect
- activity where the defect was introduced
- peer review that identified the defect

FAA-iCMM Traceability

1. Data on the conduct and results of the peer reviews are recorded. *(SW: PR-Ac3)*
2. Data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process. *(SE: SPE-Ac9)*

Table PA 17-1: Merging Peer Review Practices

Peer Review base practices	***SW-CMM*** **Peer Review:** **(*SE- Software Product Evolution)** ***Activities Performed***
1. Conduct peer reviews	2. Peer reviews are performed according to a documented procedure.
2. Record peer review data	3. Data on the conduct and results of the peer reviews are recorded. * **SPE**-Ac 9. Data on defects identified in peer reviews and testing are collected and analyzed according to the project's defined software process.
covered by generic practices	1. Peer reviews are planned, and the plans are documented.

PA 18: Measurement

Process Area Summary

Purpose
The purpose of Measurement is to:
- develop a quantitative understanding of product quality,
- establish and achieve specific product quality objectives, and
- control the process performance of the project quantitatively.

Process performance is the actual results achieved by performing the process.

Major points addressed
Measurement is important for all processes, across all disciplines. Measurement, when integrated into the life cycle established for a project or organization, provides the objective information required to effectively plan, track, and control the associated activities and tasks across the product or project life cycle. Measurements support management of a project including development, production, usage, disposal and retirement activities, and the product, as well as in product or process improvement efforts .

Goals
1. Measurements are established, maintained and used based on the project and organization goals. (BP 18.01, BP 18.04)
2. Measurements are collected, analyzed and reported. (BP 18.02, BP 18.03)

Notes
Process measurements provide for organizational process improvement as well as project planning and tracking. Product quality metrics are related to process metrics since product consistency is highly correlated with production process consistency. The process metrics may include product attribute measurements such as defect rates, but they do not include direct product quality measures such as those related to the evaluation of product performance: size, durability, maintainability, usability, or safety. Some metrics can be both process and product related, depending on the way they are to be used, such as checksheet data that sums to product defect rates, but also provides indications of where in the process defects are inserted.

Example categories of metrics include those which address objectives and issues in the following areas:
- schedule and progress
- resources and cost
- size and stability
- product quality
- contractor performance
- technical adequacy

Relationships between this PA and other PAs

Measurement should be integrated into the life cycle process structure to support Project Management (PA 11) in the following ways:

- Objective project and organizational planning and estimating, including quality targets
- Tracking actual project and organizational performance against established plans and objectives, including statistical quality control, and
- Identification and resolution of process-related issues.

In addition, this PA is required to support PA 21, Organizational Process Improvement , and PA 23, Innovation, at Maturity Level 5.

If solicitation of contractors/subcontractors is required, the measurement program must be addressed in the solicitation request and response (See PA 05, Outsourcing).

A primary source to identify issues to be measured is the Risk Management (PA 13) program.

This PA is also related to Quality Assurance and Management (PA 15) since it is QA's responsibility to assure that the processes used by the project are followed and measured.

Measure Process is a generic practice at capability level 2 of the FAA-iCMM. It begins measurement used in tracking processes and projects, but capability level 2 metrics are intended to be limited to cost and schedule. The generic practices at level 4 provide for a measurement program to quantitatively understand and control project performance. This includes stable processes that provide predictable outcomes that allow the organization to set achievable goals and objectives.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 18.01 **Establish measures based on quantitative goals:** Establish measurements based on prioritized issues and goals early within each project, and update the measurements collected throughout the life cycle.

BP 18.02 **Collect and analyze measurement data:** Collect and analyze measurements.

BP 18.03 **Communicate quantitative status:** Use measurements to communicate process and product status.

BP 18.04 **Take corrective action:** Take appropriate corrective action when the process is operating outside its quantitative process capability.

FAA-iCMM Traceability

The Measurement process area is adapted from:

SW-CMM: Quantitative Process Management (QPM)
Software Quality Management (SQM)

SA-CMM: Quantitative Process Management (QPM)
Quantitative Acquisition Management (QAM)

BP 18.01   Establish Measures Based on Quantitative Goals

Establish measurements based on prioritized issues and goals early within each project, and update the metrics collected throughout the life cycle.

Description
Establishing measurements based on prioritized issues includes the identification of product quality, process, and project issues, prioritizing them, and identifying measurements that are related to understanding and tracking those issues. Measurement issues are derived in conjunction with the suppliers, and allocated to suppliers, as appropriate.

Typical Work Products
- measurement plan
    - issues
    - measures
    - how data are collected , used, and stored
    - responsibilities
    - communications
    - reporting

I. measurement control points/thresholds

Notes
Program and organizational process objectives, issues, business goals, and information needs drive the measurement requirements. Measures help achieve project objectives, meet organizational process improvement goals, identify and track risks, satisfy constraints, and recognize issues and problems. To do this in a cost-effective manner, only those measures that are necessary to provide the required performance or quality insight should be implemented. Project and organizational objectives and issues should initially be identified and prioritized early in the project or process improvement effort. If solicitation of contractors/subcontractors is required the measurement program should be addressed in the solicitation. The resulting profile of objectives, issues, and business goals is then used to select and specify the required measures. This profile, and the associated measurement requirements, are thereafter revised periodically. This characteristic of the measurement PA is directly related to the need to specify measurement requirements across the life cycle. It ensures that the overall measurement process is cost effective by focusing on the most critical measurement requirements.
One statistical rule of thumb is to use three to five measurements at one time on a process and its product. These should evolve as stable process behavior and consistent product results render measurement less cost-effective at detailed levels.
An excellent resource text is AT&T's "Statistical Quality Control Handbook."

Issues may be derived from the following sources:

- risk analysis
- program constraints and objectives
- use of new technologies
- product acceptance criteria
- external requirements
- experience

A measurement program can ensure that the measures that are implemented reflect the technical and management characteristics of the process activities. This is especially important in two-party relationships between an acquirer and a developer or supplier.

FAA-iCMM Traceability

1. The quantitative objectives for each project's software products and services are defined. *(SA: QAM-Ac3)*
2. The quantitative objectives for each project's products and services are incorporated into the solicitation package and resulting contract according to the project's defined software acquisition process. *(SA: QAM-Ac4)*
3. The project's quantitative quality goals for the software products are defined, monitored, and revised throughout the software life cycle. *(SW: SQM-Ac3)*
4. The software project's quantitative quality goals for the products are allocated appropriately to subcontractors delivering software products to the project. (*SW: SQM-Ac5)*

BP 18.02 Collect and Analyze Measurement Data

Collect and analyze the measurements.

Description
Collecting and analyzing measurements involves data collection, storage, analysis, tracing to issues, looking at the project context, identifying problems and new issues, and developing recommended actions/options and development of indicators

Typical Work Products
- measurement plan or system description
- measurement data base
- measurement indicators for products and processes
- risk indicators
- problem reports
- recommended action reports

Notes
Define, collect, and analyze low level measurement data. These data are consolidated or combined into measurement indicators that provide insight into an issue or concept. All users of the measurement data for a given project or within a given organization should understand what the data represents. The users collect and analyze the data at periodic intervals. All users should have access to the same measurement data. The measurement data should be at a low enough level of detail to allow for the isolation of problems and to support a high degree of analysis flexibility. This characteristic of a measurement program ensures that the data that is analyzed materially represent the associated processes and products, and project or organizational quality or process goal achievement.

The analysis that is employed should be based on the principle of non-partiality. This promotes an environment whereby analysis, and the conclusions that are reached, are not unduly influenced by other project factors and pressures. Analysis should encourage open dialogue among all affected parties and collaborative problem solving. This characteristic of the measurement program ensures that objective analysis is performed to meet stakeholders' information needs.

Measurement results should be interpreted in the context of other project and organizational information. Quantitative measurement results must be interpreted within the context of the project or organizational characteristics. The contextual information allows the user to identify the nature of the process issues and associated causes. It also helps to identify possible courses of action. This characteristic of the measurement program ensures that the quantitative measurement data are interpreted correctly.

Measurement should be integrated into the project management process throughout its life cycle. Although the measurements change with the changing processes, activities, and tasks, the measurement process continuously provides objective information to support project and organizational process objectives. In addition, measurement and analysis of process attributes early in the life cycle provides insight into future issues. This characteristic of the measurement program ensures that measurement becomes an integral part of the management and engineering activities.

FAA-iCMM Traceability

1. The measurement data used to quantitatively control the project's defined software acquisition process are collected in accordance with the project's quantitative process management plans. *(SA: QPM-Ac3)*
2. Each project's defined software acquisition process is analyzed and quantitatively controlled according to the project's quantitative process management plans. *(SA: QPM-Ac4)*
3. Each project's acquired software products and services are measured, analyzed and compared to the project's established quantitative objectives. *(SA: QAM-Ac5)*
4. The measurement data used to control the project's defined software process quantitatively are collected according to a documented procedure. *(SW: QPM-Ac4)*
5. The project's defined software process is analyzed and brought under quantitative control according to a documented procedure. *(SW: QPM-Ac5)*
6. The quality of the project's software products is measured, analyzed, and compared to the products' quantitative quality goals on an event-driven basis. *(SW: SQM-Ac4)*

BP 18.03 Communicate quantitative status

Use measurements to communicate process and product status.

Description
Measurements provide the ability to manage by facts. Communicating the quantitative aspects of attributes of product quality and process performance together with an understanding of variation in processes provides the best hedge against over-reacting and under-reacting to changes and introducing waste and rework instead of weeding them out.

Typical Work Products
- control charts
- customer satisfaction summaries
- management metric "control panels"
- kiviat diagrams
- Quality Function Deployment sets of matrices
- Process team report appendices

Notes
Management by fact is described in Hoshin Kanri (Planning or Policy Deployment) textbooks as a method. Measurements may also be used such as control charts to communicate between process workers that operations are in or out of control, and indicate what to do if anomalous process behavior occurs.

FAA-iCMM Traceability
1. Reports documenting the results of the project team's quantitative process management activities are prepared and distributed. *(SA: QPM-Ac5)*
2. Reports documenting the results of the software project's quantitative process management activities are prepared and distributed. *(SW: QPM-Ac6)*

BP 18.04 Take corrective action

Take appropriate corrective action when the process is operating outside its quantitative process capability.

Description
The results of measurement analyses are used to quantitatively control the processes and products.

Typical Work Products
- Process team charters
- Action item lists
- Control charts

Notes
Statistical quality control involves not just tracking measurements, but prescribed types of actions to correct patterns of dysfunction that might occur ("out of control" conditions). Taking appropriate action to correct special cause of variation events usually requires stopping the process and fixing an external condition such as a bad raw material input lot, untrained staff, or equipment breakdowns. Marketing and other quantitative data also indicate when changes should be implemented, such as loss of significant market share or no bidders in the estimated competitive range for a procurement.

The AT&T "Statistical Quality Control Handbook" is an excellent reference manual on how to use control charts in operations, engineering, and management processes.

FAA-iCMM Traceability
1. Each project's defined software acquisition process is analyzed and quantitatively controlled according to the project's quantitative process management plans. *(SA: QPM-Ac4)*
2. The project's defined software process is analyzed and brought under quantitative control according to a documented procedure. *(SW: QPM-Ac5)*

Table PA 18-1: Merging Measurement Practices

Measurement base practices	*SA-CMM* **Quantitative Process Management:** ***Activities Performed***	*SA-CMM* **Quantitative Acquisition Management:** ***Activities Performed***	*SW-CMM* **Quantitative Process Management:** ***Activities Performed***	*SW-CMM* **Software Quality Management**: ***Activities Performed***
1. Establish Measures Based on Goals		3. The quantitative objectives for each project's software products and services are defined. 4. The quantitative objectives for each project's products and services are incorporated into the solicitation package and resulting contract according to the project's defined software acquisition process.		3. The project's quantitative quality goals for the software products are defined, monitored, and revised throughout the software life cycle. 5. The software project's quantitative quality goals for the products are allocated appropriately to subcontractors delivering software products to the project.
2. Collect and Analyze Measurements	3. The measurement data used to quantitatively control the project's defined software acquisition process are collected in accordance with the project's quantitative process management plans. 4. Each project's defined software acquisition process is analyzed and quantitatively controlled according to the project's quantitative process management plans.	5. Each project's acquired software products and services are measured, analyzed and compared to the project's established quantitative objectives.	4. The measurement data used to control the project's defined software process quantitatively are collected according to a documented procedure. 5. The project's defined software process is analyzed and brought under quantitative control according to a documented procedure	4. The quality of the project's software products is measured, analyzed, and compared to the products' quantitative quality goals on an event-driven basis.
3. Communicate quantitative status	5. Reports documenting the results of the project team's quantitative process management activities are prepared and distributed.		6. Reports documenting the results of the software project's quantitative process management activities are prepared and distributed.	
4. Take corrective	4. Each project's defined software		5. The project's defined software process is	

Measurement base practices	***SA-CMM*** **Quantitative Process Management:** ***Activities Performed***	***SA-CMM*** **Quantitative Acquisition Management:** ***Activities Performed***	***SW-CMM*** **Quantitative Process Management:** ***Activities Performed***	***SW-CMM*** **Software Quality Management**: ***Activities Performed***
action	acquisition process is analyzed and quantitatively controlled according to the project's quantitative process management plans.		analyzed and brought under quantitative control according to a documented procedure	
covered by generic practices	1. The acquisition organization's software acquisition process capability baseline is established and maintained according to a written procedure. 2. Each project team performs its activities in accordance with its documented quantitative process management plans. 6. Causal analysis of each project's defined software acquisition process is conducted on a periodic basis to determine root causes of variances from project plans. 7. Changes are implemented to correct the project's defined software acquisition process where it is out of expected or acceptable bounds.	1. each project team performs its activities in accordance with its documented quantitative acquisition management plans. 2. The acquisition organization utilizes quantitative measures as a normal part of management review and oversight of acquired products and services. 6. Causal analysis of each project's acquired products and services is conducted on a periodic basis to determine root causes of variances from project plans. 5. Each project's acquired software products and services are measured, analyzed and compared to the project's established quantitative objectives. 7. Changes are implemented to correct project's acquired products and services that are out of expected or acceptable bounds.	1. The software project's plan for quantitative process management is developed according to a documented procedure. 2. The software project's quantitative process management activities are performed in accordance with the project's quantitative process management plan. 3. The strategy for the data collection and the quantitative analyses to be performed are determined based on the project's defined process. 4. The measurement data used to control the project's defined software process quantitatively are collected according to a documented procedure. 7. The process capability baseline for the organization's standard software process is established and maintained according to a documented procedure.	1. The project's software quality plan is developed and maintained according to a documented procedure. 2. The project's software quality plan is the basis for the project's activities for software quality management.
to other PAs	to PA 19: 6. Causal analysis of each project's defined software acquisition	also to PA 11: 2. The acquisition organization utilizes quantitative measures as a	-	-

Measurement base practices	***SA-CMM*** **Quantitative Process Management:** ***Activities Performed***	***SA-CMM*** **Quantitative Acquisition Management:** ***Activities Performed***	***SW-CMM*** **Quantitative Process Management:** ***Activities Performed***	***SW-CMM*** **Software Quality Management**: ***Activities Performed***
	process is conducted on a periodic basis to determine root causes of variances from project plans.	normal part of management review and oversight of acquired products and services. Moved to PA 19: 6. Causal analysis of each project's acquired products and services is conducted on a periodic basis to determine root causes of variances from project plans.		

PA 19: Prevention

Process Area Summary

Purpose
The purpose of Prevention is to identify the causes of defects and prevent them from recurring.

Major Points Address
Prevention involves analyzing defects that were encountered in the past and taking specific actions to prevent the occurrence of those types of defects in the future. The defects may have been identified on other projects as well as in earlier stages or tasks of the current project. Prevention activities are also one mechanism for spreading lessons learned between projects.

Goals
1. Common causes of defects are sought out and identified. *(BP 19.01, BP 19.03)*
2. Common causes of defects are prioritized and systematically eliminated. *(BP 19.02, BP 19.04, BP 19.05)*

Notes
Trends are analyzed to track the types of defects that have been encountered and to identify defects that are likely to recur. Based on an understanding of the project's acquisition process and how it is implemented (as described in Project Management (PA 11)), the root causes of defects and the implications of the defects for future activities are determined. Both the project and the organization take specific actions to prevent recurrence of the defects.

Relationships between this PA and other PAs:
Defects are identified via Peer Review (PA 17). Some project actions may be handled as described in Project Management (PA 11). Some organizational actions may be handled as described in Organization Process Improvement (PA 21) or in Innovation (PA 23).

Base practices list
The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 19.01 **Conduct Causal Analysis Meetings**: Conduct causal analysis meeting.
BP 19.02 **Coordinate Action Proposals**: Review and coordinate implementation of action proposals from causal analysis meetings.
BP 19.03 **Document and Track Prevention Data**: Document and track defect prevention data and activities.
BP 19.04 **Revise Processes for Defect Prevention:** Revise the process to prevent defects.

FAA-iCMM Traceability

The Prevention process area is adapted from the following:

- SW-CMM: Defect Prevention (DP)

BP 19.01 Conduct Causal Analysis Meetings.

Conduct causal analysis meetings.

Description
Causal analysis meetings are typically held shortly after a task is completed. They may be conducted during a task, if and when the number of defects uncovered warrants. Meetings may also be conducted after products are released, if appropriate.

Defects are identified and analyzed to determine their root causes. The defects are assigned to categories of root causes, such as inadequate training, breakdown of communications, not accounting for all details of the problem, and making mistakes in manual procedures (e.g. typing). Common causes of defects are identified and documented and the results of the meeting are recorded for use by the organization and other projects.

Typical Work Products
- defects
- root causes
- categories of root causes
- meeting results

Notes
Proposed actions to prevent the future occurrence of identified defects and similar defects are developed and documented. Examples of proposed actions include modifications to
- the process
- training
- tools
- methods
- communications
- work products

FAA-iCMM Traceability
1. Causal analysis meetings are conducted according to a documented procedure. *(SW-DP-Ac3)*
2. Causal analysis of each project's defined software acquisition process is conducted on a periodic basis to determine root causes of variances from project plans. *(SA-QPM-Ac6)*
3. Causal analysis of each project's acquired products and services is conducted on a periodic basis to determine root causes of variances from project plans. *(SA-QAM-Ac6)*

BP 19.02 Coordinate Action Proposals

Review and coordinate implementation of action proposals from causal analysis meetings.

Description
Review the output from causal analysis meetings as well as action proposals that have been assigned by any groups in the organization and select action proposals that will be addressed. Perform a preliminary analysis of the proposals and set priorities. Document rationale for decisions and communicate to submitters of action proposals. Assign responsibility for implementing the action items resulting from the action proposals.

Review results of defect prevention experiments and take actions to incorporate the results of successful experiments into the rest of the project or organization as appropriate.

Typical Work Products
- prioritized action proposals

Notes
Priorities are usually nonrigorous and based on an understanding of the causes of defects, the implications of not addressing the defects, the cost to implement process improvements to prevent the defects, and the expected impact on quality.

FAA-iCMM Traceability:
1. Each of the teams assigned to coordinate defect prevention activities meets on a periodic basis to review and coordinate implementation of action proposals from the causal analysis meetings. *(SW-DP-Ac4)*

BP 19.03 Document and Track Prevention Data

Document and track defect prevention data and activities.

Description
Action proposals and action items are documented. Defect prevention data are managed and controlled.

