

CMMI[®] for Services, Version 1.3

CMMI-SVC, V1.3

CMMI Product Team

Improving processes for providing better services

November 2010

TECHNICAL REPORT

CMU/SEI-2010-TR-034
ESC-TR-2010-034

Software Engineering Process Management Program

Unlimited distribution subject to the copyright.

<http://www.sei.cmu.edu>



This report was prepared for the

SEI Administrative Agent
ESC/XPK
5 Eglin Street
Hanscom AFB, MA 01731-2100

The ideas and findings in this report should not be construed as an official DoD position. It is published in the interest of scientific and technical information exchange.

This work is sponsored by the U.S. Department of Defense. The Software Engineering Institute is a federally funded research and development center sponsored by the U.S. Department of Defense.

Copyright 2010 Carnegie Mellon University.

NO WARRANTY

THIS CARNEGIE MELLON UNIVERSITY AND SOFTWARE ENGINEERING INSTITUTE MATERIAL IS FURNISHED ON AN "AS-IS" BASIS. CARNEGIE MELLON UNIVERSITY MAKES NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, AS TO ANY MATTER INCLUDING, BUT NOT LIMITED TO, WARRANTY OF FITNESS FOR PURPOSE OR MERCHANTABILITY, EXCLUSIVITY, OR RESULTS OBTAINED FROM USE OF THE MATERIAL. CARNEGIE MELLON UNIVERSITY DOES NOT MAKE ANY WARRANTY OF ANY KIND WITH RESPECT TO FREEDOM FROM PATENT, TRADEMARK, OR COPYRIGHT INFRINGEMENT.

Use of any trademarks in this report is not intended in any way to infringe on the rights of the trademark holder.

Internal use. Permission to reproduce this document and to prepare derivative works from this document for internal use is granted, provided the copyright and "No Warranty" statements are included with all reproductions and derivative works.

External use. This document may be reproduced in its entirety, without modification, and freely distributed in written or electronic form without requesting formal permission. Permission is required for any other external and/or commercial use. Requests for permission should be directed to the Software Engineering Institute at permission@sei.cmu.edu.

This work was created in the performance of Federal Government Contract Number FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center. The Government of the United States has a royalty-free government-purpose license to use, duplicate, or disclose the work, in whole or in part and in any manner, and to have or permit others to do so, for government purposes pursuant to the copyright license under the clause at 252.227-7013.

For information about SEI publications, please visit the library on the SEI website (www.sei.cmu.edu/library).

The following service marks and registered marks are used in this document: Capability Maturity Model[®]

Carnegie Mellon[®] CERT[®] CMM[®] CMMI[®] CMM Integration[®] IDEALSM SCAMPISM

CMMI, CMM, CERT, CMM Integration, Carnegie Mellon, and Capability Maturity Model are registered in the U.S. Patent and Trademark Office.

SCAMPI and IDEAL are service marks of Carnegie Mellon University.

Preface

CMMI[®] (Capability Maturity Model[®] Integration) models are collections of best practices that help organizations to improve their processes. These models are developed by product teams with members from industry, government, and the Software Engineering Institute (SEI).

This model, called CMMI for Services (CMMI-SVC), provides a comprehensive integrated set of guidelines for providing superior services.

Purpose

The CMMI-SVC model provides guidance for applying CMMI best practices in a service provider organization. Best practices in the model focus on activities for providing quality services to customers and end users. CMMI-SVC integrates bodies of knowledge that are essential for a service provider.

The CMMI-SVC, V1.3 model is a collection of service best practices from government and industry that is generated from the CMMI V1.3 Architecture and Framework.¹ CMMI-SVC is based on the CMMI Model Foundation or CMF (i.e., model components common to all CMMI models and constellations²) and incorporates work by service organizations to adapt CMMI for use in the service industry.

CMMI-SVC provides a comprehensive set of best practices for providing services. CMMI for Development (CMMI-DEV) can be treated as a reference for the development of the service system, which supports delivery of the service [SEI 2010a]. In cases in which the service system is large and complex, the CMMI-DEV model can be effectively used to develop such a system. (See the definition of “service system” in the glossary.)

Acknowledgments

Many talented people were involved in the development of the V1.3 CMMI Product Suite. Three primary groups were the CMMI Steering Group, Product Team, and Configuration Control Board (CCB).

¹ The CMMI Framework is the basic structure that organizes CMMI components and combines them into CMMI constellations and models.

² A constellation is a collection of CMMI components that are used to construct models, training materials, and appraisal related documents for an area of interest (e.g., development, acquisition, services).

The Steering Group guided and approved the plans of the Product Team, provided consultation on significant CMMI project issues, and ensured involvement from a variety of interested communities.

The Steering Group oversaw the development of the Services constellation recognizing the importance of providing best practices to service providers.

The Product Team wrote, reviewed, revised, discussed, and agreed on the structure and technical content of the CMMI Product Suite, including the framework, models, training, and appraisal materials. Development activities were based on multiple inputs. These inputs included an A-Specification and guidance specific to each release provided by the Steering Group, source models, change requests received from the user community, and input received from pilots and other stakeholders.

The CCB is the official mechanism for controlling changes to CMMI models, appraisal related documents, and *Introduction to CMMI* training. As such, this group ensures integrity over the life of the product suite by reviewing all proposed changes to the baseline and approving only those changes that satisfy identified issues and meet criteria for the upcoming release.

Members of the groups involved in developing CMMI-SVC, V1.3 are listed in Appendix C.

Audience

The audience for CMMI-SVC includes anyone interested in process improvement in a service provider environment. Whether you are familiar with the concept of Capability Maturity Models or are seeking information to begin improving your service processes, CMMI-SVC will be useful to you. This model is also intended for organizations that want to use a reference model for an appraisal of their service related processes.³

Organization of this Document

This document is organized into three main parts:

- Part One: About CMMI for Services
- Part Two: Generic Goals and Generic Practices, and the Process Areas
- Part Three: The Appendices and Glossary

Part One: About CMMI for Services, consists of five chapters:

- Chapter 1, Introduction, offers a broad view of CMMI and the Services constellation, concepts of process improvement, and the history of models used for process improvement and different process improvement approaches.

³ An appraisal is an examination of one or more processes by a trained team of professionals using a reference model (e.g., CMMI-SVC) as the basis for determining strengths and weaknesses.

- Chapter 2, Process Area Components, describes all of the components of the CMMI-SVC process areas.⁴
- Chapter 3, Tying It All Together, assembles the model components, explains the concepts of maturity levels and capability levels, and outlines important service concepts.
- Chapter 4, Relationships Among Process Areas, provides insight into the meaning and interactions among the CMMI-SVC process areas.
- Chapter 5, Using CMMI Models, describes paths to adoption and the use of CMMI-SVC for process improvement and benchmarking of practices in a service providing organization.

Part Two: Generic Goals and Generic Practices, and the Process Areas, contains all of this CMMI model's required and expected components. It also contains related informative components, including subpractices, notes, examples, and example work products.

Part Two contains 25 sections. The first section contains the generic goals and practices. The remaining 24 sections each represent one of the CMMI-SVC process areas.

To make these process areas easy to find, they are organized alphabetically by process area acronym. Each section contains descriptions of goals, best practices, and examples.

Part Three: The Appendices and Glossary, consists of four sections:

- Appendix A: References, contains references you can use to locate documented sources of information such as reports, process improvement models, industry standards, and books that are related to CMMI-SVC.
- Appendix B: Acronyms, defines the acronyms used in the model.
- Appendix C: CMMI Version 1.3 Project Participants, contains lists of team members who participated in the development of CMMI-SVC, V1.3.
- Appendix D: Glossary, defines many of the terms used in CMMI-SVC.

How to Use this Document

Whether you are new to process improvement, new to CMMI, or already familiar with CMMI, Part One can help you understand why CMMI-SVC is the model to use for improving your service processes.

Readers New to Process Improvement

If you are new to process improvement or new to the Capability Maturity Model (CMM®) concept, we suggest that you read Chapter 1 first. Chapter 1

⁴ A process area is a cluster of related practices in an area that, when implemented collectively, satisfies a set of goals considered important for making improvement in that area. This concept is covered in detail in Chapter 2.

contains an overview of process improvement that explains what CMMI is all about.

Next, skim Part Two, including generic goals and practices and specific goals and practices, to get a feel for the scope of the best practices contained in the model. Pay close attention to the purpose and introductory notes at the beginning of each process area.

In Part Three, look through the references in Appendix A and select additional sources you think would be beneficial to read before moving forward with using CMMI-SVC. Read through the acronyms and glossary to become familiar with the language of CMMI. Then, go back and read the details of Part Two.

Readers Experienced with Process Improvement

If you are new to CMMI but have experience with other process improvement models, such as the Software CMM or International Organization for Standardization (ISO) 9001, you will immediately recognize many similarities in their structure and content [ISO 2008c].

We recommend that you read Part One to understand how CMMI is different from other process improvement models. If you have experience with other models, you may want to select which sections to read first. Read Part Two with an eye for best practices you recognize from the models that you have already used. By identifying familiar material, you will gain an understanding of what is new, what has been carried over, and what is familiar from the models you already know.

Next, review the glossary to understand how some terminology can differ from that used in the process improvement models you know. Many concepts are repeated, but they may be called something different.

Readers Familiar with CMMI

If you have reviewed or used a CMMI model before, you will quickly recognize the CMMI concepts discussed and the best practices presented. As always, the improvements that the CMMI Product Team made to CMMI for the V1.3 release were driven by user input. Change requests were carefully considered, analyzed, and implemented.

Some significant improvements you can expect in CMMI-SVC, V1.3 include the following:

- High maturity process areas are significantly improved to reflect industry best practices, including a new specific goal and several new specific practices in the process area that was renamed from Organizational Innovation and Deployment (OID) to Organizational Performance Management (OPM).
- Improvements were made to the model architecture that simplify the use of multiple models.
- The Incident Resolution and Prevention (IRP) process area was reorganized and clarified.

- Glossary definitions and model terminology were improved to enhance the clarity, accuracy, and usability of the model, including the replacement of “project” with terms such as “work” or “work group” that are more meaningful for services.
- Level 4 and 5 generic goals and practices were eliminated as well as capability levels 4 and 5 to appropriately focus high maturity on the achievement of business objectives, which is accomplished by applying capability level 1-3 to the high maturity process areas (Causal Analysis and Resolution, Quantitative Work Management, Organizational Performance Management, and Organizational Process Performance).

For a more complete and detailed list of improvements, see <http://www.sei.cmu.edu/cmmi/tools/cmmiv1-3/>.

Additional Information and Reader Feedback

Many sources of information about CMMI are listed in Appendix A and are also published on the CMMI website—<http://www.sei.cmu.edu/cmmi/>.