Typical Work Products
- action proposals, which may contain
    - originator of the action proposal
    - description of the defect
    - description of the defect cause
    - defect cause category
    - stage when defect was injected
    - stage when defect was identified
    - description of the action proposal
    - action proposal category
- action items, which may contain
    - person responsible for implementing it
    - description of areas affected
    - individuals who are to be kept informed of its status
    - next date that status will be reviewed
    - rationale for key decisions
    - description of implementation actions
    - time and cost for identifying the defect and correcting it
    - estimated cost of not fixing the defect
- defect prevention data

Notes
Defect prevention data may be placed under Configuration Management (PA 16).

FAA-iCMM Traceability
1. Defect prevention data are documented and tracked across the teams coordinating defect prevention activities. *(SW-DP-Ac5)*

BP 19.04 Revise Processes for Defect Prevention

Revise the process to prevent defects..

Description
Revise the process as a result of defect prevention actions.

Typical Work Products
- revised processes

Notes
The processes revised may be the organization's standard process or the project's process. Refer also to Project Management (PA 11) or Organization Process Improvement (PA 21).

FAA-iCMM Traceability:
1. Revisions to the organization's standard software process resulting from defect prevention actions are incorporated according to a documented procedure. *(SW-DP-Ac6)*
2. Revisions to the project's defined software process resulting from defect prevention actions are incorporated according to a documented procedure. *(SW-DP-Ac7)*

Table PA 19-1: Merging Prevention Practices

Prevention base practices	***SW-CMM*** **Defect Prevention:** ***Activities Performed***	***SA-CMM*** **Quantitative Performance Management:** **(* Quantitative Acquistion Management)** ***selected Activities Performed***
1. Conduct causal analysis meetings	3. Causal analysis meetings are conducted according to a documented procedure.	6. Causal analysis of each project's defined software acquisition process is conducted on a periodic basis to determine root causes of variances from project plans. *** QAM-**Ac 6. Causal analysis of each project's acquired products and services is conducted on a periodic basis to determine root causes of variances from project plans.
2. Coordinate action proposals	4. Each of the teams assigned to coordinate defect prevention activities meets on a periodic basis to review and coordinate implementation of action proposals from the causal analysis meetings.	
3. Document and track prevention data	5. Defect prevention data are documented and tracked across the teams coordinating defect prevention activities.	
4. Revise processes for defect prevention	6. Revisions to the organization's standard software process resulting from defect prevention actions are incorporated according to a documented procedure. 7. Revisions to the project's defined software process resulting from defect prevention actions are incorporated according to a documented procedure.	
covered by generic practices	1. The software project develops and maintains a plan for its defect prevention activities. 2. At the beginning of a software task, the members of the team performing the task meet to	

Prevention base practices	***SW-CMM*** **Defect Prevention:** ***Activities Performed***	***SA-CMM*** **Quantitative Performance Management:** **(* Quantitative Acquistion Management)** ***selected Activities Performed***
	prepare for the activities of that task and the related defect preventions. 8. Members of the software engineering group and software-related groups receive feedback on the status and results of the organization's and project's defect prevention activities on a periodic basis.	

PA20: Organization Process Definition

Process Area Summary

Purpose

The purpose of Organization Process Definition is to define and maintain a usable set of process assets that support organizational learning and improve process performance across the projects.

Major Points Addressed

Organization Process Definition involves creating, coordinating, and managing the organization's standard processes, that can be tailored subsequently by a project to form the processes that it will follow in developing or acquiring its system or products.

This includes defining and maintaining process(es) that will meet the business goals of the organization, as well as collecting, designing, developing, and documenting process assets. Assets include example processes, process fragments, process-related documentation, process architectures, process-tailoring rules and tools, and process measurements.

Goals

1. The organization's set of standard processes is established and maintained. *(BP20.03)*
2. Guides for tailoring the organization's standard processes are established and maintained. *(BP20.04)*
3. Goals, performance data, and other assets for the organization's processes are collected, maintained, and communicated. *(BP20.02, BP20.05, BP20.06)*
4. Process definition and improvement activities are coordinated across the organization. *(BP20.01, BP20.06)*

Notes

A "project" is an organizational element that produces an output or outcome. An "organization" is a unit within which many projects are managed as a whole. An organization shares a common top-level manager and common policies.

A "set of standard processes" is a group of standard processes within an organization that share some common characteristics, but that are different enough in their domain of applicability to be considered as separate standard processes.

Relationships between this PA and other PAs

This process area covers the initial activities required to collect and maintain process assets, including the organization's standard acquisition process. The improvement of the process assets is covered in Organization Process Improvement (PA21).

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 20.01 **Appraise Processes:** Appraise the organization's processes periodically and develop action plans to address the findings.

BP 20.02 **Identify Process Goals**: Identify goals and performance standards for the organization's set of standard processes.

BP 20.03 **Establish Standard Processes**: Establish and maintain a set of standard processes for the organization.

BP 20.04 **Develop Tailoring Guidelines**: Establish and maintain tailoring guidelines for the organization's set of standard processes.

BP 20.05 **Maintain Process Assets**: Collect and maintain process assets from projects and support groups.

BP20.06 **Coordinate and Communicate Process Definition:** Coordinate and communicate process definition and improvement activities across the organization .

FAA-iCMM Traceability

The Organization Process Definition process area merges the following process areas and key process areas:

SE-CMM:	Define Organization's Systems Engineering Process (PA13)
SA-CMM:	Process Definition and Maintenance (PDM)
SW-CMM:	Organization Process Focus (OPF)
	Organization Process Definition (OPD)

In addition, some base practices and purpose are extracted from the CCF standard component called "Organizational Process Definition" (OPD).

BP 20.01 Appraise Processes

Appraise the organization's processes periodically, and develop action plans to address the findings.

Description

Understanding the strengths and weaknesses of the processes currently being performed in the organization is a key to establishing a baseline for improvement activities. Measurements of process performance and lessons learned should be considered in the appraisal. Appraisal can occur in many forms, and appraisal methods should be selected to match the culture and needs of the organization.

Typical Work Products

- process maturity profiles
- process performance analyses
- appraisal findings
- gap analyses

Notes

An example of an appraisal scenario is to appraise the organization's current processes using the FAA-iCMM and its associated appraisal method. Use the results of the appraisal to establish or update process performance goals.

If delays and queues occur in the execution of the current processes, then an organization may focus on them as starting points for cycle-time reduction. Check process features such as readiness criteria, inputs, and verification mechanisms.

FAA-iCMM Traceability

1. Appraise the existing processes being performed in the organization to understand their strengths and weaknesses *(SE: BP 14.01)*
2. The acquisition organization's standard software acquisition process is appraised periodically and action plans developed to address the findings of the appraisal. *(SA: PDM-Ac3)*
3. The software process is assessed periodically, and action plans are developed to address the assessment findings.*(SW: OPF-Ac1)*

BP 20.02 Identify Process Goals

Identify goals and performance standards for the organization’s set of standard processes.

Description
Establish goals for the set of the organization's standard processes from the organization's business goals. The process operates in a business context, that is explicitly recognized to institutionalize the organization's standard practice. Process goals consider the financial, quality, human resource, and marketing issues important to the success of the business.

Typical Work Products
- goals of the organization's process
- requirements for the organization's standard process
- requirements for the organization's process asset library
- process asset library

Notes
Establishing goals may include determining the tradeoff criteria for process performance based on time-to-market, quality, and productivity business issues.

FAA-iCMM Traceability
1. CCF standard component “Organizational Process Definition,” shared activity 2.
2. Establish goals for the organization's systems engineering process from the organization's business goals *(SE: BP 13.01)*

BP 20.03 Establish Standard Processes

Establish and maintain a set of standard processes for the organization.

Description
Develop a set of standard processes for the organization. The organization's set of standard processes is developed using the facilities of the process asset library. The organization's standard processes are placed in the process asset library.

Typical Work Products
- organization's set of standard processes
- inputs to training
- inputs to process improvement

Notes
Standard processes should include the interfaces to the organization's other defined processes. In addition, references used to define the process (e.g., military standards, IEEE standards) should be cited and maintained.

To develop the standard process, an organization can identify all the process elements or activities of the organization's process. The organization must evaluate the process elements for consistency of inputs and outputs, redundant activities, and missing activities. Inconsistencies must be resolved between process elements and provision made for appropriate sequencing and verification features. The resulting process should be well defined.

A well-defined process includes
- readiness criteria
- inputs
- standards and procedures
- validation mechanisms and criteria
    - success criteria
    - peer reviews
- outputs
- completion criteria
- a process owner or sponsor
- roles and responsibilities
- defined internal and external interfaces

FAA-iCMM Traceability
1. CCF standard component "Organizational Process Definition," shared activity 1.
2. Develop a well-defined standard systems engineering process for the organization *(SE: BP 13.03).*
3. The acquisition organization's standard software acquisition process is defined and maintained in accordance with its documented process definition and maintenance plans. *(SA: PDM.Ac2)*

4. The organization's standard software process is developed and maintained according to a documented procedure. *(SW: OPD.Ac1)*

BP 20.04 Develop Tailoring Guidelines

Establish and maintain tailoring guidelines for the organization’s set of standard processes.

Description
Define guidelines for tailoring the organization's standard process for project use in developing the project's defined process. Since the organization's standard processes may not be suitable for every project's situation, guidelines for tailoring it are needed. The guidelines are designed to fit a variety of situations, while not allowing projects to bypass standards that must be followed or substantial and important practices prescribed by organizational policy.

Typical Work Products
- tailoring guidelines for the set of organization standard processes

Notes
Guidelines should enable the organization’s standard processes to be tailored to address contextual variables such as the domain of the project; the cost, schedule, and quality tradeoffs; the experience of the project's staff; the nature of the customer; the technical difficulty of the project, etc.

FAA-iCMM Traceability
1. CCF standard component “Organizational Process Definition,” shared activity 4.
2. Define guidelines for tailoring the organization's standard systems engineering process for project use in developing the project's defined process *(SE: BP 13.04)*
3. Guidelines and criteria for a project’s selection and tailoring of the acquisition organization’s standard software acquisition process are developed and maintained.*(SA: PDM-Ac5)*
4. Guidelines and criteria for the projects’ tailoring of the organization’s standard software process are developed and maintained *(SW: OPD-Ac4)*

BP 20.05 Maintain Process Assets

Collect and maintain process assets from projects and support groups.

Description
The information generated by the process definition activity, both at the organization and project levels, is stored (e.g., in a process asset library), made accessible to those who are involved in tailoring and process design efforts, and maintained so as to remain current. New process assets may be necessary during the development task and should be added to the process asset library. New processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization.

Typical Work Products
- instructions for use of a process asset library
- design specifications for a process asset library
- process assets

Notes
The purpose of a process asset repository and library is to store and make available process assets that projects will find useful in defining the process for developing the system. The repository or library should contain examples of processes that have been defined, and the measurements of the process. When the organization's standard process has been defined, it should be added to the process asset library, along with guidelines for projects to tailor the organization's standard process when defining the project's process. Project staff must be informed of the contents of the process asset library, have access to it, and be trained in its use.

Process assets typically include
- the organization's standard process
- the approved or recommended acquisition and development life cycles
- project processes together with measurements collected during the execution of the processes
- guidelines and criteria for tailoring the organization's standard acquisition process
- process-related reference documentation
- measurements of the project
- lessons learned

FAA-iCMM Traceability
1. CCF standard component “Organizational Process Definition,” shared activity 6.
2. Collect and maintain systems-engineering process assets *(SE: BP 13.02)*
3. The acquisition organization’s and projects’ activities for defining and maintaining their software acquisition processes are coordinated at the organization level.*(SA: PDM-Ac4)*
4. An organizational repository of software acquisition process information is established, managed, controlled, and maintained to support process definition and maintenance activities*(SA: PDM-Ac6)*
5. The use of the organization’s software process database is coordinated at the organizational level. *(SW: OPF-Ac4)*

6. New processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization. *(SW: OPF-Ac5)*
7. Descriptions of software life cycles that are approved for use by the projects are documented and maintained. *(SW: OPD-Ac3)*
8. The organization's software process database is established and maintained. *(SW: OPD-Ac5)*
9. A library of software process-related documentation is established and maintained.. *(SW: OPD-Ac6)*

BP20.06 Coordinate and Communicate Process Definition:

Coordinate and communicate process definition and improvement activities across the organization.

Description
Groups involved or affected by organizational process definition and improvement activities or results are kept informed. The information may be at project or organization-wide scope. This information is disseminated to affected groups and stored in the process asset library.

Typical Work Products
- communication strategy for process definition and implementation
- reports, analyses, and advisories on activities
- electronic newsgroups and Web-based communications
- database of process assets
- decision memoranda
- training and information seminars

Notes
Definition and improvement both must be kept visible to the organization so a communications strategy is needed. A strategy includes
- an information needs analysis
- specification of, and allocation of the information requirements to information products
- dissemination mechanisms including training
- feedback mechanisms that monitor the effectiveness of the communications against their specified objectives

FAA-iCMM Traceability
1. Project teams are informed of the acquisition organization's and projects' activities for process definition and maintenance. *(SA: PDM-Ac7)*
2. The organization's and projects' activities for developing and improving their software processes are coordinated at the organization level. *(SW: OPF-Ac3)*
3. The use of the organization's software process database is coordinated at the organizational level. *(SW: OPF-Ac4)*
4. Training for the organization's and projects' software processes is coordinated across the organization.
5. The groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement. (SW: OPF-Ac7)
6. Communicate process improvements to existing projects and to other affected groups, as appropriate. (SE.BP14.04)

7. The software acquisition process group coordinates process improvement activities. *(SA: CPI-Ac2)*

8. The group responsible for the organization’s software process activities (e.g. software engineering process group) coordinates the software process improvement activities. *(SW: PCM-Ac2)*

Table PA20 - 1: Merging Organization Process Definition Practices

Organ-ization Process Definition base practices	***SE-CMM*** **Define Org's Systems Eng Process** ***Improve Org's Systems Eng Process** ***Base Practices***	***SA: CMM*** **Process Definition and Maintenance (PDM) *Continuous Process Improvement (CPI)** ***Activities Performed***	***SW: CMM*** **Organization Process Focus (OPF)** ***ActivitiesPerformed***	***SW: CMM*** **Organization Process Definition (OPD)** ***ActivitiesPerformed***
covered by generic practices		1. The acquisition organization performs its activities in accordance with its documented process definition and maintenance plans. 2. The acquisition organization's standard software acquisition process is defined and maintained in accordance with its documented process definition and maintenance plans.	2. The organization develops and maintains a plan for its software process development and improvement activities.*)*	2. The organization's standard software process is documented according to established organization standards.
1. Appraise processes	***BP14.01**. Appraise the existing processes being performed in the organization to understand their strengths and weaknesses.	3. The acquisition organization's standard software acquisition process is appraised periodically and action plans developed to address the findings of the appraisal.	1. The software process is assessed periodically, and action plans are developed to address the assessment findings.	
2. Identify process goals	1. Establish goals for the organization's systems engineering process from the organization's business goals.			.
3. Establish standard process	3. Develop a well-defined standard systems engineering process for the organization.	2. The acquisition organization's standard software acquisition process is defined and maintained in accordance with its documented process		1. The organization's standard software process is developed and maintained according to a documented procedure.

Organ-ization Process Definition base practices	***SE-CMM*** **Define Org's Systems Eng Process** ***Improve Org's Systems Eng Process** ***Base Practices***	***SA: CMM*** **Process Definition and Maintenance (PDM)** ***Continuous Process Improvement (CPI)** ***Activities Performed***	***SW: CMM*** **Organization Process Focus (OPF)** ***ActivitiesPerformed***	***SW: CMM*** **Organization Process Definition (OPD)** ***ActivitiesPerformed***
		definition and maintenance plans.		
4. Develop tailoring guidelines	4. Define guidelines for tailoring the organization's standard systems engineering process for project use in developing the project's defined process.	5. Guidelines and criteria for a project's selection and tailoring of the acquisition organization's standard software acquisition process are developed and maintained.		4. Guidelines and criteria for the projects' tailoring of the organization's standard software process are developed and maintained.
5. Maintain process assets	2. Collect and maintain systems-engineering process assets.	4. The acquisition organization's and projects' activities for defining and maintaining their software acquisition processes are coordinated at the organization level. 6. An organizational repository of software acquisition process information is established, managed, controlled, and maintained to support process definition and maintenance activities.	4. The use of the organization's software process database is coordinated at the organizational level. 5. New processes, methods, and tools in limited use in the organization are monitored, evaluated, and, where appropriate, transferred to other parts of the organization.	3. Descriptions of software life cycles that are approved for use by the projects are documented and maintained. 5. The organization's software process database is established and maintained. 6. A library of software process-related documentation is established and maintained.
6. Commun-icate and coordinate process definition	*** BP14.04** Communicate process improvements to existing projects and to other affected groups, as	7. Project teams are informed of the acquisition organization's and projects' activities for process definition and maintenance.	3. The organization's and projects' activities for developing and improving their software processes are coordinated at the organization level.	

Organ-ization Process Definition base practices	***SE-CMM*** **Define Org's Systems Eng Process** ***Improve Org's Systems Eng Process** ***Base Practices***	***SA: CMM*** **Process Definition and Maintenance (PDM)** ***Continuous Process Improvement (CPI)** ***Activities Performed***	***SW: CMM*** **Organization Process Focus (OPF)** ***ActivitiesPerformed***	***SW: CMM*** **Organization Process Definition (OPD)** ***ActivitiesPerformed***
	appropriate.	***2 (CPI).** The software acquisition process group coordinates process improvement activities	4. The use of the organization's software process database is coordinated at the organizational level. 6. Training for the organization's and projects' software processes is coordinated across the organization. 7. The groups involved in implementing the software processes are informed of the organization's and projects' activities for software process development and improvement. ***2. (PCM)** The group responsible for the organization's software process activities (e.g. software engineering process group) coordinates the software process improvement activities.	

PA21: Organization Process Improvement

Process Area Summary

Purpose
The purpose of Organization Process Improvement is to gain competitive advantage by continuously improving the effectiveness and efficiency of the processes used by the organization.

Major points addressed
Organization Process Improvement involves developing an understanding of the organization's processes in the context of the organization's business goals, analyzing the performance of the processes, and explicitly planning and deploying improvements to those processes through managed continuous process improvement. Quantitative objectives for the organization's standard process and the projects' defined processes are targets of the improvement activity.

Continuous improvement involves defining quantitative process improvement objectives with the involvement and sponsorship of organization management. It is a continuous effort to proactively and systematically identify, appraise, implement, and evaluate improvements to the organization processes.

The commitment to continuous process improvement is organization-wide. Training and incentive programs are established to encourage and enable all personnel to participate in the continuous process improvement activities. Improvement opportunities are identified and appraised in terms of how well they move the organization and its projects toward continuous process improvement objectives.

Goals
1. The set of standard processes and projects' defined processes are improved continuously. *(BP 21.01, BP 21.02)*

Notes
A "project" is an organizational element that produces an output or outcome. An "organization" is a unit within which many projects are managed as a whole. An organization shares a common top-level manager and common policies.
A "set of standard processes" is a group of standard processes within an organization that share some common characteristics, but that are different enough in their domain of applicability to be considered as separate standard processes.

Guidance on improving the standard process may be obtained from several sources, including lessons learned, application of the generic practices, and appraisals of the standard process against the FAA-iCMM. The resulting profile of capability levels against process areas will point to the most needed areas for improvement. Adding practices that satisfy the generic practices in these process areas will be useful.

Relationships between this PA and other PAs

This process area covers the continuing activities to improve the performance of processes in the organization. The initial collection of the organization's process assets and the definition of the organization's standard processes is covered in the process area, Organization Process Definition (PA20). When process improvements are approved for normal practice, the appropriate organization standard process and the projects' defined processes are revised accordingly. The Organization Process Definition (PA20) provides coordination of the actions for changing the standard process. Project Management (PA11) defines the actions for changing the projects' defined processes. Innovation (PA23) defines the actions for adopting and transforming new techniques and technologies into the organization.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems.

BP 21.01 **Establish process improvement program**: Plan improvements to the organization's processes based on widespread participation and analysis of the impact of potential improvements on achieving the goals of the processes.

BP 21.02 **Change the standard process**: Change the organization's set of standard processes to achieve targeted improvements.

FAA-iCMM Traceability

SE-CMM: Improve Organization's Systems Engineering Processes (PA14)
SA-CMM: Continuous Process Improvement (CPI)
SW-CMM: Process Change Management (PCM)

BP 21.01 Establish Process Improvement Program

Plan improvements to the organization's processes based on widespread participation and analysis of the impact of potential improvements on achieving the goals of the processes.

Description

Appraising the process provides momentum for change and the involvement of a spectrum of organizational personnel. This momentum must be harnessed by planning improvements that will provide the most payback for the organization in relation to its business goals. The improvement plans provide a framework for taking advantage of the momentum gained in appraisal. The planning should include targets for improvement that will lead to high-payoff improvements in the process in terms of achieving organizational goals or objectives.

Organizations may take this opportunity to "mistake-proof" the process and eliminate wasted effort. It is important to make the more effective and efficient process stable; that is, performed consistently by everyone. Deployment is commonly a challenge. In making improvements, be careful to avoid optimizing locally, and thereby creating problems in other areas. Empowering teams to define, design, develop, and deploy improvements subject to process goals related to business goals tends to work well, once measurement has been accepted as a basis to inform decisions. Wide participation on improvement teams is good for morale and deployment buy-in. Piloting the improvements for proof of concept on one project also reduces risk and instability.

Typical Work Products

- process improvement plan

Notes

Perform tradeoffs on proposed process improvements against estimated returns in cycle time, productivity, and quality. Use the techniques of the process area, Alternatives (PA04).

FAA-iCMM Traceability

1. Plan improvements to the organization’s processes based on analyzing the impact of potential improvements on achieving the goals of the processes. *(SE: BP 14.02)*
2. A software process improvement program is established which empowers the members of the organization to improve the processes of the organization. *(SW: PCM-Ac1)*
3. Members of the organization actively participate in teams to develop software process improvements for assigned process areas. *(SW: PCM-Ac6)*

BP 21.02 Change the Standard Process

Change the organization's set of standard processes to achieve targeted improvements.

Description
Improvements of the organization's standard processes, and necessary changes to the tailoring guidelines in the process asset library, will encourage projects to incorporate the improvements.

Typical Work Products
- organization's set of standard process descriptions
- tailoring guidelines for the organization's standard processes

Notes
As improvements to the standard processes are implemented and evaluated, the organization should adopt the successful improvements as permanent changes to appropriate ones of the set of standard processes. Members of the organization should actively participate in teams to develop process improvements. Where appropriate, the process improvements are installed on a pilot basis to determine their benefits and effectiveness before they are introduced into normal practice.

FAA-iCMM Traceability
1. Change the organization's standard systems engineering process to reflect targeted improvements *(SE: BP 14.03)*
2. Process improvements are transferred into practice according to a written procedure. *(SA: CPI-Ac4)*
3. Records of process improvement activities are maintained in the acquisition organization's repository for software acquisition process information. *(SA: CPI-Ac5)*
4. Software process improvement proposals are handled according to a documented procedure.*(SW: PCM-Ac5)*
5. Members of the organization actively participate in teams to develop software process improvements for assigned process areas. *(SW: PCM-Ac6)*
6. Where appropriate, the software process improvements are installed on a pilot basis to determine their benefits and effectiveness before they are introduced into normal practice. *(SW: PCM-Ac7)*

Table PA21-1: Merging Organization Process Improvement Practices

Organization Process Improvement Base Practices	***SE-CMM*** **Improve Org's Systems Engineering Process** ***Base Practices***	***SA: CMM*** **Continuous Process Improvement (CPI)** ***Activities Performed***	***SW: CMM*** **Process Change Management (PCM)** ***Activities Performed***
1.Establish process improvement program	2. Plan improvements to the organization's processes based on analyzing the impact of potential improvements on achieving the goals of the processes.	3. Process improvement proposals are handled according to a written procedure.	1. A software process improvement program is established which empowers the members of the organization to improve the processes of the organization. 5. Software process improvement proposals are handled according to a documented procedure 6. Members of the organization actively participate in teams to develop software process improvements for assigned process areas.
2. Change the standard process	3. Change the organization's standard systems engineering process to reflect targeted improvements.	4. Process improvements are transferred into practice according to a written procedure. 5. Records of process improvement activities are maintained in the acquisition organization's repository for software acquisition process information.	7. Where appropriate, the software process improvements are installed on a pilot basis to determine their benefits and effectiveness before they are introduced into normal practice.
covered by generic practices		1. The acquisition organization performs its activities in accordance with its documented continuous process improvement plans.	3. The organization develops and maintains a plan for software process improvement according to a documented procedure. 4. The software process improvement activities are performed in accordance with the software process

Organization Process Improvement Base Practices	***SE-CMM*** **Improve Org's Systems Engineering Process** *Base Practices*	***SA: CMM*** **Continuous Process Improvement (CPI)** *Activities Performed*	***SW: CMM*** **Process Change Management (PCM)** *Activities Performed*
			improvement plan. 8. When the decision is made to transfer a software process improvement into normal practice, the improvement is implemented according to a documented procedure. 9. Records of software process improvement are maintained. 10. Software managers and technical staff receive feedback on the status and results of the software process improvement activities on an event-driven basis.
to other PAs	1. Appraise the existing processes being performed in the organization to understand their strengths and weaknesses (PA20) 4. Communicate process improvements to existing projects and to other affected groups, as appropriate (PA20)	2. The software acquisition process group coordinates process improvement activities. (PA20)	2. The group responsible for the organization's software process activities (e.g. software engineering process group) coordinates the software process improvement activities. (PA20)

PA 22: Training

Process Area Summary

Purpose
The purpose of the Training process area is to develop the skills and knowledge of individuals so they can perform their roles effectively and efficiently.

Major points addressed
To ensure the effective application of critical resources that are predominantly available only from people, the knowledge and skill requirements within the organization need to be identified, as well as the specific project's or organization's needs (such as those relating to emergent programs or technology, and new products, processes, and policies).

Needed skills and knowledge can be provided both by training within the organization and by timely acquisition from sources external to the organization. Acquisition from external sources may include customer resources, temporary hires, new hires, consultants, and subcontractors. In addition, knowledge may be acquired from subject matter experts.

Goals
1. Training needs are solicited and identified. *(BP 22.01, BP 22.02)*
2. Required training is provided. *(BP 22.03, BP 22.04, BP 22.05)*

Notes
The choice of training or external sourcing for the needed skill and knowledge is often determined by the availability of training expertise, the project's schedule, and business goals. Successful training programs result from an organization's commitment. In addition, the programs are administered in a manner that optimizes the learning process, and that is repeatable, assessable, and changeable to meet changing needs of the organization. Training is not limited to classroom events, but includes mechanisms to enhance skills and the building of knowledge. When training is not a viable approach due to schedule or availability of training resources, other sources of the needed skills and knowledge are pursued.

Relationships between this PA and other PAs
The Training process area supports all other PAs ensuring that projects and the organization have the knowledge and skills to perform those processes. Project Management (PA11) activities ensure skills are available for the project.

Base practices list

The following list contains the base practices that are essential elements of good acquisition of software intensive systems:

BP 22.01 **Identify Strategic Needs**: Identify strategic training needs for the organization.
BP 22.02 **Identify Unique Training Needs**: Identify unique training needs of projects and support groups.
BP 22.03 **Train Individuals:** Train individuals to have the skills and knowledge needed to perform their assigned roles.
BP 22.04 **Obtain Training**: Obtain training to address the identified training needs.
BP 22.05 **Establish and Maintain Records:** Establish and maintain records of training and experience
BP 22.06 **Assess Training Effectiveness:** Assess the effectiveness of training to meet the identified training needs.

FAA-iCMM Traceability

The Training process area merges the following process areas and key process areas:

- SE-CMM: Provide Ongoing Skills and Knowledge (PA17)
- SA-CMM: Training Program (TP)
- SW-CMM: Training Program (TP)

In addition, the base practices and purpose are extracted from the CCF standard component called “Organizational Training Program” (OTP). Those shared activities that the CMMI project has concluded are “common across all or most existing CMMs” are included as base practices here. The CCF identified no “unique activities” from the CMMs and concluded only the shared activities represented the process area. However, we included an additional base practice, BP 22.06 Assess Training Effectiveness .

BP 22.01 Identify Strategic Needs

Identify strategic training needs for the organization.

Description
This base practice determines the improvements that are needed in strategic skill and knowledge within the organization. The needs are determined using inputs from programs, the organizational strategic plan, and a compilation of existing employee skills. The organizational strategic plan is used to help identify emerging technologies, and the existing skill level is used to assess current capability.

Identification of skill and knowledge needs should also determine training that can be consolidated to achieve efficiencies of scale, and increase communication via the use of common tools within the organization. Training should be offered in the organization's process for the acquisition of software intensive systems and in tailoring the process for specific projects.

Typical Work Products
- organization’s training needs
- strategic training needs
- strategic training plan

Notes
The organization may identify additional training needs as determined from appraisal findings (see Organization Process Improvement (PA 21)) and as identified by the defect prevention process (see Prevention (PA 19)). The organization's training plan should be developed and revised according to a documented procedure.

FAA-iCMM Traceability
1. CCF standard component “Organizational Training Program”, shared activity 1.
2. Identify needed improvements in skill and knowledge through the organization using the projects’ needs, organizational strategic plan, and existing employee skills as guidance. *(SE-PA 17.01)*
3. The organization’s training plan is developed and revised according to a documented procedure. *(SW-TP-Ac2)*
4. The organization’s training program is developed and maintained. *(SA-TP-Ac1)*

BP 22.02 Identify Unique Training Needs

Identify unique training needs of projects and support groups.

Description
This base practice determines the improvements that are needed in skill and knowledge within projects and support groups. The needs are determined using inputs from existing programs, the organizational strategic plan, and a compilation of existing employee skills. Project inputs help to identify existing deficiencies which may be remedied through training or acquisition of skills and knowledge by other means. The existing skill level is used to assess current capability.

Identification of skill and knowledge needs should also determine training that can be consolidated to achieve efficiencies of scale, and increase communication via the use of common tools within the organization. Training should be offered in the organization's process for the acquisition of software intensive systems and in tailoring the process for specific projects.

It is essential to ensure that appropriate skill and knowledge are available to the project. Through deliberate assessment and preparation, plans can be developed and executed to make available the range of required knowledge and skills, including functional engineering skills, application problem-domain knowledge, interpersonal skills, multidisciplinary skills, management skills, and process-related skills. After the needed skills have been identified, evaluations of the appropriate mode of knowledge or skill acquisition can be used to select the most effective approach.

Typical Work Products
- project and support group’s training needs
- project and support group skill or knowledge
- assessment of skill types needed by skill category
- project knowledge acquisition plan
- training plan
- list of identified and available subject matter experts

Notes
The organization may identify additional training needs as determined from appraisal findings (see Organization Process Improvement (PA 21)) and as identified by the defect prevention process (see Prevention (PA 19)). The organization's training plan should be developed and revised according to a documented procedure. Each project should develop and maintain a training plan that specifies its training needs.

Appropriate coverage of the full range of skill and knowledge types can be addressed with a checklist of knowledge types (e.g., functional engineering, problem domain, etc.) against each element of the work breakdown structure.

An example of ensuring the availability of the appropriate application-problem domain knowledge (e.g., satellite weather data processing), would be a plan to interview identified subject matter experts in connection with requirements interpretation or system design. Such an approach would be appropriate when an organization does not have the required expertise available (as with the first program in a new line of business).

FAA-iCMM Traceability

1. CCF standard component “Organizational Training Program”, shared activity 2.
2. Identify needed improvements in skill and knowledge through the organization using the projects’ needs, organizational strategic plan, and existing employee skills as guidance. *(SE-PA17.01)*
3. Ensure that appropriate skill and knowledge are available to the systems engineering effort. *(SE-PA17.03)*
4. Each software acquisition project identifies specific training needs and develops a training plan in accordance with training program procedures. *(SA-TP-Ac2)*
5. Each software project develops and maintains a training plan that specifies its training needs. *(SW-TP-Ac1)*
6. The organization’s training plan is developed and revised according to a documented procedure. *(SW-TP-Ac2)*
7. The org’s training program is developed and maintained. *(SA-TP-Ac1)*

BP 22.03 Train Individuals

Train individuals to have the skills and knowledge needed to perform their assigned roles.

Description
Personnel are trained in accordance with the training plan and developed material.

Typical Work Products
- trained personnel
- training waiver

Notes
Offer the training in a timely manner (just-in-time training) to ensure optimal retention and the highest possible skill level.
- A procedure should exist to determine the skill level of the employee prior to receiving the training.
- A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform their designated roles.
- A process exists to provide incentives and motivate the students to participate in the training.
- Online training/customized instruction modules accommodate different learning styles and cultures, in addition to transferring smaller units of knowledge.

FAA-iCMM Traceability
1. CCF standard component "Organizational Training Program", shared activity 3.
2. Train personnel to have the skills and knowledge needed to perform their assigned roles. (SE-PA17.05)
3. Sw training for the project team is performed in accordance with the org's training program. (SA-TP-Ac3)
4. A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform their designated roles. *(SA-TP-Ac4)*
5. A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform their designated roles. *(SW-TP-Ac5)*
6. The training for the organization is performed in accordance with the organization's training plan. *(SW-TP-Ac3)*

BP 22.04 Obtain Training

Obtain training to address the identified training needs

Description
Evaluate and select the appropriate mode of acquiring knowledge or skills with respect to training or other sources to ensure that the most effective method is chosen to make needed skill and knowledge available to individuals in a timely manner. Project and organizational needs are analyzed, and the methods of the Alternatives process area (PA04) are employed to choose among alternatives such as consultants, subcontracts, knowledge acquisition from identified subject matter experts, or training.

Prepare training materials based upon the identified training needs for each class that is being developed and facilitated by people within the organization, or obtain the training material for each class that is being procured.

Training effectiveness assessment results should be used to adjust training as appropriate.

Typical Work Products
- survey of needed skills or knowledge
- trade-study results indicating the most effective mode of skill or knowledge acquisition
- course descriptions and requirements
- training material

Notes
Example criteria which may be used to determine the most effective mode of acquiring knowledge or skill acquisition include
- time available to prepare for project execution
- business objectives
- availability of in-house expertise
- availability of training

Course description should include
- intended audience
- preparation for participation
- training objective
- length of training
- lesson plans
- criteria for determining the students' satisfactory completion

Prepare
- procedures for periodically evaluating the effectiveness of the training and special considerations, such as piloting and field testing the training course
- needs for refresher training and opportunities for follow-up training

- materials for training a specific practice to be used as part of the process (e.g., method technique)
- materials for training a process
- materials for training process skills such as statistical techniques, statistical process control, quality tools and techniques, descriptive process modeling, process definition, and process measurement

Review the training material with some or all of the following: instructional experts, subject matters experts, and students from the pilot programs.

FAA-iCMM Traceability
1. CCF standard component "Organizational Training Program", shared activity 4.
2. Select mode of knowledge or skill acquisition. *(SE-PA17.2)*
3. Prepare training materials. *(SE-PA17.4)*
4. Training courses prepared at the organizational level are developed and maintained according to the organization standards. *(SW-TP-Ac4)*

BP 22.05 Establish and Maintain Records

Establish and maintain records of training and experience.

Description
Records are maintained to track the training that each employee has received and the employee's skills and capabilities.

Courseware material is maintained in a repository for future access by employees and for maintaining traceability in changes into course material.

Typical Work Products
- training and experience records
- baselined training materials
- revisions to training materials
- training waivers

Notes
Records are kept of all students who successfully complete each training course or other approved training activity. Also, records of successfully completed training are made available for consideration in the assignment of the staff and managers.

Maintain a repository of training materials and make it available to all employees. (For example, the organization's library could make books, notebooks, videotapes, etc., available; soft-copy training materials could be maintained in a public file server.) Incorporate lessons learned into process training materials and the training program. Update process training materials with all process changes and improvements.

FAA-iCMM Traceability
1. CCF standard component "Organizational Training Program", shared activity 5.
2. Maintain training records. *(SE-PA17.07)*
3. Maintain training materials. *(SE-PA17.08)*
4. Training records are maintained. *(SA-TP-Ac5)*
5. Training courses prepared at the organizational level are developed and maintained according to the organization standards. *(SW-TP-Ac4)*
6. Records of training are maintained. *(SW-TP-Ac6)*

BP 22.06 Assess Training Effectiveness

Assess the effectiveness of training to meet the identified training needs.

Description
A key aspect of training is determining its effectiveness. Methods of evaluating effectiveness need to be addressed concurrent with the development of the training plan and training material. In some cases, these methods need to be an integral part of the training material. The results of the effectiveness assessment must be reported in a timely manner so that adjustments can be made to the training.

Typical Work Products
- analysis of training effectiveness
- modification to training

Notes
A procedure should exist to determine the skill level of the employee after receiving the training to determine the success of the training. This could be accomplished via formal testing, on-the-job skills demonstration, or assessment mechanisms embedded in the courseware.

FAA-iCMM Traceability
1. Assess training effectiveness. *(SE-PA17.06)*
2. Measurements are used to determine the quality of the training program. *(SA-TP-Ac6)*

Table PA22-1: Merging Training Practices

Training base practices	***SE-CMM*** **Provide Ongoing Skills and Knowledge:** ***Base Practices***	***SA-CMM*** **Training Program:** ***Activities Performed***	***SW-CMM*** **Training Program:** ***Activities Performed***
1. Identify strategic training needs	17.1 Identify training needs.	1. The org's training program is developed and maintained.	2. The organization's training plan is developed and revised according to a documented procedure.
2. Identify uniques training needs	17.1 Identify training needs. 17.3 Assure availability of skill and knowledge.	1. The org's training program is developed and maintained. 2. Each software acquisition project identifies specific training needs and develops a training plan in accordance with training program procedures.	1. Each software project develops and maintains a training plan that specifies its training needs. 2. The organization's training plan is developed and revised according to a documented procedure.
3. Train individuals	17.5 Train personnel.	3. Sw training for the project team is performed in accordance with the org's training program. 4. A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform their designated roles.	3. The training for the organization is performed in accordance with the organization's training plan. 5. A waiver procedure for required training is established and used to determine whether individuals already possess the knowledge and skills required to perform their designated roles.
4. Obtain training	17.2 Select mode of knowledge or skill acquisition. 17.4 Prepare training materials.		4. Training courses prepared at the organizational level are developed and maintained according to the organization standards.
5. Establish and maintain records	17.7 Maintain training records. 17.8 Maintain training materials.	5. Training records are maintained.	4. Training courses prepared at the organizational level are developed and maintained according to the organization standards 6. Records of training are maintained.
6. Assess training effectiveness	17.6 Assess training effectiveness.	6. Measurements are used to determine the quality of the training program.	

PA 23: Innovation

Process Area Summary

Purpose
The purpose of the Innovation process area is to ensure that the people engaged in system development and acquisition activities are provided with a support environment that is continuously improved. In addition, upgrades to the support environment will be performed in a manner that is minimally disruptive. Upgrades to the support environment include technologies such as processes, tools, techniques, methodologies, practices, and even management strategies (such as integrated product development or product lines).