Your suggestions for improving CMMI are welcome. For information on how to provide feedback, see the CMMI website at <http://www.sei.cmu.edu/cmmi/tools/cr/>. If you have questions about CMMI, send email to cmmi-comments@sei.cmu.edu.

Table of Contents

Preface	ii
Purpose	i
Acknowledgments	i
Audience	ii
Organization of this Document	ii
How to Use this Document	iii
Readers New to Process Improvement	iii
Readers Experienced with Process Improvement	iv
Readers Familiar with CMMI	iv
Additional Information and Reader Feedback	v
 Part One: About CMMI for Services	 1
1 Introduction	3
About Process Improvement	3
About Capability Maturity Models	4
Evolution of CMMI	5
CMMI Framework	7
CMMI for Services	7
2 Process Area Components	9
Core Process Areas and CMMI Models	9
Required, Expected, and Informative Components	9
Required Components	9
Expected Components	9
Informative Components	10
Components Associated with Part Two	10
Process Areas	11
Purpose Statements	11
Introductory Notes	12
Related Process Areas	12
Specific Goals	12
Generic Goals	12
Specific Goal and Practice Summaries	13
Specific Practices	13
Example Work Products	13
Subpractices	13
Generic Practices	13
Generic Practice Elaborations	14
Additions	14
Supporting Informative Components	14
Notes	15
Examples	15
References	15
Numbering Scheme	15
Typographical Conventions	16
3 Tying It All Together	21

Understanding Levels	21
Structures of the Continuous and Staged Representations	22
Understanding Capability Levels	24
Capability Level 0: Incomplete	24
Capability Level 1: Performed	24
Capability Level 2: Managed	25
Capability Level 3: Defined	25
Advancing Through Capability Levels	25
Understanding Maturity Levels	26
Maturity Level 1: Initial	27
Maturity Level 2: Managed	27
Maturity Level 3: Defined	28
Maturity Level 4: Quantitatively Managed	28
Maturity Level 5: Optimizing	29
Advancing Through Maturity Levels	29
Process Areas	30
Equivalent Staging	34
Achieving High Maturity	38
Understanding Key Concepts in the Use of CMMI for Services	38
Service	38
Service System	39
Service Agreement	40
Service Request	41
Service Incident	41
Project, Work Group, and Work	42
4 Relationships Among Process Areas	45
Relationships that Drive Service Establishment and Delivery	46
Relationships that Drive Service Management	47
5 Using CMMI Models	49
Adopting CMMI	49
Your Process Improvement Program	50
Selections that Influence Your Program	50
CMMI Models	51
Using CMMI Appraisals	52
Appraisal Requirements for CMMI	52
SCAMPI Appraisal Methods	52
Appraisal Considerations	53
CMMI Related Training	54
Part Two: Generic Goals and Generic Practices, and the Process Areas	55
Generic Goals and Generic Practices	57
Overview	57
Process Institutionalization	57
Performed Process	57
Managed Process	58
Defined Process	58
Relationships Among Processes	59
Generic Goals and Generic Practices	60
Applying Generic Practices	120

Process Areas that Support Generic Practices	120
Capacity and Availability Management	125
Causal Analysis and Resolution	141
Configuration Management	151
Decision Analysis and Resolution	163
Incident Resolution and Prevention	171
Integrated Work Management	187
Measurement and Analysis	205
Organizational Process Definition	221
Organizational Process Focus	233
Organizational Performance Management	247
Organizational Process Performance	263
Organizational Training	275
Process and Product Quality Assurance	285
Quantitative Work Management	291
Requirements Management	309
Risk Management	317
Supplier Agreement Management	331
Service Continuity	343
Service Delivery	355
Service System Development	373
Service System Transition	399
Strategic Service Management	409
Work Monitoring and Control	419
Work Planning	429
 Part Three: The Appendices	 451
Appendix A: References	453
Information Assurance/Information Security Related Sources	457
Appendix B: Acronyms	459
Appendix C: CMMI Version 1.3 Project Participants	463
CMMI Steering Group	463
Steering Group Members	463
Ex-Officio Steering Group Members	464
Steering Group Support	464
CMMI for Services Advisory Group	464
CMMI V1.3 Coordination Team	465
CMMI V1.3 Configuration Control Board	465
CMMI V1.3 Core Model Team	466
CMMI V1.3 Translation Team	466
CMMI V1.3 High Maturity Team	467

CMMI V1.3 Acquisition Mini Team	467
CMMI V1.3 Services Mini Team	467
CMMI V1.3 SCAMPI Upgrade Team	468
CMMI Version 1.3 Training Teams	468
ACQ and DEV Training Team	468
SVC Training Team	469
CMMI V1.3 Quality Team	469
Appendix D: Glossary	471

Part One: **About CMMI for Services**

1 Introduction

The service industry is a significant driver for worldwide economic growth. Guidance on developing and improving mature service practices is a key contributor to the service provider performance and customer satisfaction. The CMMI® for Services (CMMI-SVC) model is designed to begin meeting that need.

CMMI-SVC contains 24 process areas. Of those process areas, 16 are core process areas, 1 is a shared process area, and 7 are service-specific process areas that include 1 *addition*. (See more about *additions* in Chapter 2.)⁵

All CMMI-SVC model practices focus on the activities of the service provider. Seven process areas focus on practices specific to services, addressing capacity and availability management, service continuity, service delivery, incident resolution and prevention, service transition, service system development, and strategic service management processes.

About Process Improvement

In its research to help organizations to develop and maintain quality products and services, the Software Engineering Institute (SEI) has found several dimensions that an organization can focus on to improve its business. Figure 1.1 illustrates the three critical dimensions that organizations typically focus on: people, procedures and methods, and tools and equipment.

⁵ A core process area is a process area that is common to all CMMI models. A shared process area is shared by at least two CMMI models, but not all of them.

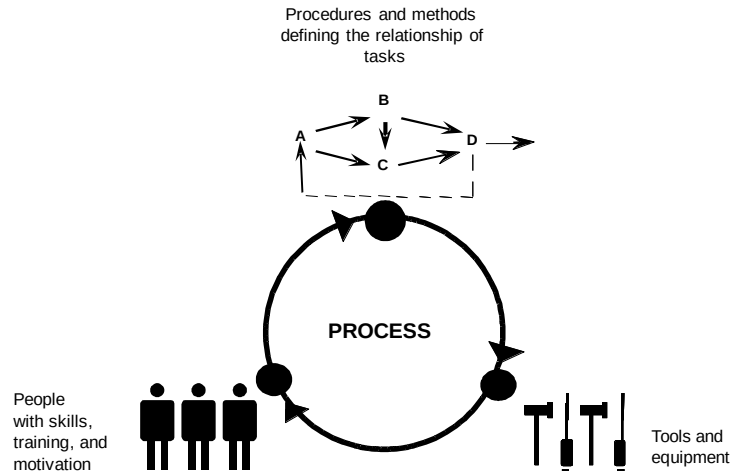


Figure 1.1: The Three Critical Dimensions

What holds everything together? It is the *processes* used in your organization. Processes allow you to align the way you do business. They allow you to address scalability and provide a way to incorporate knowledge of how to do things better. Processes allow you to leverage your resources and to examine business trends.

This is not to say that people and technology are not important. We are living in a world where technology is changing at an incredible speed. Similarly, people typically work for many companies throughout their careers. We live in a dynamic world. A focus on process provides the infrastructure and stability necessary to deal with an ever-changing world and to maximize the productivity of people and the use of technology to be competitive.

Manufacturing has long recognized the importance of process effectiveness and efficiency. Today, many organizations in manufacturing and service industries recognize the importance of quality processes. Process helps an organization's workforce to meet business objectives by helping them to work smarter, not harder, and with improved consistency. Effective processes also provide a vehicle for introducing and using new technology in a way that best meets the business objectives of the organization.

About Capability Maturity Models

A Capability Maturity Model® (CMM®), including CMMI, is a simplified representation of the world. CMMs contain the essential elements of effective processes. These elements are based on the concepts developed by Crosby, Deming, Juran, and Humphrey.

In the 1930s, Walter Shewhart began work in process improvement with his principles of statistical quality control [Shewhart 1931]. These principles were refined by W. Edwards Deming [Deming 1986], Phillip Crosby [Crosby 1979], and Joseph Juran [Juran 1988]. Watts Humphrey, Ron Radice, and others extended these principles further and began applying them to

software in their work at IBM (International Business Machines) and the SEI [Humphrey 1989]. Humphrey's book, *Managing the Software Process*, provides a description of the basic principles and concepts on which many of the Capability Maturity Models® (CMMs®) are based.

The SEI has taken the process management premise, "the quality of a system or product is highly influenced by the quality of the process used to develop and maintain it," and defined CMMs that embody this premise. The belief in this premise is seen worldwide in quality movements, as evidenced by the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) body of standards.

CMMs focus on improving processes in an organization. They contain the essential elements of effective processes for one or more disciplines and describe an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness.

Like other CMMs, CMMI models provide guidance to use when developing processes. CMMI models are not processes or process descriptions. The actual processes used in an organization depend on many factors, including application domains and organization structure and size. In particular, the process areas of a CMMI model typically do not map one to one with the processes used in your organization.

The SEI created the first CMM designed for software organizations and published it in a book, *The Capability Maturity Model: Guidelines for Improving the Software Process* [SEI 1995].

Today, CMMI is an application of the principles introduced almost a century ago to this never-ending cycle of process improvement. The value of this process improvement approach has been confirmed over time. Organizations have experienced increased productivity and quality, improved cycle time, and more accurate and predictable schedules and budgets [Gibson 2006].

Evolution of CMMI

The CMM Integration® project was formed to sort out the problem of using multiple CMMs. The combination of selected models into a single improvement framework was intended for use by organizations in their pursuit of enterprise-wide process improvement.

Developing a set of integrated models involved more than simply combining existing model materials. Using processes that promote consensus, the CMMI Product Team built a framework that accommodates multiple constellations.

The first model to be developed was the CMMI for Development model (then simply called "CMMI"). Figure 1.2 illustrates the models that led to CMMI Version 1.3.