Major points addressed
In order to improve the support environment, the organization must stay aware of the current environment and of technological advances as well. Technology should be inserted when improvements in evolution, cost, schedule, or performance of the organization's products, processes, or process capability can reasonably be expected to result from such improvements. Proper introduction of new technologies requires attention to the needs of the users and awareness of potential problems that might occur during implementation; hence, pilot projects are often implemented prior to organization-wide upgrades.

Goals
1. Agile adaptation to change is driven by the organization’s profound knowledge of its products, processes, technologies, and core competencies. *(BP 23.01, BP 23.02, BP 23.03, BP 23.04, BP 23.05)*
2. The organization environment is updated in a planned, controlled manner while minimizing disruptions to users. *(BP 23.03, BP 23.04, BP 23.05)*

Notes
(none)

Relationships between this PA and other PAs
This process area addresses innovation and insertion of technology into the organization's support environment. Product Evolution (PA 10) addresses insertion of technology improvements into the organization's products and services.

Improvements in the support environment are adopted in concert with the Organization Process Improvement (PA 21).

Base Practice List
The following list contains the base practices that are essential elements of good acquisition of software-intensive systems:

BP 23.01 **Maintain New Technology Awareness**: Maintain awareness of new technologies that support the organization's goals.

BP 23.02 **Select New Technologies**: Choose new technologies to adopt.

BP 23.03 **Prepare for Infusion**: Perform the necessary preliminary activities to ensure that technology infusion will be successful and will advance the organization's goals.

BP 23.04 **Infuse New Technologies**: Insert new technologies into the organization's support environment and processes.

BP 23.05 **Support Innovation**: Adapt the support environment to support individual projects, to improve business results and to ensure easy adoption of further technology improvement initiatives.

FAA-iCMM Traceability

The Innovation process area merges the following process areas and key process areas:

- SE-CMM: Manage Systems Engineering Support Environment (PA 16)
- SA-CMM: Acquisition Innovation Management (AIM)
- SW-CMM: Technology Change Management (TCM).

BP 23.01 Maintain New Technology Awareness

Maintain awareness of new technologies that support the organization's goals.

Description
Awareness of the current state of the art or state of the practice is a necessary element for assessing improvement options. A sufficient awareness of new technology must be present in the organization, whether maintained internally or acquired. Appropriate decision makers must be kept informed of new technologies so that they can request insertion when new technologies would be most beneficially adopted. Those seeking technology improvements must conversely be aware of projects' perceived needs for technology changes.

Typical Work Products
- Reviews of technology applicable to the support environment
- Lists of perceived technology improvement needs

Notes
Examples of activities to maintain awareness of technological advances include
- reading technical journals
- participating in professional societies
- maintaining a technical library
- soliciting ideas for technology improvements from projects and from process teams
- systematic searching for technology solutions to project or organizational problems
- capturing and disseminating lessons learned from projects using new technologies

FAA-iCMM Traceability:
1. Maintain awareness of the technologies that support the organization's goals. *(SE-CMM:BP 16.01)*
2. Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage. *(SE-CMM: BP 15.02)*
3. Software acquisition management personnel are kept informed of new technologies. *(SA-CMM: AIM.Ac5)*
4. The group responsible for the organization's technology change management activities works with the software projects in identifying areas of technology change. *(SW-CMM: TCM.Ac2)*
5. Software managers and technical staff are kept informed of new technologies. *(SW-CMM: TCM.Ac3)*

BP 23.02 Select New Technologies

Choose new technologies to adopt.

Description

Identify needs for technology enhancements and identify new technologies. In accordance with PA 04, Alternatives, select the best technologies to adopt using appropriate criteria. Choosing new technologies involves determining problems with current technology, what the potential users of the new technology would like to see in the solution, and what the needs of the projects are, including economics and concern for the ease of transition. Then assess potential solutions to the technology problems against these criteria make appropriate modifications to improve the best match, and choose the best solution from the candidate solutions. Finally, prioritize which technology improvements should be implemented first.

Typical Work Products

- technology needs statement
- technology trade study analyses and tradeoffs, including economic analyses
- reviews of technology used or proposed
- user and other requirements for technology changes in the support environment
- implementation priorities

Notes

Examples of activities to develop a detailed technology needs statement include

- Determine the organization's needs for computer network performance, improved analysis methods, business and technical software, or process restructuring
- Determining how to obtain required process measurements in a background automated manner so that metric gathering is not intrusive
- Provide ways to collect feedback from users on the benefits and drawbacks of the current support environment and on suggested improvements

The support environment may also include any of the following: Software productivity tools, systems engineering tools, systems analysis and simulation tools, proprietary tools, customized versions of commercially available tools, special test equipment, and facilities.

FAA-iCMM Traceability:

1. Determine requirements for the organization's systems engineering support environment based on organizational needs. *(SE-CMM: BP16.02)*
2. Monitor the systems engineering support environment for improvement opportunities. *(SE-CMM: BP 16.07)*
3. The group responsible for conducting acquisition innovation management activities conducts routine and periodic appraisals of new techniques and technologies as candidates for inclusion in the acquisition organization's standard software acquisition process. *(SA-CMM: AIM.Ac2)*

4. The group responsible for the organization's technology change management systematically analyzes the organization's standard software process to identify areas that need or could benefit from new technology. *(SW-CMM: TCM.Ac4)*
5. Technologies are selected and acquired for the organization and software projects according to a documented procedure. *(SW-CMM: TCM.Ac5)*

BP 23.03 Prepare for Infusion

Perform the necessary preliminary activities to ensure that technology infusion will be successful and will advance the organization's goals.

Description
Once the appropriate technology to be inserted has been selected, additional steps must be taken to ensure the insertion will be successful. Pilot efforts are often conducted to determine the feasibility or economics of untried or advanced technologies. Plans for insertion should be reviewed with affected personnel and consideration should be given to transition time and costs, including training of affected personnel. The group responsible for technology innovation should be prepared to provide consultation and assistance to pilot projects and to projects involved in broader insertion.

Typical Work Products
- pilot project plans and documented results, including the decision whether to proceed to broader insertion of the technology
- statement of transition risks and workarounds

Notes
Affected groups might include planners, software engineering, systems engineering, test, quality assurance, configuration management, contract management, and documentation support in addition to the projects directly involved in the pilot or broader infusion of the technology.

FAA-iCMM Traceability
1. Obtain a systems engineering support environment that meets the requirements established in Determine Support Requirements by using the practices in the Analyze Candidate Solutions process area. *(SE-CMM:* PA *16.03)*
2. Pilot efforts for improving technology are conducted, where appropriate, before a new technology is introduced into normal practice. *(SW-CMM: TCM.Ac6)*

BP 23.04 Infuse New Technologies

Infuse new technologies into the organization's support environment and processes.

Description
The organization's support environment must be updated with new technologies as they emerge and are found to support the organization's business goals and the projects' needs. Training in the use of the new technology must be provided. In addition, the organization's and projects' processes should be modified as required to conform to use of the new technologies.

Typical Work Products
- new support environment
- process changes

Notes
Incorporation of process changes is discussed in PA 21, Organization Process Improvement. Technology infusion is accompanied by any necessary process improvements as well.

To minimize insertion difficulties, consider the following steps
- test the new technology prior to insertion
- decide into which parts of the organization to insert the improvements
- notify those affected by the changes of the impending change as early as possible
- provide necessary training in use of the new technology
- monitor the acceptance of the new technology and take additional steps where needed

FAA-iCMM Traceability
1. Insert new technologies into the systems engineering support environment based on the organization's business goals and the projects' needs. *(SE-CMM:* PA *16.05)*
2. Insert new technology into product development, marketing, and manufacturing. *(SE-CMM:* PA *15.05)*
3. Appropriate new technologies are incorporated into the organization's standard software process according to a documented procedure. *(SW-CMM: TCM.Ac7)*
4. Appropriate new technologies are incorporated into the projects' defined software processes according to a documented procedure. *(SW-CMM: TCM.Ac8)*

BP 23.05 Support Innovation

Evolve the support environment to support individual projects, to improve business results and to ensure easy adoption of further technology improvement initiatives.

Description
A technology strategy for innovation is created that improves the total support environment and responds to the needs of the organization as a whole. An individual project, however, may have unique needs for selected elements of this environment. In this case tailoring the elements of the environment can allow the project to operate more efficiently. In addition, maintenance of the support environment must be conducted to ensure satisfaction of the users with the technology improvements.

Users' satisfaction will not only improve business results but will also foster acceptance of future initiatives to insert technology.

Typical Work Products
- technical strategy for innovation
- tailored support environment
- support environment performance reporting
- support environment user satisfaction ratings

Notes
Examples of tailoring include
- removing signal processing automation tools from the support environments of projects that do not involve signal processing
- adding specific tools to the support environment of a project that needs more extensive tools than are needed organization-wide (for example, when particular tools are called out by a customer).

Examples of support environment maintenance include
- hiring or training of computer system administrators
- development of expert users in selected automation tools
- development of methodology or process experts, who can be used on a variety of projects

FAA-iCMM Traceability
1. Tailor the systems engineering support environment to individual project's needs. *(SE-CMM: BP 16.04)*
2. Maintain the systems engineering support environment to continuously support the projects dependent on it. *(SE-CMM: BP 16.06)*
3. Monitor the systems engineering support environment for improvement opportunities. *(SE-CMM: BP 16.07)*
4. The acquisition organization works with the projects to foster an environment which facilitates adoption of initiatives beneficial to the acquisition organization. *(SA-CMM: AIM.Ac4)*

Table PA 23 - 1: Merging Innovation Practices

Innovation base practices	***SE-CMM*** **Manage Systems Engineering Support Environment:** ***Base Practices***	***SA-CMM*** **Acquisition Innovation Management:** ***Activities Performed***	***SW-CMM*** **Technology Change Management:** ***Activities Performed***	***SE-CMM*** **Manage Product Line Evolution:** ***selected Base Practices***
1. Maintain New Technology Awareness	16.1 Maintain awareness of the technologies that support the organization's goals	5. Software acquisition management personnel are kept informed of new technologies	2. The group responsible for the organization's technology change management activities works with the software projects in identifying areas of technology change. 3. Software managers and technical staff are kept informed of new technologies	15.2 Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.
2. Select New Technologies	16.2 Determine requirements for the organization's systems engineering support environment based on organizational needs 16.7 Monitor the systems engineering support environment for improvement opportunities	2. The group responsible for conducting acquisition innovation management activities conducts routine and periodic appraisals of new techniques and technologies as candidates for inclusion in the acquisition organization's standard software acquisition process.	4. The group responsible for the organization's technology change management systematically analyzes the organization's standard software process to identify areas that need or could benefit from new technology. 5. Technologies are selected and acquired for the organization and software projects according to a documented procedure.	
3. Prepare for Infusion	16.3 Obtain a systems engineering support environment that meets the requirements established in Determine Support Requirements by using		6. Pilot efforts for improving technology are conducted, where appropriate, before a new technology is introduced into	

Innovation base practices	***SE-CMM*** **Manage Systems Engineering Support Environment:** ***Base Practices***	***SA-CMM*** **Acquisition Innovation Management:** ***Activities Performed***	***SW-CMM*** **Technology Change Management:** ***Activities Performed***	***SE-CMM*** **Manage Product Line Evolution:** ***selected Base Practices***
	the practices in the Analyze Candidate Solutions process area.		normal practice.	
4. Infuse New Technologies	16.5 Insert new technologies into the systems engineering support environment based on the organization's business goals and the projects' needs.		7. Appropriate new technologies are incorporated into the organization's standard software process according to a documented procedure. 8. Appropriate new technologies are incorporated into the projects' defined software processes according to a documented procedure.	15.5 Insert new technology into product development, marketing, and manufacturing.
5. Support Innovation	16.4 Tailor the systems engineering support environment to individual project's needs. 16.6. Maintain the systems engineering support environment to continuously support the projects dependent on it. 16.7 Monitor the systems engineering support environment for improvement opportunities.	4. The acquisition organization works with the projects to foster an environment which facilitates adoption of initiatives beneficial to the acquisition organization.		
covered by generic practices		1. The acquisition organization performs its activities in accordance with documented acquisition innovation management plans.	1. The organization develops and maintains a plan for technology change management.	

Innovation base practices	***SE-CMM* Manage Systems Engineering Support Environment: *Base Practices***	***SA-CMM* Acquisition Innovation Management: *Activities Performed***	***SW-CMM* Technology Change Management: *Activities Performed***	***SE-CMM* Manage Product Line Evolution: *selected Base Practices***
		3. The project team performs its activities in accordance with its documented acquisition innovation management plans.		

Part 3: Appendices

Appendix A: Change History

Appendix B: Glossary

Appendix C: References

Appendix D: CMM Tracing Tables

Appendix A: Change History

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❐ Architecture
❐ PAs
❐ Terminology
❐ ________________</td><td>❐ APPLICATION
❐ Appraisal Method
❐ Pilots
❐ Assurance
❐ ________________</td><td>❐ PROJECT
❐ Sponsorship
❐ Participation
❐ Schedule
❐ ________________</td></tr>
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Appendix B: Glossary

This glossary contains four glossaries: The CMM Starter Glossary, from CCF Draft E, and the glossaries of the three source CMMs, the SA-CMM, the SE-CMM, and the SW-CMM. Any terms that are in the Starter Glossary are deleted from the individual CMM glossaries since that starter glossary is intended to provide common definitions for common terms found in most CMMs.

B.1 CMM Starter Glossary

ability to perform	See *common features*
activity	Any step taken or function performed, both mental and physical, toward achieving some objective. [SW-CMM v1.1]
appraisal	The act of appraising. [American Heritage, 1976]
assess	To evaluate, appraise.
baseline	(1) A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures. (2) A document or a set of such documents formally designated and fixed at a specific time during the life cycle of a configuration item. (3) Any agreement or result designated and fixed at a given time, from which changes require justification and approval. [IEEE STD 610.12-1990]
capability	*see* process capability.
capability evaluation	An independent process assessment by a trained team of professionals. [SEI]
capability maturity model	A capability maturity model (CMM) for a given discipline is a model which describes the key elements of an effective process for the discipline. It also describes an evolutionary improvement path of five stages from an ad hoc, immature process to a disciplined, mature process with improved quality and effectiveness. Associated with the model one or more process assessment method that facilitates the determinations of current process capabilities and/or identifies the most critical issues for improved quality and process effectiveness. [CCF]
commitment	A pact that is freely assumed, visible, and expected to be kept by all parties. [SW-CMM v1.1]

common cause of variation	A cause of variation that is inherently part of a process or system [Adapted from Scherkenbach]
configuration	The arrangement of the parts or elements of a work product or deliverable product. [Adapted from American Heritage, 1976]
configuration item	An aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process. [IEEE STD 610.12-1990]
configuration management	A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements. [IEEE STD 610.12-1990]
correction action	An action taken to bring expected future performance into line with the plan. [Adapted from PMBoK]
customer satisfaction	The result of delivering a product or service that meets customer requirements. [ASQC]
defined process	A repeatable process that has clearly stated inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria. A defined process is typically defined at the organizational level or tailored from the organization's set of standards software processes. Expectations are documented, reviewed, and approved. Work products of a defined process are, as appropriate, peer reviewed.
evaluate	To examine and judge carefully.
implementation	In product development context: (1) The process of translating a design into hardware components, software components, or both. (2) The result of the process of (1). [IEEE STD 610.12-1990]
institutionalization	The building and reinforcement of infrastructure and corporate culture that supports methods, practices, and procedures so that they are the way of doing business, even after those who originally defined them gone. [CCF]
life cycle	The scope of the systems or product evolution beginning with the identification of a perceived customer need, addressing development, test, manufacturing, operation, support and training activities, continuing through various upgrades or evolution, until the product and its related processes are disposed of. [IEEE 93]

manager	A role that provides technician and/or administrative direction and control. Typical functions of a manger include allocating resources, motivating, organizing, directing, controlling, and work within of responsibility. [SW-CMM v1.1, P-CMM]
measure	1) The dimensions, quantity, or capacity of something as ascertained by measuring. 2) A reference standard or sample used for the quantitative comparison of properties. Examples include lines of code, function points, weigh and pages of documentation. [SEI] 3) An act of measurement. [American Heritage, 1976] 4) A unit of measurement such as source lines of code or document pages of design. [SW-CMM v1.1]
measurement	The act of measuring or the process of being measured. Examples include three million lines of code, 1000 function points and 200 pages of documentation.
model	A simplified representation of a part of the real world. [Lave & March]
normative model	A model that prescribes behavior to achieve a goal. [Lave & March]
organization	An autonomous entity within a company, government agency or military branch. Organizations typically have responsibility for planning, allocating resources, motivation, organizing, directing, controlling, and improving their people processes and technologies. Note: Organizations are typically comprised of numerous defined organizational components (e.g. departments, sections, or projects). The term “organization” is used to connote an infrastructure to support common strategic business and process-related functions shared by these components.
Organizational maturity	*see* organizational process maturity
organizational	The extent to which an organization has explicitly and consistently deployed process maturity processes that are documented, manage, measured, controlled, and continually improving. Note: Organizational maturity may be measured via a process assessment.
Organizational process maturity	*see* asset library
peer review	(*also* defect review) Review of a work product, following procedures, by peers of the product’s producers for the purpose of identifying defects and improvements. [CCF]
policy	Guiding principle designed to influence and determine decisions, actions, and other matters. [derived from American Heritage]

procedure	A description of a course of action to be taken to perform a given task.
process	A set of activities performed to achieve a given purpose.
process assessment	To evaluate the capability of an organization's processes with respect to one or more reference models.
process asset library	A collection of process assets, maintained by an organization, for use by projects in developing, tailoring, maintaining, and implementing their defined processes.
process assets	A collection of entities, maintained by an organization, for use by projects in developing, tailoring, maintaining, and implementing their processes. These process assets typically include: • the organization standard processes, • descriptions of the life cycle models approved for use on software projects, • the guidelines & criteria for tailoring the organization's standard processes, • the organization's measurement database, and • a library of process-related documentation Any entity that the organization considers useful in performing the activities of process definition and maintenance could be included as a process asset.
process capability	The range of expected results that can be achieved by following a process. [SW-CMM]
process management	The set of activities, methods, and tools applied to the definition implementation, and monitoring of a process.
process maturity	The extent to which a process is explicitly documented, managed, measured, controlled, and continually improved. Note: Process maturity may be measured via a process assessment.
process performance	A measure of actual results achieved by following a process. [Bate-SEI]
process tailoring	To make, alter, or adapt a process description for a particular end. For example, a project tailors its defined process from the organizations set of standard processes to meet the constraints & environment of the project. [Adapted from American Heritage, 1976]
product	Result of activities or processes. Something produced by human or mechanical effort or by a natural process. As used in the CMM, something designed for delivery to a customer or end user.

project	An organizational unit dedicated to achieving defined objectives that satisfy a need or desire within time, budget, and technical performance specifications. [Cleland]
project manager	A manager with responsibility for an entire project. The project manager directs, controls, administers and regulates a project. [SW-CMM v1.1]
quality assurance	A planned and systematic means for assuring management that defined standards, practices, procedures, and methods of the process are applied. [Bate-SEI]
reference model	A model that is used as a benchmark for measuring some attribute.
reliability	The ability of a system or component to perform its required functions under stated conditions for a specified period of time. [IEEE STD 610.12-1990]
repeatable process	Set of activities performed to achieve a given purpose that is: • guided by organizational policies, • documented and planned, • allocated adequate resources (including funding, people, and tools), • staffed with responsibilities assigned, • implemented by trained individuals, • measured, • tracked with appropriate corrective actions, and • reviewed by appropriate levels of management, Work products of a repeatable process are, as appropriate: • reviewed by affected parties, • complaint with specified standards, and • placed under change control or configuration management
requirement	a condition or capability needed by a user to solve a problem or achieve an objective. [IEEE 610.12-1990]
risk	Possibility of suffering harm or loss. [American Heritage, 1976]
risk management	an organized, analytic process to identify what can go wrong and cause harm or loss (risks) to quantify and assess associated risks, and to implement/control the appropriate approach for preventing or handling each risk identified. [MIL-STD 499B]
senior manager	(also executive manager) A manager role at a high enough level in an organization that the primary focus is the long-term vitality of the organization, rather than short-term project and contractual concerns and pressures.
software capability evaluation	see capability evaluation.

special cause of variation	A cause of variation that is not inherently part of a process or system. [Adapted from Scherkenbach]
standard	An acknowledgment measure of comparison for quantitative or qualitative value, criterion. [American Heritage #2a]
statistical process control	Statistically based analysis of a process and measurements of performance, identify common and special causes of variations in the process performance, and maintain process performance within limits. [Jones-IBM]
supplier	The entity who produces a product for a customer. The customer and supplier may be members of the same organization. [IEEE 1074-1991]
system	An integrated composite of people, products, and/or process that provide a capability to satisfy a stated need or objective. [MIL-STD 499B]
tailor	To make, alter, or adapt, for a particular end. [American Heritage, 1976
training program	The set of training activities that focus on addressing an organization's training needs. [P-CMM]
validation	Confirmation by examination and provision of objective evidence that particular requirements for a specific intended use are fulfilled. Notes: (1) In design and development, validation concerns the process of examining a product to determine conformity with users needs. (2) Validation is normally performed on the final product under defined operating conditions. It may be necessary in earlier stages. (3) "Validated" is uses to designate the corresponding status. (4) Multiple validations may be carried out if there are different intended uses. [ISO 8402:1994, 2.18]
verification	(1) The process of determining whether or not the products of a given set of activities fulfill the requirements established during the previous set. [CCF] (2) Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Notes: (1) In design and development, verification concerns the process of examining the result of a given activity to determine conformity with the stated requirement for that activity. (2) The term "Verified" is used to designate the corresponding status. [ISO 8402.1994, 217]
work product	1) All the data, files, documents, assemblies, components, etc., generated in the course of performing any process. [CCF] (2) Result of activities or processes. For example, the data, files, documents, assemblies, components, etc. generated in the course of performing any process. Note: As used in the CMM's, a work product may or may not be delivered to a customer or end user.