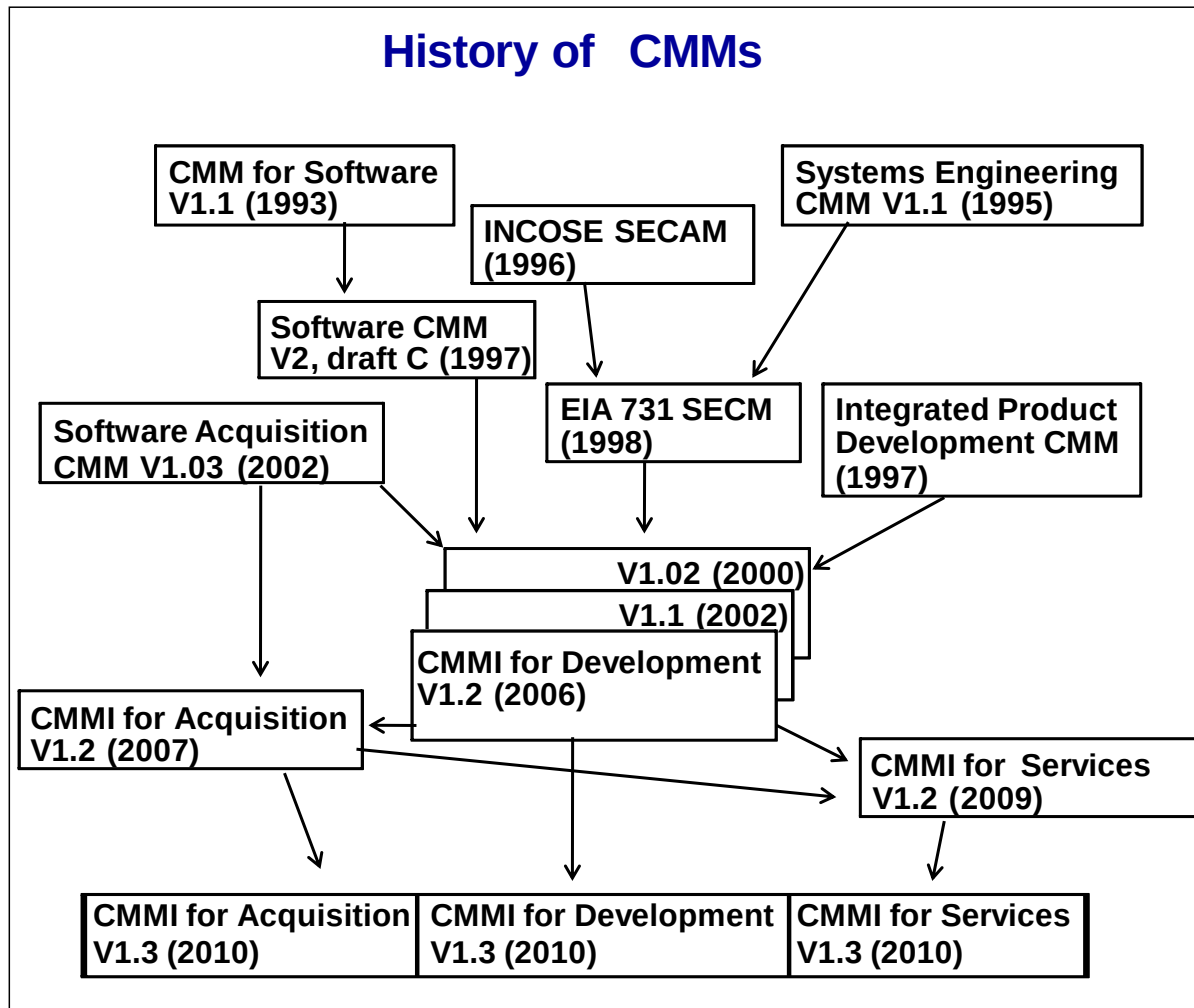


Figure 1.2: The History of CMMs⁶

Initially, CMMI was one model that combined three source models: the *Capability Maturity Model for Software* (SW-CMM) v2.0 draft C, the *Systems Engineering Capability Model* (SECM) [EIA 2002a], and the *Integrated Product Development Capability Maturity Model* (IPD-CMM) v0.98.

These three source models were selected because of their successful adoption or promising approach to improving processes in an organization.

The first CMMI model (V1.02) was designed for use by development organizations in their pursuit of enterprise-wide process improvement. It was released in 2000. Two years later version 1.1 was released and four years after that, version 1.2 was released.

By the time that version 1.2 was released, two other CMMI models were being planned. Because of this planned expansion, the name of the first

⁶ EIA 731 SECM is the Electronic Industries Alliance standard 731, or the Systems Engineering Capability Model. INCOSE SECAM is International Council on Systems Engineering Systems Engineering Capability Assessment Model [EIA 2002].

CMMI model had to change to become CMMI for Development and the concept of constellations was created.

The CMMI for Acquisition model was released in 2007. Since it built on the CMMI for Development Version 1.2 model, it also was named Version 1.2. Two years later the CMMI for Services model was released. It built on the other two models and also was named Version 1.2.

In 2008 plans were drawn to begin developing Version 1.3, which would ensure consistency among all three models and improve high maturity material. Version 1.3 of CMMI for Acquisition [Gallagher 2011, SEI 2010b], CMMI for Development [Chrissis 2011, SEI 2010a], and CMMI for Services [Forrester 2011] were released in November 2010.

CMMI Framework

The CMMI Framework provides the structure needed to produce CMMI models, training, and appraisal components. To allow the use of multiple models within the CMMI Framework, model components are classified as either common to all CMMI models or applicable to a specific model. The common material is called the “CMMI Model Foundation” or “CMF.”

The components of the CMF are part of every model generated from the CMMI Framework. Those components are combined with material applicable to an area of interest (e.g., acquisition, development, services) to produce a model.

A “constellation” is defined as a collection of CMMI components that are used to construct models, training materials, and appraisal related documents for an area of interest (e.g., acquisition, development, services). The Services constellation’s model is called “CMMI for Services” or “CMMI-SVC.”

CMMI for Services

CMMI-SVC draws on concepts and practices from CMMI and other service focused standards and models, including the following:

- Information Technology Infrastructure Library (ITIL)
- ISO/IEC 20000: Information Technology—Service Management
- Control Objectives for Information and related Technology (CobiT)
- Information Technology Services Capability Maturity Model (ITSCMM)

Familiarity with these and other service-oriented standards and models is not required to comprehend CMMI-SVC, and this model is not structured in a way that is intended to conform to any of them. However, knowledge of other standards and models can provide a richer understanding of CMMI-SVC.

The CMMI-SVC model covers the activities required to establish, deliver, and manage services. As defined in the CMMI context, a service is an

intangible, non-storable product. The CMMI-SVC model has been developed to be compatible with this broad definition.

CMMI-SVC goals and practices are therefore potentially relevant to any organization concerned with the delivery of services, including enterprises in sectors such as defense, information technology (IT), health care, finance, and transportation. Early users of CMMI-SVC include organizations that deliver services as varied as training, logistics, maintenance, refugee services, lawn care, book shelving, research, consulting, auditing, independent verification and validation, human resources, financial management, health care, and IT services.

The CMMI-SVC model contains practices that cover work management, process management, service establishment, service delivery and support, and supporting processes. The CMMI-SVC model shares a great deal of material with CMMI models in other constellations. Therefore, those who are familiar with another CMMI constellation will find much of the CMMI-SVC content familiar.

When using this model, use professional judgment and common sense to interpret it for your organization. That is, although the process areas described in this model depict behaviors considered best practices for most service providers, all process areas and practices should be interpreted using an in-depth knowledge of CMMI-SVC, organizational constraints, and the business environment.

Organizations interested in evaluating and improving their processes to *develop* systems for delivering services can use the CMMI-DEV model. This approach is especially recommended for organizations that are already using CMMI-DEV or that must develop and maintain complex systems for delivering services. However, the CMMI-SVC model provides an alternative, streamlined approach to evaluating and improving the development of service systems that can be more appropriate in certain contexts.

2 Process Area Components

This chapter describes the components found in each process area and in the generic goals and generic practices. Understanding these components is critical to using the information in Part Two effectively. If you are unfamiliar with Part Two, you may want to skim the Generic Goals and Generic Practices section and a couple of process area sections to get a general feel for the content and layout before reading this chapter.

Core Process Areas and CMMI Models

All CMMI models are produced from the CMMI Framework. This framework contains all of the goals and practices that are used to produce CMMI models that belong to CMMI constellations.

All CMMI models contain 16 core process areas. These process areas cover basic concepts that are fundamental to process improvement in any area of interest (i.e., acquisition, development, services). Some of the material in the core process areas is the same in all constellations. Other material may be adjusted to address a specific area of interest. Consequently, the material in the core process areas may not be exactly the same.

Required, Expected, and Informative Components

Model components are grouped into three categories—required, expected, and informative—that reflect how to interpret them.

Required Components

Required components are CMMI components that are essential to achieving process improvement in a given process area. This achievement must be visibly implemented in an organization's processes. The required components in CMMI are the specific and generic goals. Goal satisfaction is used in appraisals as the basis for deciding whether a process area has been satisfied.

Expected Components

Expected components are CMMI components that describe the activities that are important in achieving a required CMMI component. Expected components guide those who implement improvements or perform appraisals. The expected components in CMMI are the specific and generic practices.

Before goals can be considered to be satisfied, either their practices as described, or acceptable alternatives to them, must be present in the planned and implemented processes of the organization.

Informative Components

Informative components are CMMI components that help model users understand CMMI required and expected components of a model. These components can be example boxes, detailed explanations, or other helpful information. Subpractices, notes, references, goal titles, practice titles, sources, example work products, and generic practice elaborations are informative model components.

The informative material plays an important role in understanding the model. It is often impossible to adequately describe the behavior required or expected of an organization using only a single goal or practice statement. The model's informative material provides information necessary to achieve the correct understanding of goals and practices and thus cannot be ignored.

Components Associated with Part Two

The model components associated with Part Two are summarized in Figure 2.1 to illustrate their relationships.

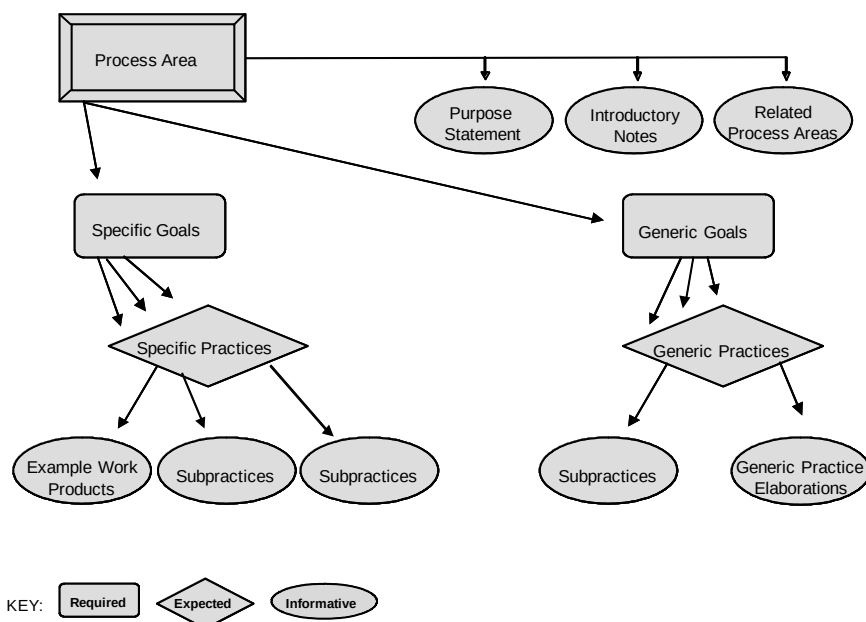


Figure 2.1: CMMI Model Components

The following sections provide detailed descriptions of CMMI model components.

Process Areas

A process area is a cluster of related practices in an area that, when implemented collectively, satisfies a set of goals considered important for making improvement in that area. (See the definition of “process area” in the glossary.)

The 24 process areas are presented in alphabetical order by acronym:

- Capacity and Availability Management (CAM)
- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Incident Resolution and Prevention (IRP)
- Integrated Work Management (IWM)
- Measurement and Analysis (MA)
- Organizational Process Definition (OPD)
- Organizational Process Focus (OPF)
- Organizational Performance Management (OPM)
- Organizational Process Performance (OPP)
- Organizational Training (OT)
- Process and Product Quality Assurance (PPQA)
- Quantitative Work Management (QWM)
- Requirements Management (REQM)
- Risk Management (RSKM)
- Supplier Agreement Management (SAM)
- Service Continuity (SCON)
- Service Delivery (SD)
- Service System Development (SSD)⁷
- Service System Transition (SST)
- Strategic Service Management (STSM)
- Work Monitoring and Control (WMC)
- Work Planning (WP)

Purpose Statements

A purpose statement describes the purpose of the process area and is an informative component.

For example, the purpose statement of the Organizational Process Definition process area is “The purpose of Organizational Process Definition (OPD) is to establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams.”

⁷ The SSD process area is an “addition.”

Introductory Notes

The introductory notes section of the process area describes the major concepts covered in the process area and is an informative component.

An example from the introductory notes of the Work Monitoring and Control process area is “When actual status deviates significantly from expected values, corrective actions are taken as appropriate.”

Related Process Areas

The Related Process Areas section lists references to related process areas and reflects the high-level relationships among the process areas. The Related Process Areas section is an informative component.

An example of a reference found in the Related Process Areas section of the Work Planning process area is “Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.”

Specific Goals

A specific goal describes the unique characteristics that must be present to satisfy the process area. A specific goal is a required model component and is used in appraisals to help determine whether a process area is satisfied. (See the definition of “specific goal” in the glossary.)

For example, a specific goal from the Configuration Management process area is “Integrity of baselines is established and maintained.”

Only the statement of the specific goal is a required model component. The title of a specific goal (preceded by the goal number) and notes associated with the goal are considered informative model components.

Generic Goals

Generic goals are called “generic” because the same goal statement applies to multiple process areas. A generic goal describes the characteristics that must be present to institutionalize processes that implement a process area. A generic goal is a required model component and is used in appraisals to determine whether a process area is satisfied. (See the Generic Goals and Generic Practices section in Part Two for a more detailed description of generic goals. See the definition of “generic goal” in the glossary.)

An example of a generic goal is “The process is institutionalized as a defined process.”

Only the statement of the generic goal is a required model component. The title of a generic goal (preceded by the goal number) and notes associated with the goal are considered informative model components.

Specific Goal and Practice Summaries

The specific goal and practice summary provides a high-level summary of the specific goals and specific practices. The specific goal and practice summary is an informative component.

Specific Practices

A specific practice is the description of an activity that is considered important in achieving the associated specific goal. The specific practices describe the activities that are expected to result in achievement of the specific goals of a process area. A specific practice is an expected model component. (See the definition of “specific practice” in the glossary.)

For example, a specific practice from the Work Monitoring and Control process area is “Monitor commitments against those identified in the work plan.”

Only the statement of the specific practice is an expected model component. The title of a specific practice (preceded by the practice number) and notes associated with the specific practice are considered informative model components.

Example Work Products

The example work products section lists sample outputs from a specific practice. An example work product is an informative model component. (See the definition of “example work product” in the glossary.)

For instance, an example work product for the specific practice “Monitor Work Planning Parameters” in the Work Monitoring and Control process area is “Records of significant deviations.”

Subpractices

A subpractice is a detailed description that provides guidance for interpreting and implementing a specific or generic practice. Subpractices can be worded as if prescriptive, but they are actually an informative component meant only to provide ideas that may be useful for process improvement. (See the definition of “subpractice” in the glossary.)

For example, a subpractice for the specific practice “Take Corrective Action” in the Work Monitoring and Control process area is “Determine and document the appropriate actions needed to address identified issues.”

Generic Practices

Generic practices are called “generic” because the same practice applies to multiple process areas. The generic practices associated with a generic goal describe the activities that are considered important in achieving the generic goal and contribute to the institutionalization of the processes associated with a process area. A generic practice is an expected model component. (See the definition of “generic practice” in the glossary.)

For example, a generic practice for the generic goal “The process is institutionalized as a managed process” is “Provide adequate resources for performing the process, developing the work products, and providing the services of the process.”

Only the statement of the generic practice is an expected model component. The title of a generic practice (preceded by the practice number) and notes associated with the practice are considered informative model components.

Generic Practice Elaborations

Generic practice elaborations appear after generic practices to provide guidance on how the generic practices can be applied uniquely to process areas. A generic practice elaboration is an informative model component. (See the definition of “generic practice elaboration” in the glossary.)

For example, a generic practice elaboration after the generic practice “Establish and maintain an organizational policy for planning and performing the process” for the Work Planning process area is “This policy establishes organizational expectations for estimating planning parameters, making internal and external commitments, and developing the plan for managing the work.”

Additions

Additions are clearly marked model components that contain information of interest to particular users. An addition can be informative material, a specific practice, a specific goal, or an entire process area that extends the scope of a model or emphasizes a particular aspect of its use. In this document, all additions are related to the Service System Development process area.

The Service System Development process area is an addition. Another example of an addition is the reference in the Integrated Work Management process area that appears after specific practice 1.1, subpractice 6, “Conduct peer reviews of the defined process for the work.” The addition states “Refer to the Service System Development process area for more information about performing peer reviews.”

Supporting Informative Components

In many places in the model, further information is needed to describe a concept. This informative material is provided in the form of the following components:

- Notes
- Examples
- References

Notes

A note is text that can accompany nearly any other model component. It may provide detail, background, or rationale. A note is an informative model component.

For example, a note that accompanies the specific practice “Implement Action Proposals” in the Causal Analysis and Resolution process area is “Only changes that prove to be of value should be considered for broad implementation.”

Examples

An example is a component comprising text and often a list of items, usually in a box, that can accompany nearly any other component and provides one or more examples to clarify a concept or described activity. An example is an informative model component.

The following is an example that accompanies the subpractice “Document noncompliance issues when they cannot be resolved in the work group” under the specific practice “Communicate and Resolve Noncompliance Issues” in the Process and Product Quality Assurance process area.

Examples of ways to resolve noncompliance in the work group include the following:

- Fixing the noncompliance
- Changing the process descriptions, standards, or procedures that were violated
- Obtaining a waiver to cover the noncompliance

References

A reference is a pointer to additional or more detailed information in related process areas and can accompany nearly any other model component. A reference is an informative model component. (See the definition of “reference” in the glossary.)

For example, a reference that accompanies the specific practice “Compose the Defined Process” in the Quantitative Work Management process area is “Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.”

Numbering Scheme

Specific and generic goals are numbered sequentially. Each specific goal begins with the prefix “SG” (e.g., SG 1). Each generic goal begins with the prefix “GG” (e.g., GG 2).

Specific and generic practices are also numbered sequentially. Each specific practice begins with the prefix “SP,” followed by a number in the form “x.y” (e.g., SP 1.1). The x is the same number as the goal to which the specific practice maps. The y is the sequence number of the specific practice under the specific goal.

An example of specific practice numbering is in the Work Planning process area. The first specific practice is numbered SP 1.1 and the second is SP 1.2.

Each generic practice begins with the prefix “GP,” followed by a number in the form “x.y” (e.g., GP 1.1).

The x corresponds to the number of the generic goal. The y is the sequence number of the generic practice under the generic goal. For example, the first generic practice associated with GG 2 is numbered GP 2.1 and the second is GP 2.2.

Typographical Conventions

The typographical conventions used in this model were designed to enable you to easily identify and select model components by presenting them in formats that allow you to find them quickly on the page.

Figures 2.2, 2.3, and 2.4 are sample pages from process areas in Part Two; they show the different process area components, labeled so that you can identify them. Notice that components differ typographically so that you can easily identify each one.