B.2 Software Acquisition CMM Glossary

acceptance criteria	The criteria that a system or component must satisfy in order to be accepted by a user, customer, or other authorized entity [IEEE-STD-610].
acceptance testing	Formal testing conducted to determine whether or not a system satisfies its acceptance criteria and to enable the customer to determine whether or not to accept the system [IEEE-STD-610].
acquisition	The process of obtaining through contract.
acquisition organization	That entity which has the oversight responsibility for the software acquisition project and which may have purview over the acquisition activities of a number of projects or contract actions.
acquisition organization's standard software acquisition process	see *software acquisition process.*
application domain	A bounded set of related systems (i.e., systems that address a particular type of problem). Development and maintenance in an application domain usually require special skills and/or resources. Examples include payroll and personnel systems, avionics, command and control systems compilers, and expert systems.
attributes *(of software)*	Characteristics of software such as reliability, maintainability, portability, and complexity. These characteristics are sometimes referred to as quality attributes.
casual analysis	The analysis of defects to determine their underlying root cause.
change control	The review, approval/disapproval, implementation, tracking, closure, and status reporting of proposed changes to an item (change management).
consistency	The degree of uniformity, standardization, and freedom from contradiction among the documents or parts of a system or component [IEEE-STD-610].
contract	A binding agreement between two or more parties that establishes the requirements for the product and services to be acquired.
contract integrity	The adherence and compliance to contractual and legal policies, regulations, and other guidance.

contract terms and conditions	The stated legal, financial, and administrative aspects of a contract.
contractor	The entity delivering the product or performing the service being acquired, even if that entity is part of the acquiring organization.
critical paths	A series of dependent tasks for a project that must be completed as planned to keep the entire project on schedule.
defect	A flaw in a system or system component that causes the system or component to fail to perform a required function.
deliverable	A product that is required to be delivered to the acquirer or other designated recipient.
deviation	A noticeable or marked departure from the appropriate norm, plan, standard, procedure, or variable being reviewed.
effective	Adequate to accomplish the intended purpose.
end user	The individual or group who will use the system for its intended operational use when it is deployed in its environment.
end user representatives	selected sample of end users who represents the total population of end users.
evaluation	The use of reviews, inspections, and/or tests, to determine that a software product or service satisfies specified requirements.
event-driven basis	A review that is performed based on the occurrence of an event within the project (i.e., a formal review or the completion of a life cycle stage). (See *periodic review* for contrast).
findings	The conclusion of an assessment, evaluation, audit, or review that identify the most important issues, problems, or opportunities within the area of investigation.
function	A set of related actions, undertaken by individuals or tools that are specifically assigned or fitted for their roles, to accomplish a set purpose or end.
group	An assemblage of personnel organized to serve a specific purpose or accomplish a task. A group may vary from a single individual assigned part-time, to several part-time individuals assigned from other organizations, to several individuals dedicated full-time.

instrumentation	The application of instruments (or metrics) for observation, measurement, or control.
managed and controlled	Implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).
method	A reasonably complete set of rules and criteria that establishes a precise and repeatable way of performing a task and arriving at a desires result.
methodology	A collection of methods, procedures, and standards that defines an integrated synthesis of approaches.
milestone	A scheduled event for which some individual is accountable and that is used to measures progress.
non-developmental item	An item of software that is available for delivery and acceptance prior to award of the contract.
non-technical software requirements	Contractual agreements, conditions, and terms that affect the activities or products of the software acquisition project.
offeror	A contractor who submits a proposal in response to a solicitation package.
organization's measurement program	The set of related elements for addressing an organization's measurement needs. It includes the definition of organization-wide measurements, methods and practices for collecting organizational measurements and analyzing data, and measurement goals for the organization.
orientation	An overview or introduction to a topic.
periodic review	A review that occurs at specified regular time intervals. (see *event-driven basis* for contrast).
prime contractor	An individual, partnership, corporation, or association that administers a subcontract to design, develop, and/or manufacture one or more products.
process capability baseline	A documented characterization of the range of expected results that would normally be achieved by following a specific process under typical circumstances. A process capability baseline is typically established at an organizational level. See *process performance baseline* for contrast).

process descriptions	Documentation that specifies, in a complete, precise, verifiable manner, that requirements, design, behavior, or other characteristics of a process. It may also include the procedures for determining whether these provisions have been satisfied.
process measurement	The set of definitions, methods, and activities used to take measurements of a process and its resulting products for the purpose of characterizing and understanding the process.
process performance baseline	A documented characterization of the actual results achieved by following a process. A process performance baseline is typically established at the project level, although the initial process performance baseline will usually be derived from the process capability baseline. (See *process capability baseline* for contrast).
project office	The aggregate of individuals assigned the primary responsibility for software acquisition in the contracted effort. A project office may vary in size from a single individual assigned part-time to a large organization assigned full-time.
project team	All individuals that have an assigned software acquisition responsibility in the contracted effort. A project team may vary in size from a single individual assigned part-time to a large to a large organization assigned full-time.
quality	(1) The degree to which a system or system component meets specified requirements (2) The degree to which a system or system component meets user needs or expectations [IEEE-STD-610].
quantitative control	Any quantitative or statistically-based technique appropriate to analyze a software acquisition process, identify special causes of variations in the performance of the software acquisition process, and bring the performance of the software acquisition process within well-defined limits.
required training	Training required by the acquisition organization. (See *training* for contrast).
role	A unit of defined responsibilities that may be assumed by one or more individuals.
software acquisition management personnel	Those individuals who are trained, educated, or experienced in software acquisition management and who are either assigned to or support the project team in the performance of software acquisition activities.

software acquisition plans	The collection of plans, both formal and informal, used to express how software acquisition activities will be performed; for example, the Software Acquisition Risk Management Plan or Project Management Plan.
software acquisition process	A set of activities, methods, practices, and transformations that people use to acquire software and the associated products. • acquisition organization's standard software acquisition process- The acquisition organization's fundamental software acquisition process which guides the establishment of each project's defined software acquisition process. • project's defined software acquisition process- The project's tailored version of the acquisition organization's standard software acquisition process.
software acquisition process group	This group is responsible for the definition, improvement, and maintenance of the acquisition organization's standard software acquisition process and related process assets, including guidelines for all projects to tailor the standard software acquisition process to their specific situations. It coordinates process activities with the software projects and related elements of the organization
software acquisition process-related documentation	Documents and document fragments that may be of use to future teams when tailoring the acquisition organization's standard software acquisition process. The examples may cover subjects such as project's defined software acquisition process, standards, procedures, software acquisition risk management plans, and training materials.
software acquisition process repository	A collection of software acquisition process information (i.e., estimated and actual data on software project size, effort, and cost, and project team productivity and quality data) gathered from the software acquisition projects that is maintained by the acquisition organization to support its software acquisition definition and improvement activities.
software acquisition project	An undertaking that is focused on acquiring the software components and associated documentation of a system. A software project may be part of a project building a hardware/software system.
software acquisition related group	A collection of individuals (both managers and technical staff) representing a software discipline that supports, but is not directly responsible for, software acquisition. Examples of software disciplines include software configuration management and software quality assurance
software architecture	The organizational structure of the software or module [IEEE-STD-610].

software engineering group	The collection of individuals (both managers and technical staff) who have responsible for software development and maintenance activities (i.e., requirements analysis, design, code, and test) for a project. Groups performing software-related work, such as the software quality assurance group and the software configuration management group, are not in the software engineering group.
software engineering personnel	Those individuals who are trained, educated, or experienced in software engineering and who are either assigned to or support the project team in the performance of software acquisition activities.
software life cycle	The period of time that begins when a software product is conceived and ends when the software is no longer available for use. The software life cycle typically includes a concept phase, requirements phase, design phase, implementation phase, test phase, installation and checkout phase, operation and maintenance, and, sometimes, retirement phase [IEEE-STD-610].
software quality assurance	(1) A planned and systematic pattern of all actions necessary to provide adequate confidence that a software work product conforms to established technical requirements. (2) A set of activities designed to evaluate the process by which software work products are developed and/or maintained.
software-related contractual requirements	All technical and non-technical requirements related to the software portion of the acquisition.
software support	The process of modifying a software system or component after delivery to correct faults, improve performance or other attributes, or adapt to a changed environment [IEEE-STD-610].
solicitation package	When seeking suppliers for a particular acquisition, it is the information distributed which tells the interested bidders what the requirements are, how to prepare their proposals, how proposals will be evaluated, and when to submit their proposals. Sometimes called Request for Proposals (RFP).
statement of work	A description of all the work required to complete a project, which is provided by the customer.
subcontractor	An individual, partnership, corporation, or association that contracts with an organization (i.e., the prime contractor) to design, and/or manufacture one or more products.
system requirement	A condition or capability that must be met or possessed by a system or system component to satisfy a condition or capability needed by a user to solve a problem [IEE-STD-610].

system requirements allocated to software	The subset of the system requirements that are to be implemented in the software components of the system.
technical software requirements	The system requirements allocated to software.
technology	The application of science and/or engineering in accomplishing a particular result.
traceability	The ability to trace, in both the forward and backward directions, the lineage of a requirement from its first level inception and subsequent refinement to its implementation in a software product and the documentation associated with the software product.
training	Project team training. (See *required training* for contrast)
training group	The collection of individuals (both managers and staff) who are responsible for coordinating and arranging the training activities for an organization. This group typically prepares and conducts most of the training courses and coordinates use of other training vehicles.
transition	The process of transferring responsibility for the acquired software products from the project manager to the software support organization.
user	(See *end user*).
waiver	A document stating cancellation or reduction of a requirement.

B.3 System Engineering CMM Glossary

action item	(1) A task assigned to an individual or group for disposition. (2) An action proposal that has been accepted. [Jones - IBM]
activities performed	A description of the tasks necessary to implement a key process area. Activities Performed typically involve establishing plans and procedures, performing the work, tracking it, and taking corrective actions as necessary. [Jones - IBM]
activity	Any step taken or function performed (mental, physical, or both) toward achieving an intended objective. [Jones - IBM]
allocation	(1) The process of distributing requirements, resources, or other entities among the components of a system or program. (2) The results of the distribution in (1). [IEEE STD 610.12-1990]
application domain	A bounded set of related systems, i.e., systems that address a particular type of problem. Development and maintenance in an application domain usually requires special skills and/or resources. Examples include payroll and personnel systems, command and control systems, compilers, and expert systems. [CMM for Software]
appraisal	A comparison of an implemented process to a process maturity model Software process assessments and software capability evaluations are examples. [Bate - SEI]
architecture	The organizational structure of a system or component. [IEEE STD 610.12-1990]
attribute	A characteristic of an item; for example, the item's color, size, or type. [IEEE STD 610.12-1990]
audit	An independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria. [IEEE STD 610.12-1990]
base practice	An engineering or management activity that addresses the purpose of a particular process area and thus belongs to it. [SPICE BPG 0.06] (adapted)

baseline	(1) A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures. (1) A document or a set of such documents formally designated and fixed at a specific time during the life cycle of a configuration item. (2) Any agreement or result designated and fixed at a given time, from which changes require justification and approval. [IEEE STD 610.12-1990]
build	An operational version of a system or component that incorporates a specified subset of the capabilities that the final product will provide. [IEEE STD 610.12-1990]
capability level	A set of common features (sets of generic practices) that work together to provide a major enhancement in the capability to perform a process area. [SPICE BPG 0.06] (adapted)
capability maturity model	A descriptive model of the stages through which organizations progress as they define, implement, evolve, and improve their processes. This model serves a guide for selecting process improvement strategies by facilitating the determination of the current process capabilities and the identification of issues most critical to quality and process improvement within a particular domain, such as software engineering or systems engineering. [CMM for Software] (adapted)
capability	A measure of the system's ability to achieve the mission objectives, given that the system is dependable and suitable. Examples of capability measures are accuracy, range, payload, lethality, information rates, number of engagements, and destructiveness. Capability measures can be used as performance requirements, design constraints. and/or technical exit criteria. Capability is a systems engineering metric. [MIL-STD 499B]
capability evaluation	An appraisal made by a trained team of professionals, using an established method (e.g., the SEI software capability evaluation method) to: (1) identify contractors qualified to perform specific task(s), or (2) monitor the state of the process used on an all information pertinent to the systems engineering process. This repository is used to preserve a historical view into the tradeoffs and decisions that evolved the system architecture and design into a given state. [IEEE P1220]
candidate solution	A solution that is developed for consideration when seeking an optimal solution. [Bate - SEI]

causal analysis	The analysis of defects to determine their underlying root cause. [CMM for Software]
certification	Acknowledgement, based on a formal demonstration, that a system or component complies with its specified requirements and is acceptable for operational use. [IEEE STD 610.12-1990] (adapted)
change control	An element of configuration management, consisting of the evaluation, coordination, approval or disapproval, and implementation of changes to work products. [SE-CMM]
change control board	A group of people responsible for evaluating and approving or disapproving proposed changes to work products, and for ensuring implementation of approved changes. Configuration control board.
change request	A formal request to change some aspect of an established baseline. [Jones - IBM]
commitment	A pact that is freely assumed, visible, and expected to be kept by all parties. [CMM for Software]
common feature	A set of practices that address an aspect of the process implementation or institutionalization. [SPICE BPG 0.06]
compatibility	(1) The ability of two or more systems or components to perform their required functions while sharing the same environment. (2) The ability of two or more systems or components to exchange information. [IEEE STD 610.12-1990] (adapted)
complexity	(1) The degree to which a system or component has a design or implementation that is difficult to understand and verify. (2) Pertaining to any of a set of structure-based metrics that measure the attribute in (1). [IEEE STD 610.12-1990]
component	One of the parts that make up a system. A component may be hardware or software and may be subdivided into other components. [IEEE STD 610.12-1990]
configuration	In configuration management, the functional and physical characteristics of hardware or software as set forth in technical documentation or achieved in a product. [IEEE STD 610.12-1990]
configuration data	Data that reflect the current configuration or state of the system or its components. [Jones - IBM]

configuration item	An aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process. [IEEE STD 610.12-1990]
configuration management	A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements. [IEEE STD 610.12-1990]
configuration management library system	A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements. [IEEE STD 610.12-1990]
configuration unit	The lowest level entity of a configuration item or component that can be placed into, and retrieved from, a configuration management library system. [CMM for Software]
corrective action recommendations	Proposed method(s) designed to correct a specific defect. [Jones - IBM].
corrective actions	Planned activities initiated to correct a defect. [Jones - IBM]
cost requirements	The financial thresholds and objectives expressed in terms of design-to-cost targets, research, development, test & evaluation (RDT&E) operating and support costs, and flyaway, weapon system, unit procurement, program acquisition, and life-cycle costs. [MIL-STD 499B]
critical components	Components that are indispensable. [Jones - Loral FS]
critical design review	A review conducted to verify that the detailed design of one or more configuration items satisfy specified requirements; to establish the compatibility among the configuration items and other risk areas for each configuration item; and, as applicable, to assess the results of producibility analyses, review preliminary hardware product specification, evaluate preliminary test planning, and evaluate the adequacy of preliminary operation and support documents. [IEEE STD 610.12-1990]
current estimate	The value of a technical parameter that is predicted to be achieved with existing resources by the end of the contract. [MIL-STD 499B]
customer	Individual(s) or organizational entity(ies) for whom the product or service is rendered; also one who uses the product or service. [Minnich - Hughes]

customer feedback	Information provided by the customer indicating the degree of satisfaction with the product or service. [Minnich - Hughes]
customer needs	What a customer believes that he needs to perform some activity of interest to him. [Bate - SEI]
customer satisfaction	An indicator of the degree to which a delivered product or service meets or exceeds the customer's expectations. [SPICE BPG 0.06]
decision database	A repository for storing acceptance criteria. The criteria that a system or component must satisfy in order to be accepted by a user, customer, or other authorized entity. [IEEE STD 610.12-1990]
defect	A flaw in a system or system component that has the potential to cause that system or component to fail to perform its required function during execution, [Jones - IBM].
defect prevention	The activities involved in identifying defects or potential defects and preventing them from being introduced into a product. [CMM for Software]
defined process	The operational definition of a set of activities. A defined process is well characterized and understood, and is described in terms of standards, tools, and methods. Note: A defined process is developed by tailoring the organization's standard process to fit the specific characteristics of its intended use. (See also standard process) [SPICE BPG 0.06]
delivery	Release of a system or component to its customer or intended user. [IEEE STD 610.12-1990]
derived requirements	Requirements which may or may not be explicitly stated in the customer requirements, and which may be inferred from contextual requirements, e.g., applicable standards, laws, policy, common practice, and management decisions. Derived requirements can also arise during analysis and design from partitions of the system. [Jones - IBM]
design	(1) The process of defining the architecture, components, interfaces, and other characteristics of a system or component. (2) The result of the process in (1). [IEEE STD 610.12-1990]
design constraints	Design limitations or implied requirements which constrain the design solution. A form of requirement which constrains the design solution set to a single or limited array of choices. This may include limitations on the logical execution, the physical characteristics, or performance of a system which are implied by a requirement statement, or derived from the analysis of conflicting or overlapping requirements. [IEEE P1220]