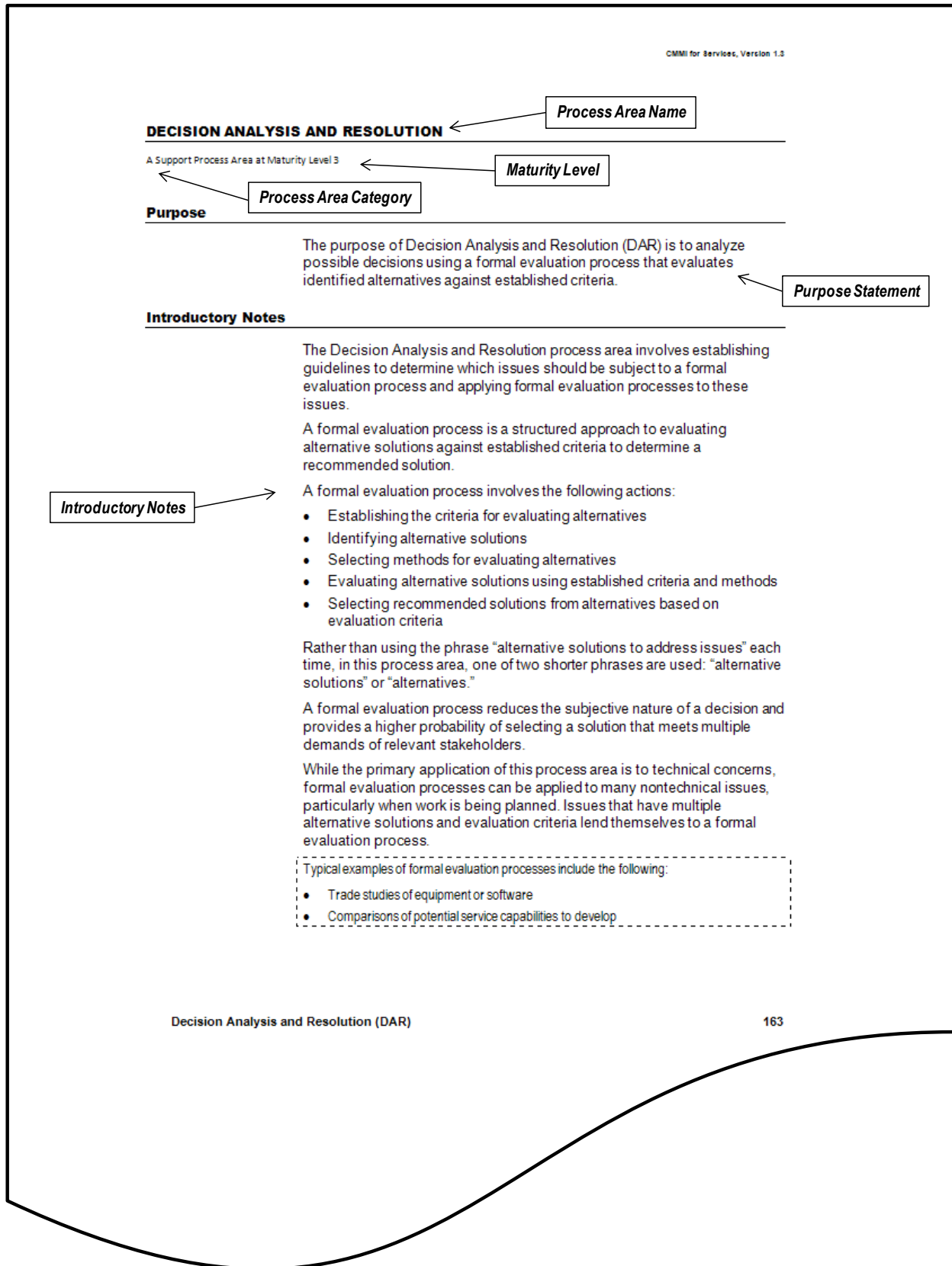


Figure 2.2: Sample Page from Decision Analysis and Resolution

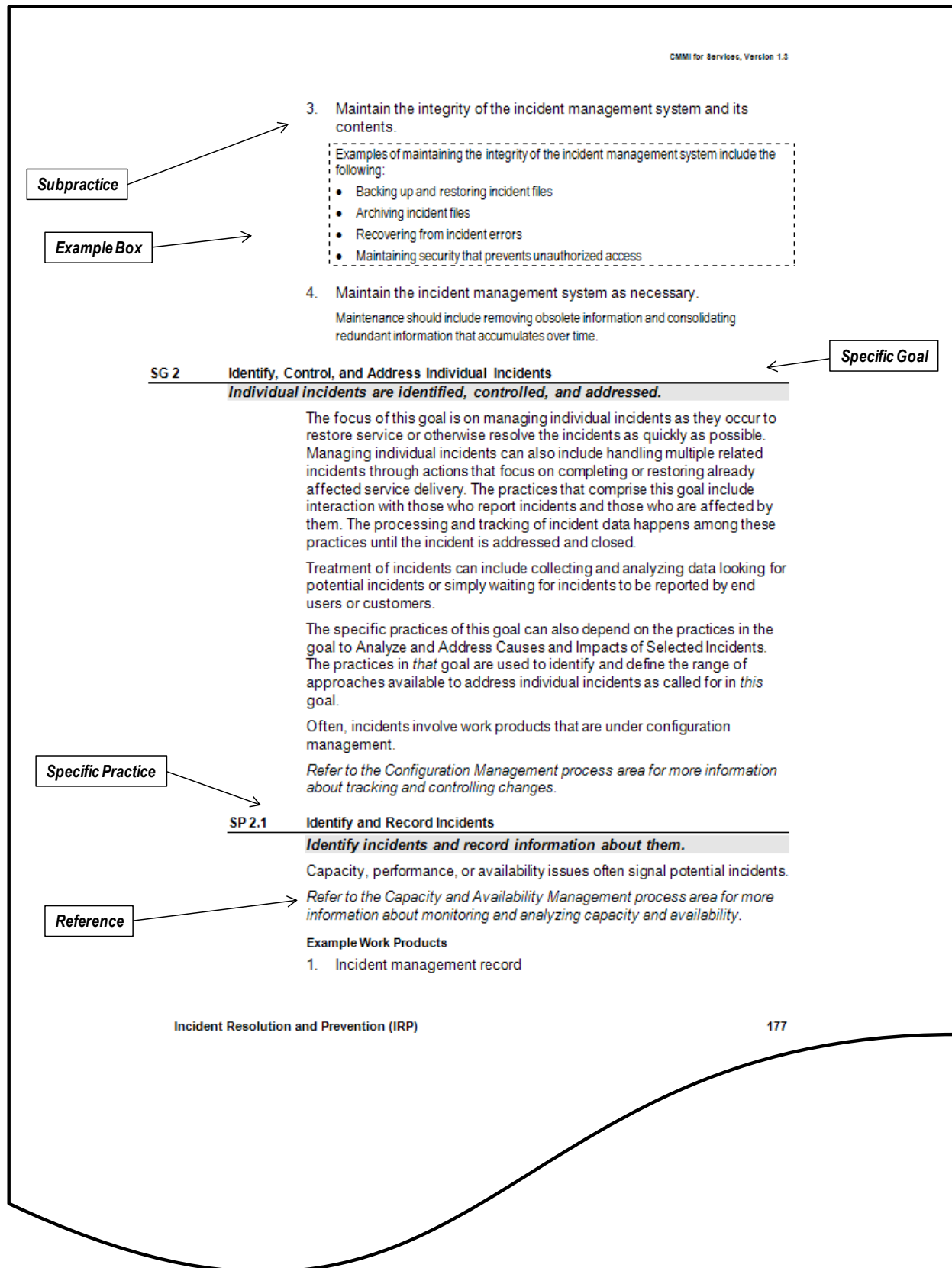


Figure 2.3: Sample Page from Incident Resolution and Prevention

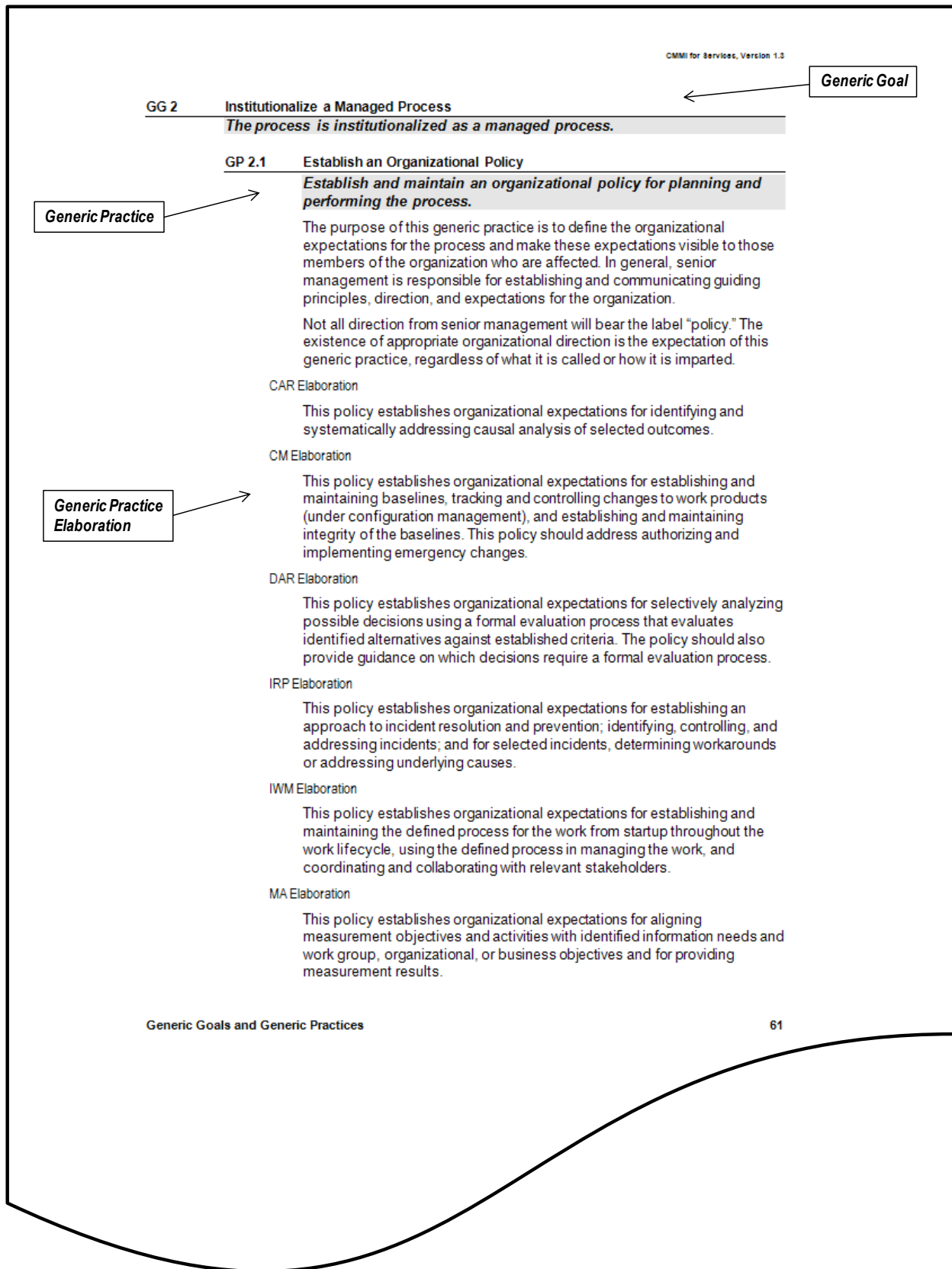


Figure 2.4: Sample Page from the Generic Goals and Generic Practices

3 Tying It All Together

Now that you have been introduced to the components of CMMI models, you need to understand how they fit together to meet your process improvement needs. This chapter introduces the concept of *levels* and shows how the process areas are organized and used. It also discusses some of the key concepts that are significant for applying a CMMI model in the context of service related work.

CMMI-SVC does not specify that a work group or organization must follow a particular process flow or that a certain number of services be delivered per day or specific performance targets be achieved. The model does specify that a work group or organization should have processes that address service related practices. To determine whether these processes are in place, a work group or organization maps its processes to the process areas in this model.

The mapping of processes to process areas enables the organization to track its progress against the CMMI-SVC model as it updates or creates processes. Do not expect that every CMMI-SVC process area will map one to one with your organization's or work group's processes.

Understanding Levels

Levels are used in CMMI-SVC to describe an evolutionary path recommended for an organization that wants to improve the processes it uses to provide services. Levels can also be the outcome of the rating activity in appraisals.⁸ Appraisals can apply to entire organizations, to a division, or to smaller organizational units that include related work groups.

CMMI supports two improvement paths using levels. One path enables organizations to incrementally improve processes corresponding to an individual process area (or group of process areas) selected by the organization. The other path enables organizations to improve a set of related processes by incrementally addressing successive sets of process areas.

These two improvement paths are associated with the two types of levels: capability levels and maturity levels. These levels correspond to two approaches to process improvement called "representations." The two representations are called "continuous" and "staged." Using the continuous

⁸ For more information about appraisals, refer to *Appraisal Requirements for CMMI* and the *Standard CMMI Appraisal Method for Process Improvement Method Definition Document* [SEI 2011a, SEI 2011b].

representation enables you to achieve “capability levels.” Using the staged representation enables you to achieve “maturity levels.”

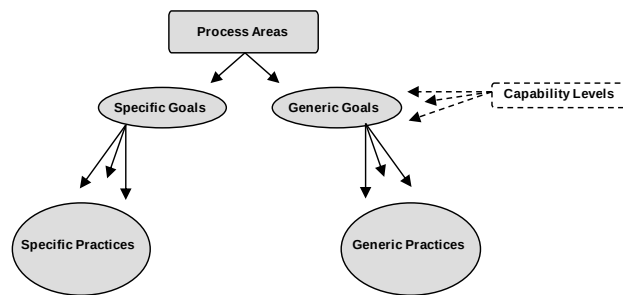
To reach a particular level, an organization must satisfy all of the goals of the process area or set of process areas that are targeted for improvement, regardless of whether it is a capability or a maturity level.

Both representations provide ways to improve your processes to achieve business objectives, and both provide the same essential content and use the same model components.

Structures of the Continuous and Staged Representations

Figure 3.1 illustrates the structures of the continuous and staged representations. The differences between the structures are subtle but significant. The staged representation uses maturity levels to characterize the overall state of the organization’s processes relative to the model as a whole, whereas the continuous representation uses capability levels to characterize the state of the organization’s processes relative to an individual process area.

Continuous Representation



Staged Representation

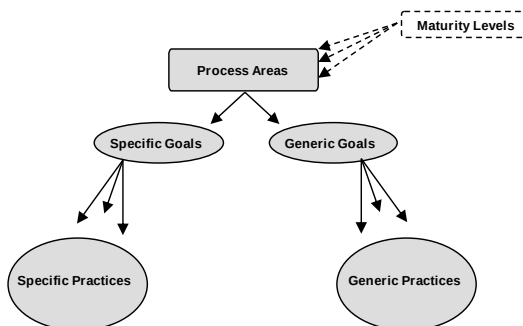


Figure 3.1: Structure of the Continuous and Staged Representations

What may strike you as you compare these two representations is their similarity. Both have many of the same components (e.g., process areas, specific goals, specific practices), and these components have the same hierarchy and configuration.

What is not readily apparent from the high-level view in Figure 3.1 is that the continuous representation focuses on process area capability as measured by capability levels and the staged representation focuses on overall maturity as measured by maturity levels. This dimension (the capability/maturity dimension) of CMMI is used for benchmarking and appraisal activities, as well as guiding an organization's improvement efforts.

Capability levels apply to an organization's process improvement achievement in individual process areas. These levels are a means for incrementally improving the processes corresponding to a given process area. The four capability levels are numbered 0 through 3.

Maturity levels apply to an organization's process improvement achievement across multiple process areas. These levels are a means of improving the processes corresponding to a given set of process areas (i.e., maturity level). The five maturity levels are numbered 1 through 5.

Table 3.1 compares the four capability levels to the five maturity levels. Notice that the names of two of the levels are the same in both representations (i.e., Managed and Defined). The differences are that there is no maturity level 0; there are no capability levels 4 and 5; and at level 1, the names used for capability level 1 and maturity level 1 are different.

Table 3.1 Comparison of Capability and Maturity Levels

<i>Level</i>	<i>Continuous Representation Capability Levels</i>	<i>Staged Representation Maturity Levels</i>
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing

The continuous representation is concerned with selecting both a particular process area to improve and the desired capability level for that process area. In this context, whether a process is performed or incomplete is important. Therefore, the name "Incomplete" is given to the continuous representation starting point.

The staged representation is concerned with selecting multiple process areas to improve within a maturity level; whether individual processes are performed or incomplete is not the primary focus. Therefore, the name “Initial” is given to the staged representation starting point.

Both capability levels and maturity levels provide a way to improve the processes of an organization and measure how well organizations can and do improve their processes. However, the associated approach to process improvement is different.

Understanding Capability Levels

To support those who use the continuous representation, all CMMI models reflect capability levels in their design and content.

The four capability levels, each a layer in the foundation for ongoing process improvement, are designated by the numbers 0 through 3:

- 0. Incomplete
- 1. Performed
- 2. Managed
- 3. Defined

A capability level for a process area is achieved when all of the generic goals are satisfied up to that level. The fact that capability levels 2 and 3 use the same terms as generic goals 2 and 3 is intentional because each of these generic goals and practices reflects the meaning of the capability levels of the goals and practices. (See the Generic Goals and Generic Practices section in Part Two for more information about generic goals and practices.) A short description of each capability level follows.

Capability Level 0: Incomplete

An *incomplete process* is a process that either is not performed or is partially performed. One or more of the specific goals of the process area are not satisfied and no generic goals exist for this level since there is no reason to institutionalize a partially performed process.

Capability Level 1: Performed

A capability level 1 process is characterized as a *performed process*. A performed process is a process that accomplishes the needed work to produce work products; the specific goals of the process area are satisfied.

Although capability level 1 results in important improvements, those improvements can be lost over time if they are not institutionalized. The application of institutionalization (the CMMI generic practices at capability levels 2 and 3) helps to ensure that improvements are maintained.

Capability Level 2: Managed

A capability level 2 process is characterized as a *managed process*. A managed process is a performed process that is planned and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.

The process discipline reflected by capability level 2 helps to ensure that existing practices are retained during times of stress.

Capability Level 3: Defined

A capability level 3 process is characterized as a *defined process*. A defined process is a managed process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines; has a maintained process description; and contributes process related assets to the organizational process assets.

A critical distinction between capability levels 2 and 3 is the scope of standards, process descriptions, and procedures. At capability level 2, the standards, process descriptions, and procedures can be quite different in each specific instance of the process (i.e., used by a particular work group). At capability level 3, the standards, process descriptions, and procedures for work are tailored from the organization's set of standard processes to suit a particular work group or organizational unit and therefore are more consistent, except for the differences allowed by the tailoring guidelines.

Another critical distinction is that at capability level 3 processes are typically described more rigorously than at capability level 2. A defined process clearly states the purpose, inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria. At capability level 3, processes are managed more proactively using an understanding of the interrelationships of the process activities and detailed measures of the process and its work products.

Advancing Through Capability Levels

The capability levels of a process area are achieved through the application of generic practices or suitable alternatives to the processes associated with that process area.

Reaching capability level 1 for a process area is equivalent to saying that the processes associated with that process area are *performed processes*.

Reaching capability level 2 for a process area is equivalent to saying that there is a policy that indicates you will perform the process. There is a plan for performing it, resources are provided, responsibilities are assigned, training to perform it is provided, selected work products related to performing the process are controlled, and so on. In other words, a capability level 2 process can be planned and monitored just like any work or support activity.

Reaching capability level 3 for a process area is equivalent to saying that an organizational standard process exists associated with that process area, which can be tailored to the needs of the work. The processes in the organization are now more consistently defined and applied because they are based on organizational standard processes.

After an organization has reached capability level 3 in the process areas it has selected for improvement, it can continue its improvement journey by addressing high maturity process areas (Organizational Process Performance, Quantitative Work Management, Causal Analysis and Resolution, and Organizational Performance Management).

The high maturity process areas focus on improving the performance of those processes already implemented. The high maturity process areas describe the use of statistical and other quantitative techniques to improve organizational and work group processes to better achieve business objectives.

When continuing its improvement journey in this way an organization can derive the most benefit by first selecting the OPP and QWM process areas, and bringing those process areas to capability levels 1, 2, and 3. In doing so, work groups and organizations align the selection and analyses of processes more closely with their business objectives.

After the organization attains capability level 3 in the OPP and QWM process areas, the organization can continue its improvement path by selecting the CAR and OPM process areas. In doing so, the organization analyzes the business performance using statistical and other quantitative techniques to determine performance shortfalls, and identifies and deploys process and technology improvements that contribute to meeting quality and process performance objectives. Work groups and the organization use causal analysis to identify and resolve issues affecting performance and promote the dissemination of best practices.

Understanding Maturity Levels

To support those who use the staged representation, all CMMI models reflect maturity levels in their design and content. A maturity level consists of related specific and generic practices for a predefined set of process areas that improve the organization's overall performance.

The maturity level of an organization provides a way to characterize its performance. Experience has shown that organizations do their best when they focus their process improvement efforts on a manageable number of process areas at a time and that those areas require increasing sophistication as the organization improves.

A maturity level is a defined evolutionary plateau for organizational process improvement. Each maturity level matures an important subset of the organization's processes, preparing it to move to the next maturity level. The maturity levels are measured by the achievement of the specific and generic goals associated with each predefined set of process areas.

The five maturity levels, each a layer in the foundation for ongoing process improvement, are designated by the numbers 1 through 5:

1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Remember that maturity levels 2 and 3 use the same terms as capability levels 2 and 3. This consistency of terminology was intentional because the concepts of maturity levels and capability levels are complementary. Maturity levels are used to characterize organizational improvement relative to a set of process areas, and capability levels characterize organizational improvement relative to an individual process area.

Maturity Level 1: Initial

At maturity level 1, processes are usually ad hoc and chaotic. The organization usually does not provide a stable environment to support processes. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes. In spite of this chaos, maturity level 1 organizations provide services that often work, but they frequently exceed the budget and schedule documented in their plans.

Maturity level 1 organizations are characterized by a tendency to overcommit, abandon their processes in a time of crisis, and be unable to repeat their successes.

Maturity Level 2: Managed

At maturity level 2, work groups establish the foundation for an organization to become an effective service provider by institutionalizing selected Project and Work Management, Support, and Service Establishment and Delivery processes. Work groups define a service strategy, create work plans, and monitor and control the work to ensure the service is delivered as planned. The service provider establishes agreements with customers and develops and manages customer and contractual requirements. Configuration management and process and product quality assurance are institutionalized, and the service provider also develops the capability to measure and analyze process performance.

Also at maturity level 2, work groups, work activities, processes, work products, and services are managed. The service provider ensures that processes are planned in accordance with policy. To execute the process, the service provider provides adequate resources, assigns responsibility for performing the process, trains people on the process, and ensures the designated work products of the process are under appropriate levels of configuration management. The service provider identifies and involves relevant stakeholders and periodically monitors and controls the process.