design requirement	A requirement that specifies or constrains the design of a system or system component. [IEEE STD 610.12-1990]
design review	A process or meeting during which a system, hardware, or software design is presented to project personnel, managers, users, customers, or other interested parties for comment or approval. Types include critical design review, preliminary design review, system design review. [IEEE STD 610.12-1990]
detailed operational concept	A detailed description, derived from the preliminary operational concept of the user's interaction with the system that satisfies the operational need. [Bate - SEI]
development	The process of translating a design into hardware and/or software components. [Jones - IBM]
deviation	A departure from the appropriate requirement, plan, standard, or procedure. [Jones - IBM]
documented procedure	A written description of a course of action to be taken to perform a given task. [IEEE STD 610.12-1990]
effectiveness analysis	An analytical approach used to determine how well a system performs in its intended utilization environment. [MIL-STD 499B]
efficiency	The degree to which a system or component performs its designated functions with minimum consumption of resources. [IEEE STD 610.12-1990]
end user	The individual or groups who will use the system for its intended operational use when it is deployed in its environment. [CMM for Software]
engineering change	In configuration management, an alteration in the configuration of a configuration item or other designated item after formal establishment of its configuration identification. [IEEE STD 610.12-1990].
engineering requirements	A translation of the set of essential customer needs into engineering language, specific to the domain expertise of the engineering staff that is charged with executing the design of the system. Engineering requirements are product requirements that are restated in engineering terms and are suitable for system development.
engineering staff	The technical people (e.g., analysts, programmers, and engineers, including task leaders), who are not managers and who perform the product development and maintenance activities for the project. [Bate - SEI]

enterprise	A unit within a company or spanning several companies within which many projects are managed as a whole. All projects within an enterprise, at the top of the reporting structure, share a common manager and common policies. [Jones - IBM]
environment	The circumstances or conditions that will surround the system when it is in use. Examples include the natural environment (weather, climate, ocean conditions, terrain, vegetation, space conditions); combat environment (dust, fog, nuclear-chemical-biological); threat environment (effects of existing and potential threat systems to include electronic warfare and communications interception); operations environment (thermal, shock, vibration, power variations); transportation and storage environment; maintenance environment; test environments; manufacturing environments (critical process conditions, clean room, stress); and other environments (e.g., software engineering environment, electromagnetic) related to system utilization.[MIL-STD 499B] (adapted)
environment performance report	A summary of the performance of the systems engineering support environment compared to its expected performance. [SE-CMM]
evaluation criteria	The criteria against which a selection, decision, or set of decisions will be made. [Jones - IBM]
exception report	A report that describes differences between requirement or design specifications and the measured properties of a system or system elements. [[Kuhn - TI]]
exit criteria	The specific accomplishments or conditions that must be satisfactorily demonstrated before an effort can progress further in the current acquisition phase or transition to the next acquisition phase. Technical exit criteria are used for SEMS events and for acquisition phase milestone reviews. [MIL-STD 499B]
external system (interfaces)	The system or product interfaces to other systems, communication networks, power supplies, resource connectors, etc., that affect the design of the product under consideration. [IEEE P1220]
failure	The inability of a system or component to perform its required functions within specified performance requirements. [IEEE STD 610.12-1990]
fault	(1) A defect in a hardware device or component; for example, a short circuit or broken wire. (2) An incorrect step, process, or data definition in a computer program.[IEEE STD 610.12-1990]

feasibility	The degree to which the requirements, design, or plans for a system or component can be implemented under existing constraints.[IEEE STD 610.12-1990]
findings	(1) The conclusions of an assessment, evaluation, audit, or review that identify the most important issues, problems, or opportunities within the area of investigation. (2) The issues, problems, or opportunities so identified. [Jones - IBM]
formal review	A formal meeting at which a product is presented to the end user, customer, or other interested parties for comment and approval. It can also be a review of the management and technical activities and of the progress of the project. [CMM for Software]
function	A task, action, or activity that must be accomplished to achieve a desired outcome or provide a desired capability. [IEEE P1220]
functional architecture	The arrangement of functions, their decomposition, and interfaces (internal and external) that defines the execution sequencing, conditions for control or data flow, and the relative performance levels of achievement for a desired outcome, or that provides a desired capability. [IEEE P1220]
functional interface requirement	The functional and performance requirements and constraints that exist at a common boundary between two or more functions in a functional architecture. [Bate - SEI]
functional requirement	A requirement that specifies a task, action, or activity that a system or system component must be able to perform. [Bate- SEI]
generic practice	An implementation or institutionalization practice that enhances the capability to perform any process. Generic practices are used during process appraisals to determine capability in any process area. [Jones - Loral FS]
group	The collection of people who have responsibility for a set of tasks or activities. [Jones - Loral FS]
implementation	(1) The process of translating a design into hardware components, software components, or both. (2) The result of the process in (1). [IEEE STD 610.12-1990]

inspection	A method used to verify requirements. It involves the visual examination of documentation or a physical product (e.g., software code, hardware equipment) against predefined criteria or characteristics. An internal process of examining and evaluating the technical content of a work product against a set of predefined criteria. [IBM Fed Systems Co]
institutionalization	The building of infrastructure and corporate culture that support methods, practices, and procedures so that they are the ongoing way of doing business, even after those who originally defined them are gone. [CMM for Software]
integrated management	The unification and integration of the engineering and management activities into a coherent defined process based on the organization's standard process and related process assets. [Jones - IBM].
integrated product development	A systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause developers, from the outset, to consider all elements of the product life cycle from conception through disposal (including quality, cost, schedule, and user requirements). [IDA]
integrated system	The product that the engineering staff builds to satisfy the product requirements.
integration	The merger or combining of one or more components, parts, or configuration items into a higher level system for ensuring that the logical and physical interfaces can be satisfied, and the integrated system satisfies its intended purpose. [IEEE P1220]
integration plan	A plan describing the schedule, resources and approach to integrating the system elements. [Kuhn TI]
integration report	Report describing the compliance of integration efforts with integration plans, the observed successes of integration efforts, and the observed failures of integration efforts. [SE-CMM]
interface control document	A specification, derived from the physical interface requirements, that details the physical interface between two system elements, including the number and types of wires, connectors and pins, electrical parameters, mechanical properties, and environmental constraints. [Kuhn - TI]
interface requirement	The functional, performance, electrical, environmental, human, and physical requirements and constraints that exist at a common boundary between two or more functions, system elements, configuration items, or systems. [MIL-STD 499B]

interface specification	A specification, derived from the interface requirements, that details the mechanical properties and/or logical connection between system elements, including the exact format and structure of the data and/or electrical signal communicated across the interface. [Kuhn - TI]
interfacing groups	Separate groups that must communicate in order to accomplish a unified set of goals or objectives.
item	A nonspecific term used to denote any product, including systems, subsystems, assemblies. subassemblies, units, sets, parts, accessories, computer programs. or computer software. In this standard, it also denotes any process that includes a series of actions, changes, or functions to achieve an end or result. [MIL-STD 499B]
key design issues	A set of issues that, once decided, determine the technical direction of major portions of the system design. [Minnich - Hughes]
key practices	The infrastructures and activities that contribute most to the effective implementation and institutionalization of a key process area. [CMM for Software]
life cycle	The scope of the system or product evolution beginning with the identification of a perceived customer need, addressing development, test, manufacturing, operation, support and training activities, continuing through various upgrades or evolutions, until the product and its related processes are disposed of. [IEEE P1220]
life-cycle cost	The total investment in product development, test, manufacturing, distribution, operation, refining, and disposal. This investment typically is allocated across the anticipated number of units to be produced over the production life cycle, thus providing a per-unit view of life-cycle cost. [IEEE P1220]
maintenance	The process of modifying a system or component after delivery to correct faults, improve performance or other attributes, or adapt to a changed environment. [Bate - SEI]
manager	A person who provides technical and administrative direction and control to individuals performing tasks or activities within the manager's area of responsibility. The traditional functions of a manager include planning, allocating resources, organizing, directing, and controlling work within an area of responsibility. [Jones - IBM]
market survey	Investigation that focuses on a set of potential customers to help identify the customer requirements for a product or service. [Jones - Loral FS]

maturity level	A well-defined evolutionary plateau toward achieving a mature software process. The five maturity levels in the SEI Capability Maturity Model are initial, repeatable, defined, managed, and optimizing. [CMM for Software]
maturity model	A model of the stages through which organizations progress as they define, implement, evolve, and improve their processes. This model serves as a guide for selecting process improvement strategies by facilitating the determination of current process capabilities and identification of the issues most critical to quality and process improvement. [Bate - SEI]
measure	A unit of measurement such as source lines of code or document pages of design. [CMM for Software]
measurement	A raw data item collected on a process. The basic quantitative value that describes the magnitude of an element of the process. [IBM Fed Systems Co]
measures of effectiveness	The figures-of-merit which provide a quantitative means for comparing alternative system solutions. [IEEE P1220]
method	A reasonably complete set of rules and criteria that establish a precise and repeatable way of performing a task to provide a desired result. [Jones - IBM]
methodology	A collection of methods, procedures, and standards that defines an integrated synthesis of engineering approaches to the development of a product. [CMM for Software]
metric	A composite of two or more measurements resulting in a value that defines a characteristic of the process. [IBM Fed Systems Co]
milestone	A scheduled event for which some project member or manager is held accountable and at which progress toward a defined goal is measured. [Jones - Loral FS]
modification	The act of changing a system or component after delivery to improve performance or some other attribute, or to adapt the system or component to function in a changed environment. [Jones - Loral FS]
need	A user related capability shortfall (such as those documented in a Mission Need Statement, field deficiency report, or engineering change proposal), or an opportunity to satisfy a capability requirement because of a new technology application or breakthrough, or to reduce costs. Also a statement of capability required for each supplier related primary function including disposal. [MIL-STD 499B]

operational environment	The natural or induced environmental conditions, and user interactions, within which the system is expected to be operated. [IEEE P1220]
operational requirements	The statements that identify the essential capabilities (the process or series of actions performed to effect a purpose or result) that are desired in the system under development. [IEEE P1220]
organization	A unit within an entity (e.g., company, government agency, or branch of service) within which many projects are managed as a whole. All projects within an organization, at the top of the reporting structure, share a common manager and common policies. [Jones - Loral FS]
organization's business goals	The reasons for an organization's existence. Such goals may include reducing the number of change requests during a system's integration phase, reducing development cycle time, increasing the number of errors found in a system's first or second phase of development, reducing the number of customer-reported defects, etc., when applied to systems engineering activities. [Jones - Loral FS]
organization's process assets	A collection of entities, maintained by an organization, for use by the projects and others in developing, tailoring, maintaining, and implementing their product development processes. These process assets typically include the organization's standard product development processes, descriptions of the product life cycles approved for use, the guidelines and criteria for tailoring the organization's standard product development process, the organization's product development process database, and a library of product development process-related documentation. Any entity that the organization considers useful in performing the activities of process definition and maintenance could be included as a process asset. [Bate - SEI]
organization's product development process database	A database established to collect and make available data on development the product processes and resulting work products particularly as they relate to the organization's standard product development process. The database also contains or references the actual measurement data and related information and data that are needed to understand and interpret the measurement data and assess it for reasonableness and applicability. Examples of process and work product data include estimates of product size, effort, and cost; actual data on product size, effort, and cost; productivity data; peer review coverage and efficiency; and number and severity of defects found in the product. [Bate - SEI]

organization's standard product development process	The operational definition of the basic process that guides the establishment of a common product development process across the development projects in the organization. It describes the fundamental elements of the product development process that each project is expected to incorporate into its defined process. It also describes the relationships, e.g., ordering and interfaces between these elements of the product development process. [Bate - SEI]
organization's standard systems engineering process	The operational definition of the basic process that guides the establishment of a common systems engineering process across the projects in the organization. It describes the fundamental elements of the systems engineering process that each product development project is expected to incorporate into its defined systems engineering process. It also describes the relationships e.g., ordering and interfaces, between these systems engineering process elements. [Bate - SEI]
peer review	A review of a work product, following defined procedures, by peers of the product's producers for the purpose of identifying defects and improvements. In the [SE-CMM] questionnaire, this is called a defect review. [Jones - IBM]
performance	The degree to which a system or component accomplishes its designated functions within given constraints, such as speed, accuracy, or memory usage. IEE STD 610.12-1990
performance requirement	A requirement that imposes conditions on a functional requirement, for example, a requirement that specifies the speed, accuracy, or memory usage with which a given function must be performed. [IEEE STD 610.12-1990]
physical architecture	The hierarchical arrangement of product and process solutions, their functional and performance requirements, their internal and external (external to the aggregation itself) functional and physical interfaces and requirements, and the physical constraints that form the basis of design requirements. The physical architecture provides the basis for system/configuration item baselines as a function of the acquisition phase. It documents one or more physical designs as required to (1) accomplish effectiveness analysis, risk analysis, and technology transition planning; (2) establish the feasibility of physically realizing the functional architecture; (3) identify manufacturing verification, support, and training requirements; (4) document the configuration of prototypes and other test articles; and (5) define in increasing detail the solution to identified needs. [MIL-STD 499B]
physical characteristics	The physical attributes or distinguishing features that pertain to a distinctive quality. [IEEE P1220]

physical interface requirement	The performance, electrical, environmental, human, and physical requirements and constraints that exist at a common boundary between two or more system elements, configuration items, or systems. [Bate - SEI]
physical requirement	A requirement that specifies a physical characteristic that a system or system component must possess (for example, material, shape, size, weight). [IEEE STD 610.12-1990]
planned profile	Profile representing the projected time-phased demonstration of a technical parameter requirement. [MIL-STD 499B]
planned value	Predicted value of the technical parameter for the time of measurement based on the planned profile. [MIL-STD 499B]
policy	A guiding principle, typically established by senior management, that is adopted by an organization or project to influence and determine decisions. [CMM for Software]
pratice	An activity, or set of activities, that contributes to the achievement of a process area purpose. These practices are of two types: base practices and generic practices. (See also base practice and generic practice.) [Bate - SEI]
preliminary design	The process of analyzing design alternatives and defining the architecture, components, interfaces, and timing and sizing estimates for a system or component. [IEEE STD 610.12-1990]
preliminary design review	A review conducted to evaluate the progress, technical adequacy, and risk resolution of the selected design approach for one or more configuration items; to determine each design's compatibility with the requirements for the configuration item; to evaluate the degree of definition and assess the technical risk associated with the selected manufacturing methods and processes; to establish the existence and compatibility of the physical and functional interfaces among the configuration items and other items of equipment, facilities, software and personnel; and, as applicable, to evaluate the preliminary operational an support documents. [IEEE STD 610.12-1990]
preliminary concept operational	A conceptual description of how the customer envisions using or how the customer might use the product. This concept gives insight into the reason behind customer desires. [Bate - SEI]

primary functions	Those essential tasks, actions, or activities that must be accomplished to ensure that the system will satisfy customer needs from a system life-cycle perspective. The eight primary system life-cycle functions are development, manufacturing, verification, deployment, operations, support, training, and disposal. [MIL-STD 499B]
procedure	A written description of a sequence of actions to be taken to perform a given task. [Jones - IBM]
process	A system of operation or series of actions, changes, or functions, that bring about an end or result including the transition criteria for progressing from one stage or process step to the next. [IEEE P1220]
process area	A grouping of a purpose and a set of related practices that, when performed collectively, can achieve the purpose of the process area. [Bate - SEI]
process asset library	A library of process assets that exist within a defined architecture that gives structure to the example processes, process fragments, process-related documentation, process architectures, process tailoring rules and tools, and process measurements. [SE-CMM]
process assets	Example processes, process fragments, process-related documentation, process architectures, process tailoring rules and tools, and process measurements. These assets are to be tailored by a project to form the specific process that it will follow in developing its system. [SE-CMM]
process capability	The range of expected results that can be achieved by following a process. [CMM for Software]
process description	The operational definition of the major components of a process. Documentation that specifies, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a process. It may also include the procedures for determining whether these provisions have been satisfied. Process descriptions may be found at the activity, project, or organizational level. [CMM for Software]
process element	The constituent elements of a process. Each process element covers a well-defined, bounded, closely related set of tasks (e.g., estimating element, design element, coding element, and peer review element). The descriptions of the process elements may be templates to be filled in, fragments to be completed, abstractions to be refined, or complete descriptions to be modified or used unmodified. [CMM for Software]

process enactment technology	A specific method of process implementation that involves automation of the transfer and collection of information from entities charged with executing subprocesses or tasks. [Jones - Loral FS]
process evaluation	Analysis of process measurements to understand and improve the process. [Bate - SEI]
process measurement	The set of definitions, methods, and activities used to take measurements of a process and its resulting products for the purpose of characterizing and understanding the process. [CMM for Software]
process performance	A measure of actual results achieved by following a process. [Bate - SEI]
process tailoring	The activity of creating a process description by elaborating or adapting process elements or other incomplete specifications of a process. Specific business needs for a project will usually be addressed during process tailoring. [Jones - IBM]
process technology	The application of a science and/or engineering technology (e.g., tools or methodology) to a process or subprocess
product	The result of a human, mechanical or natural effort or process, such as, a manufacturing process. [IEEE P1220]
product baseline	In configuration management, the initial approved technical documentation (including, for software, the source code listing) defining a configuration item during the production, operation, maintenance, and logistic support of its life cycle. [IEEE STD 610.12-1990]
product development cycle	The time required to execute the product development process. [Jones - Loral FS]
product development process	The process by which new products are created and brought to market. [Kuhn - TI]
product line requirements	The requirements for a family of products that can satisfy the organization's strategic vision. Requirements for a set of development projects chosen to provide superior products and processes. [Kuhn - TI]
product quality certification	A formal demonstration that a system or component complies with its specified quality requirements and the product is acceptable for operational use.

product requirements	The translation of customer needs and expectations into a set of requirements for the system to be built in terms that the customer understands and upon which any desired agreements between the customer and systems engineering organization can be based.
profile	A comparison, usually in graphical form, of plans or projections versus actual data, typically over time. [CMM for Software]
program	An initiative, prescribed plan, or course of action, such as a training program or process improvement program, which is usually undertaken at the organizational level. A program typically specifies the objective, methods, activities, plans, and success measures for the target of the program. [CMM for Software]
project	The aggregate of effort and other resources focused on developing and/or maintaining a specific product. The product may include hardware, software, and other components. Typically a project has its own funding, cost accounting, and delivery schedule. [CMM for Software]
project plan	A document that describes the technical and management approach to be followed for a project. The plan typically describes the work to be done, the resources required, the methods to be used, the procedures to be followed, the schedules to be met, and the way that the project will be organized (for example, a software development plan). [IEEE STD 610.12-1990]
project's defined process	The operational definition of the process as used by a specific project. Well characterized and understood, it is described in terms of standards, procedures, tools, and methods. It is developed by tailoring the organization's standard process to fit the specific characteristics of the project. [Jones - IBM]
prototype	A preliminary type, form, or instance of a system that serves as a model for later stages or for the final, complete version of the system. [IEEE STD 610.12-1990]
prototyping	A hardware and software development technique in which a preliminary version of part or all of the hardware or software is developed to permit user feedback, determine feasibility, or investigate timing or other issues in support of the development process. [IEEE STD 610.12-1990]
quality assurance	A planned and systematic means for assuring management that defined standards, practices, procedures, and methods of the process are applied. [Bate - SEI]
records of training and experience	A mapping of an organization's personnel to the training and experience that each individual has completed or accomplished.

reliability	The ability of a system or component to perform its required functions under stated conditions for a specified period of time. [IEEE STD 610.12-1990]
requirements	Statements which identify the essential needs for a system in order for it to have value and utility. Requirements may be derived or based upon interpretation of stated requirements to assist in providing a common understanding of the desired operational characteristics of a system. [IEEE P1220]
requirements analysis	The process of studying user needs to arrive at a definition of system, hardware, or software requirements. [IEEE STD 610.12-1990]
requirements for engineering support environment	An environment in which development activities are systems supported with needed development and process enactment technology. Included are computer software, computer hardware, test equipment, etc. (See also systems engineering support environment.) [Garcia - SEI]
risk	A measure of the uncertainty of attaining a goal, objective, or requirement pertaining to technical performance, cost, and schedule. Risk level is categorized by the probability of occurrence and the consequences of occurrence. Risk is assessed for program, product, and process aspects of the system. This includes the adverse consequences of process variability. The sources of risk include technical (e.g., feasibility, operability, producibility, testability, and system effectiveness); cost (e.g., estimates, goals); schedule (e.g., technology/material availability, technical achievements, milestones); and programmatic (e.g., resources, contractual). [MIL-STD 499B]
risk management	An organized, analytic process to identify what can go wrong, to quantify and assess associated risks, and to implement/control the appropriate approach for preventing or handling each risk identified. [MIL-STD 499B]
risk management plan	A document which describes the risk management activities to be performed on a project. [Jones - Loral FS]
risk mitigation activities	Actions taken to reduce the impact or likelihood of a risk. [Garcia - SEI]
risk mitigation strategies	The principles used to identify the order in which risk mitigation activities are implemented. [Jones - Loral FS]
role	Defined responsibilities that may be assumed by one or more individuals. [Jones - IBM]

sensitivity analysis	A technique for discovering the behavior of a system by changing one input at a time by a small amount and determining the changes in the outputs. A matrix of the quotients of the output changes over the input changes is called a sensitivity matrix. [Bate - SEI]
software capability evaluation	An appraisal by a trained team of professionals, using a method such as the SEI software capability evaluation method, to (1) identify contractors who are qualified to perform the software work, or (2) monitor the state of the software process used on an existing software effort. [CMM for Software]
software development plan	The collection of plans that describe the activities to be performed for the software project. It governs the management of the activities performed by the software engineering group for a software project. It is not limited to the scope of any particular planning standard, such as DOD STD 2167A and IEEE-STD-1058, which may use similar terminology. [CMM for Software]
software process	A set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products e.g., project plans, design documents, code, test cases, and user manuals. [CMM for Software]
software product	The complete set, or any of the individual items of the set, of computer programs, procedures, and associated documentation and data designated for delivery to a customer or end user. [IEEE STD 610.12-1990]
software requirements	A condition or capability that must be met by software needed by a user to solve a problem or achieve an objective. [IEEE STD 610.12-1990]
solution (or solution set)	The selected candidate solution(s) that best satisfies the analysis requirements. [Minnich - Hughes]
specification	A document prepared to support acquisition and life-cycle management that clearly and accurately describes essential technical requirements and verification procedures for items, materials, and services. When invoked by a contract, it is legally enforceable and its requirements are contractually binding. [MIL-STD 499B]
staff	The people, including task leaders, who are not managers and who are responsible for accomplishing the assigned business function. [CMM for Software]
standard	An approved, documented, and available set of criteria used to determine the adequacy of an action or object. [CMM for Software]

standard process	The operational definition of the basic process that guides the establishment of a common process in an organization. It describes the fundamental process elements that are expected to be incorporated into any defined process. It also describes the relationships (e.g., ordering and interfaces) between these process elements. (See also defined process.) [SPICE BPG 0.06]
standard process family	A group of standard processes within an organization that share some common characteristics, but that are different enough in their domain of applicability to be considered as separate standard processes. Organizations that find they are constantly tailoring the same areas of their standard process to meet the needs of a specific group within the organization may find the concept of a standard process family a useful way of characterizing their standard processes. [Garcia - SEI]
statistical process control	A statistically based technique appropriate to analyze a process, identify special causes of variations in the performance of the process, and bring the performance of the process within well-defined limits. [Jones - IBM]
strategic vision	The political, economic, and psychological forces of an organization that ensure the maximum support for the adopted market goals of the organization. In this context, strategic vision can be expressed as the architecture of a family of products. [Webster] (adapted)
subcontract manager	A person who has direct responsibility for administering and managing a subcontract. [Jones - IBM]
subcontractor	An individual, partnership, corporation, or association who contracts with an organization to design, develop, and/or manufacture items. [CMM for Software]
subprocess	A process that is part of a higher level process. [Jones - IBM]
subsystem	A grouping of items satisfying a logical group of functions within a particular system. [MIL-STD 499B]
suppliers	The development, manufacturing, verification, and deployment personnel that define, design, code, fabricate, assemble, integrate, verify, test, deliver and/or install system end items, and safely dispose of the by-products of their activities. [MIL-STD 499B]
support environment technology reviews	Reviews of the available support technology, including literature reviews, in-house demos, and trial usage of support technology. Such technology includes computer software, computer hardware, test equipment, etc.

support function	The tasks, actions, and activities to be performed and the system elements required to provide operations, maintenance, logistics (including training) and materiel management support. It provides for the definition of tasks, equipment, skills, personnel, facilities, materials, services, supplies, and procedures required to ensure the proper supply, storage, and maintenance of a system end item. [MIL-STD 499B]
synthesis	The combining of information, concepts, constraints, components, or elements to establish a complete and consistent system architecture, or to identify conflicts or deficiencies in established requirements or design solutions. [IEEE P1220]
system	An integrated composite of people, products, and processes that provide a capability to satisfy a stated need or objective. [MIL-STD 499B]
system architecture	The composite of the functional, physical, and foundation architectures, which form the basis for establishing a system design. The system architecture includes the supporting requirement traceability and allocation matrices which identifies the relationship between the system design, and the elements of the functional, physical, and foundation architectures. [IEEE P1220]
system configurations	Configuration data and status on the current state of the system.
system design	The product of the development process which provides sufficient details, drawings, or other pertinent information, on the system components, elements, parts, interfaces, etc., to permit the fabrication, production, assembly, integration and testing of the system under development. [IEEE P1220]
system design review	A review conducted to evaluate the manner in which the requirements for a system have been allocated to configuration items, the system engineering process that produced the allocation, the engineering planning for the next phase of the effort, manufacturing considerations, and the planning for production engineering. [IEEE STD 610.12-1990]
system development	The summation of the creative actions taken during the system development cycle. [Jones - Loral FS]
system development cycle	The period of time that begins with the decision to develop a system and ends when the system is delivered to its end user. [IEEE STD 610.12-1990]
system development process	The engineering process employed to develop a new system.

system effectiveness	A measure of the ability of a system to satisfy its intended operational uses when called upon to do so. System effectiveness is a composite view of how the system performs under anticipated environmental conditions, the reliability and maintainability of system parts and components, and the ability to produce, distribute, support, train, operate and dispose of the system throughout its life cycle. IEEE P1220] (adapted)
system elements	The basic constituents (hardware, software, facilities, personnel, data, material, services, or techniques) that comprise a system and satisfy one or more requirements in the lowest levels of the functional architecture. [MIL-STD 499B]
system end item	A deployed system product and/or process that is ready for its intended use. [MIL-STD 499B]
system requirements	A description of desired capabilities, constraints, and other details which pertain to the product's functional, performance, and physical characteristics. These descriptions provide the stimulus for investigating product alternatives, and for making trade-offs among requirement sets. These requirements should establish the capabilities, physical characteristics, and customer quality attributes which define a quality product offering within the marketplace. [IEEE P1220] (adapted)
system testing	Testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. [IEEE STD 610.12-1990]
systems analysis and control	The assessment and control mechanisms, including performance based progress measurements, to: • Establish system effectiveness. • Balance cost, schedule, performance, and risk. • Control the system configuration.[MIL-STD 499B]
systems engineering	The selective application of scientific and engineering efforts to: 1. transform an operational need into a description of a system configuration which best satisfies the operational need according to the measures of effectiveness; 2. integrate related technical parameters and ensure compatibility of all physical, functional, and technical program interfaces in a manner which optimizes the total system definition and design; 3. integrate the efforts of all engineering disciplines and specialities into the total engineering effort. FM 770-78

systems engineering process	A comprehensive, iterative problem solving process that is used to: (a) transform validated customer needs and requirements into a life-cycle balanced solution set of system product and process designs, (b) generate information for decision makers, and (c) provide information for the next acquisition phase. The problem and success criteria are defined through requirements analysis, functional analysis/allocation, and systems analysis and control. Alternative solutions, evaluation of those alternatives, selection of the best life-cycle balanced solution, and the description of the solution through the design package are accomplished through synthesis and systems analysis and control. [MIL-STD 499B]
systems engineering support environment	An environment in which development activities are supported with needed development and process enactment technology. These include computer software, computer hardware, test equipment, etc. [Bate - SEI]
tailor	To adapt a process or a set of standards or procedures to better match process or product requirements. [CMM for Software]
task	Well-defined unit of work in the process that provides management with visible checkpoints into the status of the project. Tasks have readiness criteria and completion criteria. [Jones - IBM]
task leader	A team leader for a specific task who has technical responsibility and provides the technical direction to the staff working on that task (including him/herself). [Jones - IBM]
team	A collection of people, drawn from diverse, but related, groups, to perform a well-defined function for an organization or a project. Team members may have other primary responsibilities. [Jones - IBM]
technical effort	The total engineering, test, manufacturing, and specialty engineering effort associated with the development of a product offering which encompasses all of the system, equipment, facilities, etc., necessary for the Enterprise to develop, produce, distribute, operate, test, support, train, and dispose of the product. [IEEE P1220]
technical management plan	A plan that describes how the technical effort will be managed and conducted. [MIL-STD 499B]

technical objectives	The "target" values for the development effort when insufficient data is available for stating binding technical requirements. Also can be used to define capabilities beyond established technical requirements when opportunities have been identified for substantial increases in effectiveness, decreases in cost. or additional flexibility. Includes cost, schedule, and performance attributes deemed important. MIL-STD 499B]
technical parameters	A selected subset of the system's technical metrics tracked in TPM. Critical technical parameters are identified from risk analyses and contract specification or incentivization, and are designated by management. Example of Technical Parameters include: a. Specification Requirements. b. Metrics associated with technical objectives and other key decision metrics used to guide and control progressive development. c. Design to cost requirements. d. Parameters identified in the acquisition program baseline or user requirements documentation. [MIL-STD 499B]
technical requirements	Those requirements that describe what the product must do. Examples of technical requirements include functions, performance, and interface requirements. [CMM for Software] (adapted)
technical reviews	A series of systems engineering activities by which the technical progress of a program is assessed relative to its technical or contractual requirements. Conducted at logical transition points in the development effort to reduce risk by identifying and correcting problems/issues resulting from the work completed before the program is disrupted or delayed. Provide a method for the contractor and Government to determine that the development of a system and/or configuration item and its documentation have met contract requirements. Includes incremental reviews (functional, subsystem, and interim system) and major system level technical reviews. [MIL-STD 499B]
technology	The tools and methods that can be applied by people in accomplishing some particular result. [CMM for Software]
test	An activity in which a system or component is executed under specified conditions, the results are observed or recorded, and an evaluation is made of some aspect of the system or component. [IEEE STD 610.12-1990]
test plan	A plan describing the schedule, resources, and approach to verify the compliance of a system or its elements with the requirements. [Minnich - Hughes]

test report	Report that describes the compliance of test efforts with test plans, and the behavior and faults of the objects under test. [Bate - SEI]
testability	The degree to which a requirement is stated in terms that permit establishment of test criteria and performance of tests to determine whether those criteria have been met. [IEEE STD 610.12-1990]
threshold	The limiting acceptable value of a technical parameter, usually a contractual performance requirement [MIL-STD 499B]
tolerance band	Management alert limits placed on each side of the planned profile to indicate the envelope or degree of variation allowed. The tolerance band represents the projected level of estimating error. [MIL-STD 499B]
traceability	The degree to which a relationship can be established between two or more products of the development process, especially products having a predecessor-successor or master-subordinate relationship to one another. [IEEE STD 610.12-1990]
traceability matrix	a matrix that records the relationship between two or more products of the development process; for example, a matrix that records the relationship between the requirements and the design of a given component. [IEEE STD 610.12-1990]
train	To make proficient with specialized instruction and practice. [CMM for Software]
training materials	Developed or acquired materials that are or will be used in building the needed skills among the organization's employees. These may include books, manuals, computer hardware, computer software, video tapes, audio tapes, etc. [SE-CMM]
training program	An initiative that includes the organization's training plan, training materials, development of training, conduct of training, training facilities, evaluation of training, and maintenance records of training. [CMM for Software]
trend analysis	An analysis technique that relies on a collection of history for making future projections. [SE-CMM]
users	The operators and supporters of system end items, and the trainers that train the operations and support personnel. Users execute the operations, support, training, and disposal functions associated with system end items. [MIL-STD 499B]

validation	Validation involves evaluation of the customer requirements against customer needs and expectations, and evaluation of the delivered system to meet the customer's operational need in the most representative environment achievable. [Wells-Lockheed]
variation	Difference between the planned value of the technical parameter and the achievement-to-date value derived from analysis, test, or demonstration. [MIL-STD 499B]
verification	The process of determining whether or not the products of a given phase of development fulfill the requirements established during the previous phase. [IEEE P1220]
well-defined process	A process that includes readiness criteria, inputs, standards and procedures, verification mechanisms such as peer reviews, outputs, and completion criteria. [SPICE BPG 0.06]
work product	All the data, files, documents, assemblies, components, etc., generated in the course of performing any process. [SE-CMM]

B.4 Software CMM Glossary

ability to perform	(See common features.)
acceptance criteria	The criteria that a system or component must satisfy in order to be accepted by a user, customer, or other authorized entity. [IEEE-STD-610]
acceptance testing	Formal testing conducted to determine whether or not a system satisfies its acceptance criteria and to enable the customer to determine whether or not to accept the system. [IEEE-STD-610]
activity	Any step taken or function performed, both mental and physical, toward achieving some objective. Activities include all the work the managers and technical staff do to perform the tasks of the project and organization. (See *task* for contrast.)
activities performed	(See common features.)
action item	(1) A unit in a list that has been assigned to an individual or group for disposition. (2) An action proposal that has been accepted.
action proposal	A documented suggestion for change to a process or process-related item that will prevent the future occurrence of defects identified as a result of defect prevention activities. (See also software process improvement proposal.)
allocated requirements	(See system requirements allocated to software.)
application domain	A bounded set of related systems (i.e., systems that address a particular type of problem). Development and maintenance in an application domain usually requires special skills and/or resources. Examples include payroll and personnel systems, command and control systems, compilers, and expert systems.
assessment	(See software process assessment.)
audit	An independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria. [IEEE-STD-610]
baseline	A specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures. [IEEE-STD-610]

baseline configuration management	The establishment of baselines that are formally reviewed and agreed on and serve as the basis for further development. Some software work products, e.g., the software design and the code, should have baselines established at predetermined points, and a rigorous change control process should be applied these items. These baselines provide control and stability when interacting with the customer. (See also baseline management.)
baseline management	In configuration management, the application of technical and administrative direction to designate the documents and changes to those documents that formally identify and establish baselines at specific times during the life cycle of a configuration item. [IEEE-STD-610]
benchmark	A standard against which measurements or comparisons can be made. [IEEE-STD-610]
bidder	An individual, partnership, corporation, or association that has submitted a proposal and is a candidate to be awarded a contract to design, develop, and/or manufacture one or more products.
capability maturity model	A description of the stages through which software organizations evolve as they define, implement, measure, control, and improve their software processes. This model provides a guide for selecting process improvement strategies by facilitating the determination of current process capabilities and the identification of the issues most critical to software quality and process improvement.
causal analysis	The analysis of defects to determine their underlying root cause.
causal analysis meeting	A meeting, conducted after completing a specific task, to analyze defects uncovered during the performance of that task.
CMM commitment	Acronym for capability maturity model. A pact that is freely assumed, visible, and expected to be kept by all parties.
commitment to perform	(See common features.)
common cause (of a defect)	A cause of a defect that is inherently part of a process or system. Common causes affect every outcome of the process and everyone working in the process. (See special cause for contrast.)

common features	The subdivision categories of the CMM key process areas. The common features are attributes that indicate whether the implementation and institutionalization of a key process area is effective, repeatable, and lasting. The CMM common features are the following: commitment to perform - The actions the organization must take to ensure that the process is established and will endure. Commitment to Perform typically involves establishing organizational policies and senior management sponsorship. ability to perform - The preconditions that must exist in the project or organization to implement the software process competently. Ability to perform typically involves resources, organizational structures, and training. activities performed - A description of the roles procedures necessary to implement a key process area. Activities Performed typically involve establishing plans and procedures, performing the work, tracking it, and taking corrective actions as necessary. measurement and analysis - A description of the need to measure the process and analyze the measurements. Measurement and Analysis typically includes examples of the measurements that could be taken to determine the status and effectiveness of the Activities Performed. verifying implementation - The steps to ensure that the activities are performed in compliance with the process that has been established. Verification typically encompasses reviews and audits by management and software quality assurance.
configuration	In configuration management, the functional and physical characteristics of hardware or software as set forth in technical documentation or achieved in a product. [IEEE-STD-610].
configuration control	An element of configuration management, consisting of the evaluation, coordination, approval or disapproval, and implementation of items after formal establishment of their configuration identification. [IEEE-STD-610]
configuration identification	An element of configuration management, consisting of selecting the configuration items for a system and recording their functional and physical characteristics in technical documentation. [IEEE-STD-610]
configuration item	An aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process. [IEEE-STD-610]

configuration management	A discipline applying technical and administrative direction and surveillance to identify and document the functional and physical characteristics of a configuration item, control changes to those characteristics, record and report change processing and implementation status, and verify compliance with specified requirements. [IEEE-STD-610]
configuration management library system	The tools and procedures to access the contents of the software baseline library.
configuration unit	The lowest level entity of a configuration item or component that can be placed into, and retrieved from, a configuration management library system
consistency	The degree of uniformity, standardization, and freedom from contradiction among the documents or parts of system or component. [IEEE-STD-610]
contingency factor	An adjustment (increase) of a size, cost, or schedule plan to account for likely underestimates of these parameters due to incomplete specification, inexperience in estimating the application domain, etc.
contract terms and conditions	The stated legal, financial, and administrative aspects of a contract.
critical computer resource	The parameters of the computing resources deemed to be a source of risk to the project because the potential need for those resources may exceed the amount that is available. Examples include target computer memory and host computer disk space.
critical path	A series of dependent tasks for a project that must be completed as planned to keep the entire project on schedule.
customer	The individual or organization that is responsible for accepting the product and authorizing payment to the developing organization
defect	A flaw in a system or system component that causes the system or component to fail to perform its required function. A defect, if encountered during execution, may cause a failure of the system.
defect density	The number of defects identified in a product divided by the size of the product component (expressed in standard measurement terms for that product).
defect prevention	The activities involved in identifying defects or potential defects and preventing them from being introduced into a product.
defect root cause	The underlying reason (e.g., process deficiency) that allowed a defect to be introduced.

defined level	(See *maturity level.*)
defined software process	(See *project's defined software process.*)
dependency item	A product, action, piece of information, etc., that must be provided by one individual or group to a second individual or group so that the second individual or group can perform a planned task.
developmental configuration management	The application of technical and administrative direction to designate and control software and associated technical documentation that define the evolving configuration of a software work product during development. Developmental configuration management is under the direct control of the developer. Items under developmental configuration management are not baselines, although they may be baselined and placed under baseline configuration management at some point in their development.
deviation	A noticeable or marked departure from the appropriate norm, plan, standard, procedure, or variable being reviewed.
documented procedure	(See *procedure*.)
effective process	A process that can be characterized as practiced, documented, enforced, trained, measured, and able to improve. (See also *well-defined process*.)
end user	The individual or group who will use the system for its intended operational use when it is deployed in its environment.
end user representatives	A selected sample of end users who represent the total population of end users.
engineering group	A collection of individuals (both managers and technical staff) representing an engineering discipline. Examples of engineering disciplines include systems engineering, hardware engineering, system test, software engineering, software configuration management, and software quality assurance.
evaluation	(See software capability evaluation.)
event-driven review/activity	A review or activity that is performed based on the occurrence of an event within the project (e.g., a formal review or the completion of a life cycle stage). (See periodic review/activity for contrast.)
findings	The conclusions of an assessment, evaluation, audit, or review that identify the most important issues, problems, or opportunities within the area of investigation.