Process adherence is periodically evaluated and process performance is shared with senior management. The process discipline reflected by maturity level 2 helps to ensure that existing practices are retained during times of stress.

Maturity Level 3: Defined

At maturity level 3, service providers use defined processes for managing work. They embed tenets of project and work management and services best practices, such as service continuity and incident resolution and prevention, into the standard process set. The service provider verifies that selected work products meet their requirements and validates services to ensure they meet the needs of the customer and end user. These processes are well characterized and understood and are described in standards, procedures, tools, and methods.

The organization's set of standard processes, which is the basis for maturity level 3, is established and improved over time. These standard processes are used to establish consistency across the organization. Work groups establish their defined processes by tailoring the organization's set of standard processes according to tailoring guidelines. (See the definition of "organization's set of standard processes" in the glossary.)

A critical distinction between maturity levels 2 and 3 is the scope of standards, process descriptions, and procedures. At maturity level 2, the standards, process descriptions, and procedures can be quite different in each specific instance of the process (i.e., used by a particular work group). At maturity level 3, the standards, process descriptions, and work procedures are tailored from the organization's set of standard processes to suit a particular work group or organizational unit and therefore are more consistent except for the differences allowed by the tailoring guidelines.

Another critical distinction is that at maturity level 3, processes are typically described more rigorously than at maturity level 2. A defined process clearly states the purpose, inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria. At maturity level 3, processes are managed more proactively using an understanding of the interrelationships of process activities and detailed measures of the process, its work products, and its services.

At maturity level 3, the organization further improves its processes that are related to the maturity level 2 process areas. Generic practices associated with generic goal 3 that were not addressed at maturity level 2 are applied to achieve maturity level 3.

Maturity Level 4: Quantitatively Managed

At maturity level 4, service providers establish quantitative objectives for quality and process performance and use them as criteria in managing processes. Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers. Quality and process performance is understood in statistical terms and is managed throughout the life of processes.

For selected subprocesses, specific measures of process performance are collected and statistically analyzed. When selecting subprocesses for analyses, it is critical to understand the relationships between different subprocesses and their impact on achieving the objectives for quality and process performance. Such an approach helps to ensure that subprocess monitoring using statistical and other quantitative techniques is applied to where it has the most overall value to the business. Process performance baselines and models can be used to help set quality and process performance objectives that help achieve business objectives.

A critical distinction between maturity levels 3 and 4 is the predictability of process performance. At maturity level 4, the performance of processes is controlled using statistical and other quantitative techniques and predictions are based, in part, on a statistical analysis of fine-grained process data.

Maturity Level 5: Optimizing

At maturity level 5, an organization continually improves its processes based on a quantitative understanding of its business objectives and performance needs. The organization uses a quantitative approach to understand the variation inherent in the process and the causes of process outcomes.

Maturity level 5 focuses on continually improving process performance through incremental and innovative process and technological improvements. The organization's quality and process performance objectives are established, continually revised to reflect changing business objectives and organizational performance, and used as criteria in managing process improvement. The effects of deployed process improvements are measured using statistical and other quantitative techniques and compared to quality and process performance objectives. The defined processes, the organization's set of standard processes, and supporting technology are targets of measurable improvement activities.

A critical distinction between maturity levels 4 and 5 is the focus on managing and improving organizational performance. At maturity level 4, the organization and work groups focus on understanding and controlling performance at the subprocess level and using the results to manage projects. At maturity level 5, the organization is concerned with overall organizational performance using data collected from multiple work groups. Analysis of the data identifies shortfalls or gaps in performance. These gaps are used to drive organizational process improvement that generates measureable improvement in performance.

Advancing Through Maturity Levels

Organizations can achieve progressive improvements in their maturity by achieving control first at the work group level and continuing to the most advanced level—organization-wide continuous process improvement—using both qualitative and quantitative data to make decisions.

Since improved organizational maturity is associated with improvement in the range of expected results that can be achieved by an organization,

maturity is one way of predicting general outcomes of the organization's next work. For instance, at maturity level 2, the organization has been elevated from ad hoc to disciplined by establishing sound service management. As the organization achieves generic and specific goals for the set of process areas in a maturity level, it increases its organizational maturity and reaps the benefits of process improvement. Because each maturity level forms a necessary foundation for the next level, trying to skip maturity levels is usually counterproductive.

At the same time, recognize that process improvement efforts should focus on the needs of the organization in the context of its business environment and that process areas at higher maturity levels can address the current needs of an organization or work group.

For example, organizations seeking to move from maturity level 1 to maturity level 2 are frequently encouraged to establish a process group, which is addressed by the Organizational Process Focus process area at maturity level 3. Although a process group is not a necessary characteristic of a maturity level 2 organization, it can be a useful part of the organization's approach to achieving maturity level 2.

This situation is sometimes characterized as establishing a maturity level 1 process group to bootstrap the maturity level 1 organization to maturity level 2. Maturity level 1 process improvement activities may depend primarily on the insight and competence of the process group until an infrastructure to support more disciplined and widespread improvement is in place.

Organizations can institute process improvements anytime they choose, even before they are prepared to advance to the maturity level at which the specific practice is recommended. In such situations, however, organizations should understand that the success of these improvements is at risk because the foundation for their successful institutionalization has not been completed. Processes without the proper foundation can fail at the point they are needed most—under stress.

A defined process that is characteristic of a maturity level 3 organization can be placed at great risk if maturity level 2 management practices are deficient. For example, management may commit to a poorly planned schedule or fail to control changes to baselined requirements. Similarly, many organizations prematurely collect the detailed data characteristic of maturity level 4 only to find the data uninterpretable because of inconsistencies in processes and measurement definitions.

Process Areas

Process areas are viewed differently in the two representations. Figure 3.2 compares views of how process areas are used in the continuous representation and the staged representation.

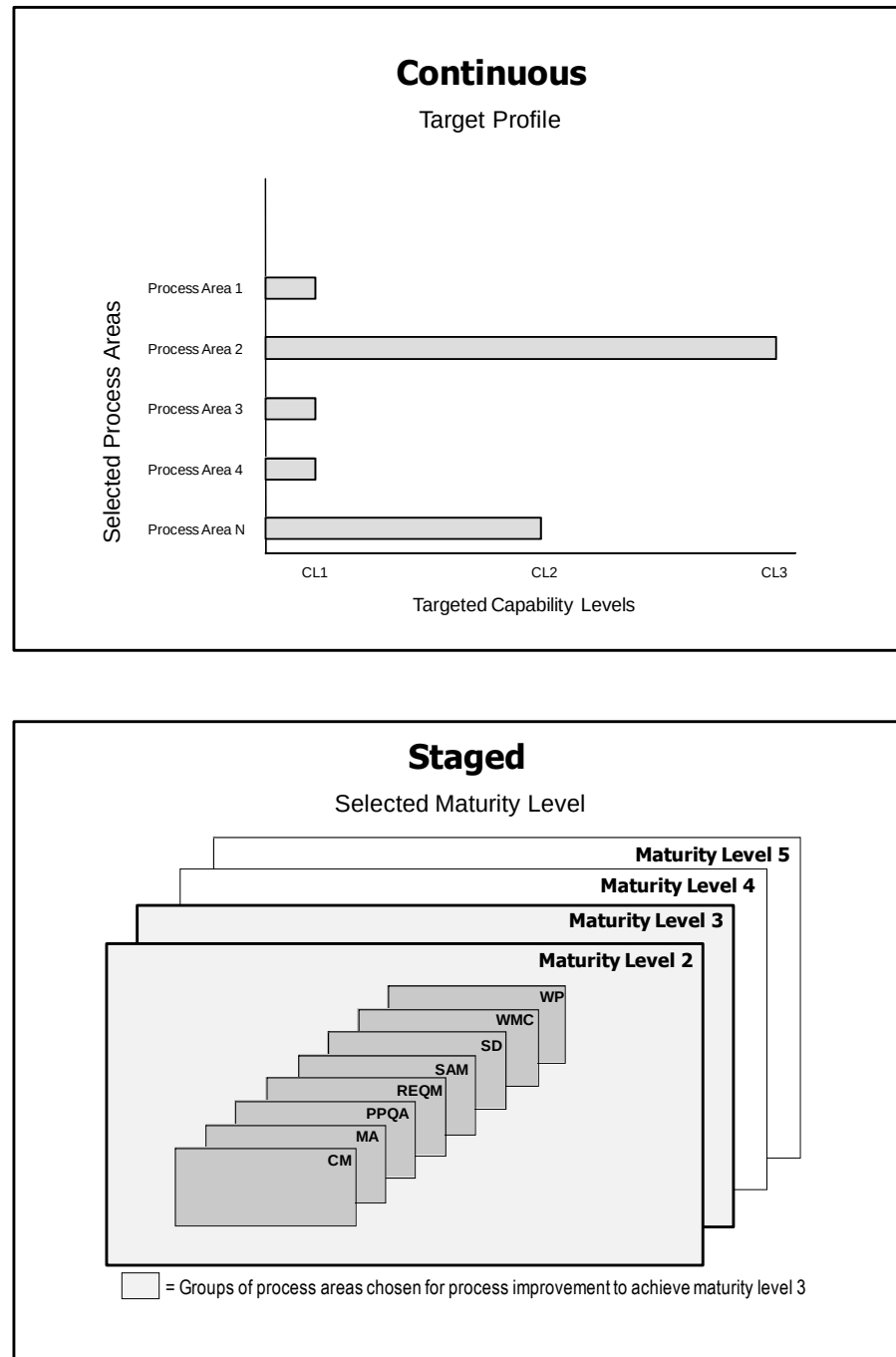


Figure 3.2: Process Areas in the Continuous and Staged Representations

The continuous representation enables the organization to choose the focus of its process improvement efforts by choosing those process areas, or sets of interrelated process areas, that best benefit the organization and its business objectives. Although there are some limits on what an organization can choose because of the dependencies among process areas, the organization has considerable freedom in its selection.

To support those who use the continuous representation, process areas are organized into four categories: Process Management, Project and Work Management, Service Establishment and Delivery, and Support. These categories emphasize some of the key relationships that exist among the process areas.

Sometimes an informal grouping of process areas is mentioned: high maturity process areas. The four high maturity process areas are: Organizational Process Performance, Quantitative Work Management, Organizational Performance Management, and Causal Analysis and Resolution. These process areas focus on improving the performance of implemented processes that most closely relate to the organization's business objectives.