first-line software manager	A manager who has direct responsibility (including providing technical direction and administering the personnel and salary functions) for the staffing and activities of a single organizational unit (e.g., a department or project team) of software engineers and other related staff.
formal review	A formal meeting at which a product is presented to the end user, customer, or other interested parties for comment and approval. It can also be a review of the management and technical activities and of the progress of the project.
function	A set of related actions, undertaken by individuals or tools that are specifically assigned or fitted for their roles, to accomplish a set purpose or end.
goals	A summary of the key practices of a key process area that can be used to determine whether an organization or project has effectively implemented the key process area. The goals signify the scope, boundaries, and intent of each key process area.
group	The collection of departments, managers, and individuals who have responsibility for a set of tasks or activities. A group could vary from a single individual assigned part time, to several part-time individuals assigned from different departments, to several individuals dedicated full time.
host computer	A computer used to develop software. (See target computer for contrast.)
initial level	(See maturity level.)
institutionalization	The building of infrastructure and corporate culture that support methods, practices, and procedures so that they are the ongoing way of doing business, even after those who originally defined them are gone.
integrated software management	The unification and integration of the software engineering and management activities into a coherent defined software process based on the organization's standard software process and related process assets.
integration	(See software integration.)
key practices	The infrastructures and activities that contribute most to the effective implementation and institutionalization of a key process area

key process area	A cluster of related activities that, when performed collectively, achieve a set of goals considered important for establishing process capability. The key process areas have been defined to reside at a single maturity level. 1 They are the areas identified by the SEI to be the principal building blocks to help determine the software process capability of an organization and understand the improvements needed to advance to higher maturity levels. The Level 2 key process areas in the CMM are Requirements Management, Software Project Planning, Software Project Tracking and Oversight, Software Subcontract Management, Software Quality Assurance, and Software Configuration Management. The Level 3 key process areas in the CMM are Organization Process Focus, Organization Process Definition, Training Program, Integrated Software Management, Software Product Engineering, Intergroup Coordination, and Peer Reviews. The Level 4 key process areas are Quantitative Process Management and Software Quality Management. The Level 5 key process areas are Defect Prevention, Technology Change Management, and Process Change Management.
life cycle	(See software life cycle.)
maintenance	The process of modifying a software system or component after delivery to correct faults, improve performance or other attributes, or adapt to a changed environment. [IEEE-STD-610]
managed and controlled	The process of identifying and defining software work products that are not part of a baseline and, therefore, are not placed under configuration management but that must be controlled for the project to proceed in a disciplined manner. "Managed and controlled" implies that the version of the work product in use at a given time (past or present) is known (i.e., version control), and changes are incorporated in a controlled manner (i.e., change control).
managed level	(See maturity level.)
manager	A role that encompasses providing technical and administrative direction and control to individuals performing tasks or activities within the manager's area of responsibility. The traditional functions of a manager include planning, resourcing, organizing, directing, and controlling work within an area of responsibility.

maturity level	A well-defined evolutionary plateau toward achieving a mature software process. The five maturity levels in the SEI's Capability Maturity Model are: initial - The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort. repeatable - Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications. defined -The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software. managed - Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled. optimizing - Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.
maturity questionnaire	A set of questions about the software process that sample the key practices in each key process area of the CMM. The maturity questionnaire is used as a springboard to appraise the capability of an organization or project to execute a software process reliably.
measure	A unit of measurement (such as source lines of code or document pages of design).
measurement	The dimension, capacity, quantity, or amount of something (e.g., 300 source lines of code or 7 document pages of design).
method	A reasonably complete set of rules and criteria that establish a precise and repeatable way of performing a task and arriving at a desired result.
methodology	A collection of methods, procedures, and standards that defines an integrated synthesis of engineering approaches to the development of a product.
milestone	A scheduled event for which some individual is accountable and that is used to measure progress.
nontechnical requirements	Agreements, conditions and/or contractual terms that affect and determine the management activities of a software project.

operational software	The software that is intended to be used and operated in a system when it is delivered to its customer and deployed in its intended environment.
optimizing level	(See maturity level.)
organization	A unit within a company or other entity (e.g., government agency or branch of service) within which many projects are managed as a whole. All projects within an organization share a common top-level manager and common policies.
organization's measurement program	The set of related elements for addressing an organization's measurement needs. It includes the definition of organization-wide measurements, methods and practices for collecting organizational measurement data, methods and practices for analyzing organizational measurement data, and measurement goals for the organization
organization's software process assets	A collection of entities, maintained by an organization, for use by projects in developing, tailoring, maintaining, and implementing their software processes. These software process assets typically include: • the organization's standard software process, • descriptions of the software life cycles approved for use, • the guidelines and criteria for tailoring the organization's standard software process, • the organization's software process database, and • library of software process-related documentation. Any entity that the organization considers useful in performing the activities of process definition and maintenance could be included as a process asset.
organization's software process database	A database established to collect and make available data on the software processes and resulting software work products, particularly as they relate to the organization's standard software process. The database contains or references both the actual measurement data and the related information needed to understand the measurement data and assess it for reasonableness and applicability. Examples of process and work product data include estimates of software size, effort, and cost; actual data on software size, effort, and cost; productivity data; peer review coverage and efficiency; and number and severity of defects found in the software code.

organization's standard software process	The operational definition of the basic process that guides the establishment of a common software process across the software projects in an organization. It describes the fundamental software process elements that each software project is expected to incorporate into its defined software process. It also describes the relationships (e.g., ordering and interfaces) between these software process elements.
orientation	An overview or introduction to a topic for those overseeing or interfacing with the individuals responsible for performing in the topic area. (See *train* for contrast.)
Pareto analysis	The analysis of defects by ranking causes from most significant to least significant. Pareto analysis is based on the principle, named after the 19th-century economist Vilfredo Pareto, that most effects come from relatively few causes, i.e., 80% of the effects come from 20% of the possible causes.
peer review	A review of a software work product, following defined procedures, by peers of the producers of the product for the purpose of identifying defects and improvements.
peer review leader	An individual specifically trained and qualified to plan, organize, and lead a peer review.
periodic review/activity	A review or activity that occurs at specified regular time intervals. (See *event-driven review/activity* for contrast.)
policy	A guiding principle, typically established by senior management, which is adopted by an organization or project to influence and determine decisions.
prime contractor	An individual, partnership, corporation, or association that administers a subcontract to design, develop, and/or manufacture one or more products.
procedure	A written description of a course of action to be taken to perform a given task. [IEEE-STD-610]
process	A sequence of steps performed for a given purpose; for example, the software development process. [IEEE-STD-610]
process capability	The range of expected results that can be achieved by following a process. (See *process performance* for contrast.)
process capability baseline	A documented characterization of the range of expected results that would normally be achieved by following a specific process under typical circumstances. A process capability baseline is typically established at an organizational level. (See *process performance baseline* for contrast.)
process database	(See *organization's software process database*.)

process description	The operational definition of the major components of a process. Documentation that specifies, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a process. It may also include the procedures for determining whether these provisions have been satisfied. Process descriptions may be found at the task, project, or organizational level.
process development	The act of defining and describing a process. It may include planning, architecture, design, implementation, and validation.
process measurement	The set of definitions, methods, and activities used to take measurements of a process and its resulting products for the purpose of characterizing and understanding the process.
process performance	A measure of the actual results achieved by following a process. (See *process capability* for contrast.)
process performance	A documented characterization of the actual results achieved by baseline following a process, which is used as a benchmark for comparing actual process performance against expected process performance. A process performance baseline is typically established at the project level, although the initial process performance baseline will usually be derived from the process capability baseline. (See *process capability baseline* for contrast.)
process tailoring	The activity of creating a process description by elaborating, adapting, and/or completing the details of process elements or other incomplete specifications of a process. Specific business needs for a project will usually be addressed during process tailoring.
product	(See *software product* and *software work product*.)
profile	A comparison, usually in graphical form, of plans or projections versus actuals, typically over time.
project	An undertaking requiring concerted effort, which is focused on developing and/or maintaining a specific product. The product may include hardware, software, and other components. Typically a project has its own funding, cost accounting, and delivery schedule.
project's defined software process	The operational definition of the software process used by a project. The project's defined software process is a well-characterized and understood software process, described in terms of software standards, procedures, tools, and methods. It is developed by tailoring the organization's standard software process to fit the specific characteristics of the project. (See also *organization's standard software process, effective process,* and *well-defined process*.)

project manager	The role with total business responsibility for an entire project; the individual who directs, controls, administers, and regulates a project building a software or hardware/software system. The project manager is the individual ultimately responsible to the customer.
project software manager	The role with total responsibility for all the software activities for a project. The project software manager is the individual the project manager deals with in terms of software commitments and who controls all the software resources for a project.
quality	(1) The degree to which a system, component, or process meets specified requirements. (2) The degree to which a system, component, or process meets customer or user needs or expectations. [IEEE-STD-610]
quality assurance	(See *software quality assurance*.)
quantitative control	Any quantitative or statistically-based technique appropriate to analyze a software process, identify special causes of variations in the performance of the software process, and bring the performance of the software process within well-defined limits.
repeatable level	(See *maturity level.*)
required training	Training designated by an organization to be required to perform a specific role.
risk	Possibility of suffering loss.
risk management	An approach to problem analysis which weighs risk in a situation by using risk probabilities to give a more accurate understanding of the risks involved. Risk management includes risk identification, analysis, prioritization, and control.
risk management plan	The collection of plans that describe the risk management activities to be performed on a project.
role	A unit of defined responsibilities that may be assumed by one or more individuals.
SCE	Acronym for software capability evaluation.
SCM	Acronym for software configuration management.
senior manager	A management role at a high enough level in an organization that the primary focus is the long-term vitality of the organization, rather than short-term project and contractual concerns and pressures. In general, a senior manager for engineering would have responsibility for multiple projects.

software architecture	The organizational structure of the software or module. [IEEE-STD-610]
software baseline audit	An examination of the structure, contents, and facilities of the software baseline library to verify that baselines conform to the documentation that describes the baselines.
software baseline library	The contents of a repository for storing configuration items and the associated records.
software build	An operational version of a software system or component that incorporates a specified subset of the capabilities the final software system or component will provide. [IEEE-STD-610]
software capability evaluation	An appraisal by a trained team of professionals to identify contractors who are qualified to perform the software work or to monitor the state of the software process used on an existing software effort.
software configuration control board	A group responsible for evaluating and approving or disapproving proposed changes to configuration items, and for ensuring implementation of approved changes.
software development plan	The collection of plans that describe the activities to be performed for the software project. It governs the management of the activities performed by the software engineering group for a software project. It is not limited to the scope of any particular planning standard, such as DOD-STD-2167A and IEEE-STD-1058, which may use similar terminology.
software engineering group	The collection of individuals (both managers and technical staff) who have responsibility for software development and maintenance activities (i.e., requirements analysis, design, code, and test) for a project. Groups performing software-related work, such as the software quality assurance group, the software configuration management group, and the software engineering process group, are not included in the software engineering group.
software engineering process group	A group of specialists who facilitate the definition, maintenance, and improvement of the software process used by the organization. In the key practices, this group is generically referred to as "the group responsible for the organization's software process activities."
software engineering staff	The software technical people (e.g., analysts, programmers, and engineers), including software task leaders, who perform the software development and maintenance activities for the project, but who are not managers.
software integration	A process of putting together selected software components to provide the set or specified subset of the capabilities the final software system will provide.

software life cycle	The period of time that begins when a software product is conceived and ends when the software is no longer available for use. The software life cycle typically includes a concept phase, requirements phase, design phase, implementation phase, test phase, installation and checkout phase, operation and maintenance phase, and, sometimes, retirement phase. [IEEE-STD-610]
software manager	Any manager, at a project or organizational level, who has direct responsibility for software development and/or maintenance.
software plans	The collection of plans, both formal and informal, used to express how software development and/or maintenance activities will be performed. Examples of plans that could be included: software development plan, software quality assurance plan, software configuration management plan, software test plan, risk management plan, and process improvement plan.
software process	A set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products (e.g., project plans, design documents, code, test cases, and user documents).
software process assessment	An appraisal by a trained team of software professionals to determine the state of an organization's current software process, to determine the high-priority software process-related issues facing an organization, and to obtain the organizational support for software process improvement.
software process assets	(See organization's software process assets.)
software process capability	(See process capability.)
software process description	The operational definition of a major software process component identified in the project's defined software process or the organization's standard software process. It documents, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a software process. (See also *process description*.)
software process element	A constituent element of a software process description. Each process element covers a well-defined, bounded, closely related set of tasks (e.g., software estimating element, software design element, coding element, and peer review element). The descriptions of the process elements may be templates to be filled in, fragments to be completed, abstractions to be refined, or complete descriptions to be modified or used unmodified.
software process improvement plan	A plan, derived from the recommendations of a software process assessment, that identifies the specific actions that will be taken to improve the software process and outlines the plans for implementing those actions. Sometimes referred to as an action plan.

software process improvement proposal	A documented suggestion for change to a process or process-related item that will improve software process capability and performance. (See also *action proposal*.)
software process maturity	The extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. Maturity implies a potential for growth in capability and indicates both the richness of an organization's software process and the consistency with which it is applied in projects throughout the organization.
software process performance	(See *process performance*.)
software process-related documentation	Example documents and document fragments, which are expected to be of use to future projects when they are tailoring the organization's standard software process. The examples may cover subjects such as a project's defined software process, standards, procedures, software development plans, measurement plans, and process training materials.
software product	The complete set, or any of the individual items of the set, of computer programs, procedures, and associated documentation and data designated for delivery to a customer or end user. [IEEE-STD-610] (See *software work product* for contrast.)
software project	An undertaking requiring concerted effort, which is focused on analyzing, specifying, designing, developing, testing, and/or maintaining the software components and associated documentation of a system. A software project may be part of a project building a hardware/software system
software quality assurance	(1) A planned and systematic pattern of all actions necessary to provide adequate confidence that a software work product conforms to established technical requirements. (2) A set of activities designed to evaluate the process by which software work products are developed and/or maintained.
software quality goal	Quantitative quality objectives defined for a software work product.
software quality management	The process of defining quality goals for a software product, establishing plans to achieve these goals, and monitoring and adjusting the software plans, software work products, activities, and quality goals to satisfy the needs and desires of the customer and end users.

software-related group	A collection of individuals (both managers and technical staff) representing a software engineering discipline that supports, but is not directly responsible for, software development and/or maintenance. Examples of software engineering disciplines include software quality assurance and software configuration management.
software requirement	A condition or capability that must be met by software needed by a user to solve a problem or achieve an objective. [IEEE-STD-610]
software work product	Any artifact created as part of defining, maintaining, or using a software process, including process descriptions, plans, procedures, computer programs, and associated documentation, which may or may not be intended for delivery to a customer or end user. (See *software product* for contrast.)
SPA	Acronym for *software process assessment*.
special cause (of a defect)	A cause of a defect that is specific to some transient circumstance and not an inherent part of a process. Special causes provide random variation (noise) in process performance. (See *common cause* for contrast.)
SQA	Acronym for *software quality assurance*
staff	The individuals, including task leaders, who are responsible for accomplishing an assigned function, such as software development or software configuration management, but who are not managers.
stage	A partition of the software effort that is of a manageable size and that represents a meaningful and measurable set of related tasks which are performed by the project. A stage is usually considered a subdivision of a software life cycle and is often ended with a formal review prior to the onset of the following stage.
standard	Mandatory requirements employed and enforced to prescribe a disciplined uniform approach to software development.
standard software process	(See *organization's standard software process*.)
statement of work	A description of all the work required to complete a project, which is provided by the customer.
subcontract manager	A manager in the prime contractor's organization who has direct responsibility for administering and managing one or more subcontracts.
subcontractor	An individual, partnership, corporation, or association that contracts with an organization (i.e., the prime contractor) to design, develop, and/or manufacture one or more products.

system	A collection of components organized to accomplish a specific function or set of functions. [IEEE-STD-610]
system engineering group	The collection of individuals (both managers and technical staff) who have responsibility for specifying the system requirements; allocating the system requirements to the hardware, software, and other components; specifying the interfaces between the hardware, software, and other components; and monitoring the design and development of these components to ensure conformance with their specifications.
system requirement	A condition or capability that must be met or possessed by a system or system component to satisfy a condition or capability needed by a user to solve a problem. [IEEE-STD-610]
system requirements allocated to software	The subset of the system requirements that are to be implemented in the software components of the system. The allocated requirements are a primary input to the software development plan. Software requirements analysis elaborates and refines the allocated requirements and results in software requirements which are documented
tailor	To modify a process, standard, or procedure to better match process or product requirements.
target computer	The computer on which delivered software is intended to operate. (See *host computer* for contrast.)
task	(1) A sequence of instructions treated as a basic unit of work. [IEEE-STD-610] (2) A well-defined unit of work in the software process that provides management with a visible checkpoint into the status of the project. Tasks have readiness criteria (preconditions) and completion criteria (postconditions). (See *activity* for contrast.)
task kick-off meeting	A meeting held at the beginning of a task of a project for the purpose of preparing the individuals involved to perform the activities of that task effectively.
task leader	The leader of a technical team for a specific task, who has technical responsibility and provides technical direction to the staff working on the task.
team	A collection of people, often drawn from diverse but related groups, assigned to perform a well-defined function for an organization or a project. Team members may be part-time participants of the team and have other primary responsibilities.

testability	(1) The degree to which a system or component facilitates the establishment of test criteria and the performance of tests to determine whether those criteria have been met. (2) The degree to which a requirement is stated in terms that permit establishment of test criteria and performance of tests to determine whether those criteria have been met. [IEEE-STD-610]
technical requirements	Those requirements that describe what the software must do and its operational constraints. Examples of technical requirements include functional, performance, interface, and quality requirements.
technology	The application of science and/or engineering in accomplishing some particular result.
traceability	The degree to which a relationship can be established between two or more products of the development process, especially products having a predecessor-successor or master-subordinate relationship to one another. [IEEE-STD-610]
train	To make proficient with specialized instruction and practice. (See also *orientation*.)
training group	The collection of individuals (both managers and staff) who are responsible for coordinating and arranging the training activities for an organization. This group typically prepares and conducts most of the training courses and coordinates use of other training vehicles.
training program	The set of related elements that focus on addressing an organization's training needs. It includes an organization's training plan, training materials, development of training, conduct of training, training facilities, evaluation of training, and maintenance of training records.
training waiver	A written approval exempting an individual from training that has been designated as required for a specific role. The exemption is granted because it has been objectively determined that the individual already possesses the needed skills to perform the role.
unit	(1) A separately testable element specified in the design of a computer software component. (2) A logically separable part of a computer program. (3) A software component that is not subdivided into other components. [IEEE-STD-610]
user	(See *end user.)*
validation	The process of evaluating software during or at the end of the development process to determine whether it satisfies specified requirements. [IEEE-STD-610]

verification	The process of evaluating software to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase. [IEEE-STD-610]
verifying implementation	(See *common features*.)
waiver	(See *training waiver).*
well-defined process	A process that includes readiness criteria, inputs, standards and procedures for performing the work, verification mechanisms (such as peer reviews), outputs, and completion criteria. (See also *effective process*.)

Appendix C: Bibliography

The Source CMMs:

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