Once you select process areas, you must also select how much you would like to mature processes associated with those process areas (i.e., select the appropriate capability level). Capability levels and generic goals and practices support the improvement of processes associated with individual process areas. For example, an organization may wish to reach capability level 2 in one process area and capability level 3 in another. As the organization reaches a capability level, it sets its sights on the next capability level for one of these same process areas or decides to widen its view and address a larger number of process areas. Once it reaches capability level 3 in most of the process areas, the organization can shift its attention to the high maturity process areas and can track the capability of each through capability level 3.

The selection of a combination of process areas and capability levels is typically described in a "target profile." A target profile defines all of the process areas to be addressed and the targeted capability level for each. This profile governs which goals and practices the organization will address in its process improvement efforts.

Most organizations, at minimum, target capability level 1 for the process areas they select, which requires that all of these process areas' specific goals be achieved. However, organizations that target capability levels higher than 1 concentrate on the institutionalization of selected processes in the organization by implementing generic goals and practices.

The staged representation provides a path of improvement from maturity level 1 to maturity level 5 that involves achieving the goals of the process areas at each maturity level. To support those who use the staged representation, process areas are grouped by maturity level, indicating which process areas to implement to achieve each maturity level.

For example, at maturity level 2, there is a set of process areas that an organization would use to guide its process improvement until it could achieve all the goals of all these process areas. Once maturity level 2 is achieved, the organization focuses its efforts on maturity level 3 process areas, and so on. The generic goals that apply to each process area are also predetermined. Generic goal 2 applies to maturity level 2 and generic goal 3 applies to maturity levels 3 through 5.

Table 3.2 provides a list of CMMI-SVC process areas and their associated categories and maturity levels.

Table 3.2 Process Areas, Categories, and Maturity Levels

Process Area	Category	Maturity Level
Capacity and Availability Management (CAM)	Project and Work Management	3
Causal Analysis and Resolution (CAR)	Support	5
Configuration Management (CM)	Support	2
Decision Analysis and Resolution (DAR)	Support	3
Incident Resolution and Prevention (IRP)	Service Establishment and Delivery	3
Integrated Work Management (IWM)	Project and Work Management	3
Measurement and Analysis (MA)	Support	2
Organizational Process Definition (OPD)	Process Management	3
Organizational Process Focus (OPF)	Process Management	3
Organizational Performance Management (OPM)	Process Management	5
Organizational Process Performance (OPP)	Process Management	4
Organizational Training (OT)	Process Management	3
Process and Product Quality Assurance (PPQA)	Support	2
Quantitative Work Management (QWM)	Project and Work Management	4

Requirements Management (REQM)	Project and Work Management	2
Risk Management (RSKM)	Project and Work Management	3
Supplier Agreement Management (SAM)	Project and Work Management	2
Service Continuity (SCON)	Project and Work Management	3
Service Delivery (SD)	Service Establishment and Delivery	2
Service System Development (SSD) ⁹	Service Establishment and Delivery	3
Service System Transition (SST)	Service Establishment and Delivery	3
Strategic Service Management (STSM)	Service Establishment and Delivery	3
Work Monitoring and Control (WMC)	Project and Work Management	2
Work Planning (WP)	Project and Work Management	2

Equivalent Staging

Equivalent staging is a way to compare results from using the continuous representation to from using the staged representation. In essence, if you measure improvement relative to selected process areas using capability levels in the continuous representation, how do you translate that work into maturity levels? Is this translation possible?

Up to this point, we have not discussed process appraisals in much detail. The SCAMPISM method¹⁰ is used to appraise organizations using CMMI, and one result of an appraisal is a rating [SEI 2011a, Ahern 2005]. If the continuous representation is used for an appraisal, the rating is a “capability level profile.” If the staged representation is used for an appraisal, the rating is a “maturity level rating” (e.g., maturity level 3).

A capability level profile is a list of process areas and the corresponding capability level achieved for each. This profile enables an organization to track its capability level by process area. The profile is called an

⁹ The SSD process area is an “addition.”

¹⁰ The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) method is described in Chapter 5.

“achievement profile” when it represents the organization’s actual progress for each process area. Alternatively, the profile is called a “target profile” when it represents the organization’s planned process improvement objectives.

Figure 3.3 illustrates a combined target and achievement profile. The gray portion of each bar represents what has been achieved. The unshaded portion represents what remains to be accomplished to meet the target profile.

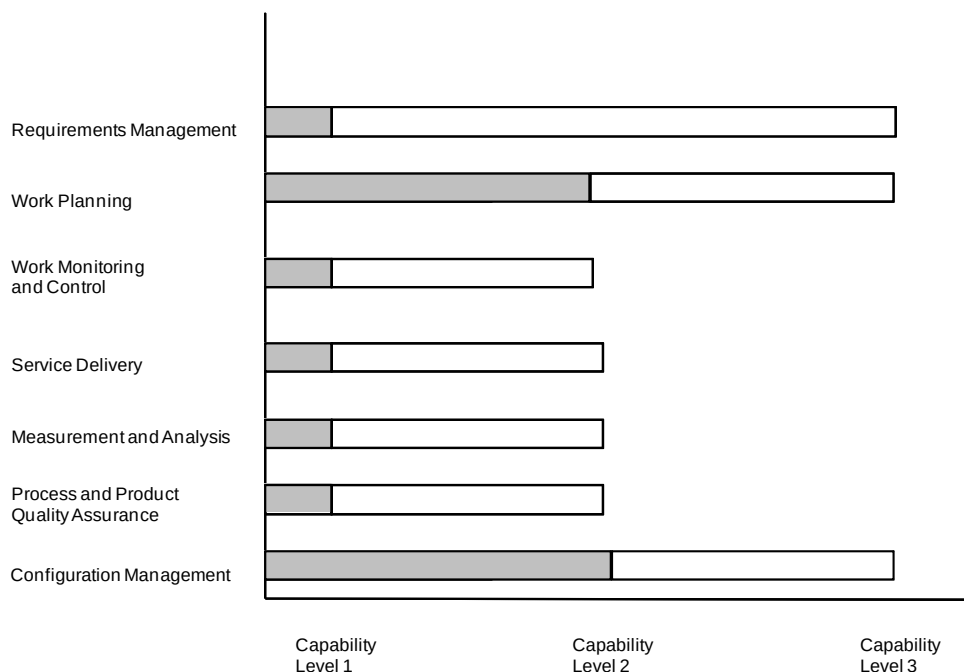


Figure 3.3: Example Combined Target and Achievement Profile

An achievement profile, when compared with a target profile, enables an organization to plan and track its progress for each selected process area. Maintaining capability level profiles is advisable when using the continuous representation.

Target staging is a sequence of target profiles that describes the path of process improvement to be followed by the organization. When building target profiles, the organization should pay attention to the dependencies between generic practices and process areas. If a generic practice depends on a process area, either to carry out the generic practice or to provide a prerequisite work product, the generic practice can be much less effective when the process area is not implemented.¹¹

Although the reasons to use the continuous representation are many, ratings consisting of capability level profiles are limited in their ability to

¹¹ See Table 6.2 in the *Generic Goals and Generic Practices* section of Part Two for more information about the dependencies between generic practices and process areas.

provide organizations with a way to generally compare themselves with other organizations. Capability level profiles can be used if each organization selects the same process areas; however, maturity levels have been used to compare organizations for years and already provide predefined sets of process areas.

Because of this situation, equivalent staging was created. Equivalent staging enables an organization using the continuous representation to convert a capability level profile to the associated maturity level rating.

The most effective way to depict equivalent staging is to provide a sequence of target profiles, each of which is equivalent to a maturity level rating of the staged representation reflected in the process areas listed in the target profile. The result is a target staging that is equivalent to the maturity levels of the staged representation.

Figure 3.4 shows a summary of the target profiles that must be achieved when using the continuous representation to be equivalent to maturity levels 2 through 5. Each shaded area in the capability level columns represents a target profile that is equivalent to a maturity level.

Name	Abbr.	ML	CL1	CL2	CL3
Configuration Management	CM	2	Target Profile 2		
Measurement and Analysis	MA	2			
Process and Product Quality Assurance	PPQA	2			
Requirements Management	REQM	2			
Supplier Agreement Management	SAM	2			
Service Delivery	SD	2			
Work Monitoring and Control	WMC	2			
Work Planning	WP	2			
Capacity and Availability Management	CAM	3	Target Profile 3		
Decision Analysis and Resolution	DAR	3			
Incident Resolution and Prevention	IRP	3			
Integrated Work Management	IWM	3			
Organizational Process Definition	OPD	3			
Organizational Process Focus	OPF	3			
Organizational Training	OT	3			
Risk Management	RSKM	3			
Service Continuity	SCON	3			
Service System Development ¹²	SSD	3			
Service System Transition	SST	3			
Strategic Service Management	STSM	3			
Organizational Process Performance	OPP	4	Target Profile 4		
Quantitative Work Management	QWM	4			
Causal Analysis and Resolution	CAR	5	Target Profile 5		
Organizational Performance Management	OPM	5			

Figure 3.4: Target Profiles and Equivalent Staging

The following rules summarize equivalent staging:

- To achieve maturity level 2, all process areas assigned to maturity level 2 must achieve capability level 2 or 3.
- To achieve maturity level 3, all process areas assigned to maturity levels 2 and 3 must achieve capability level 3.
- To achieve maturity level 4, all process areas assigned to maturity levels 2, 3, and 4 must achieve capability level 3.
- To achieve maturity level 5, all process areas must achieve capability level 3.

¹² This process area is an "SSD addition."

Achieving High Maturity

When using the staged representation, you attain high maturity when you achieve maturity level 4 or 5. Achieving maturity level 4 involves implementing all process areas for maturity levels 2, 3, and 4. Likewise, achieving maturity level 5 involves implementing all process areas for maturity levels 2, 3, 4, and 5.

When using the continuous representation, you attain high maturity using the equivalent staging concept. High maturity that is equivalent to staged maturity level 4 using equivalent staging, is attained when you achieve capability level 3 for all process areas except for Organizational Performance Management (OPM) and Causal Analysis and Resolution (CAR). High maturity that is equivalent to staged maturity level 5 using equivalent staging, is attained when you achieve capability level 3 for all process areas.

Understanding Key Concepts in the Use of CMMI for Services

The concepts and terms explained so far, such as *process areas*, *capability levels*, and *equivalent staging*, are common to all CMMI models. However, there are some additional terms that are particularly significant in the CMMI for Services model. Although all are defined in the glossary, they each employ words that can cover a range of possible meanings to users from different backgrounds, and so they merit some additional discussion to ensure that model material that includes these concepts is not misinterpreted.

Service

The most important of these terms is probably the word “service” itself, which the glossary defines as a product that is intangible and non-storable. While this definition accurately captures the intended scope of meaning for the word “service,” it does not highlight some of the possible subtleties or misunderstandings of this concept in the CMMI context.

The first point to highlight is that a service is a kind of *product*, given this definition. Many people routinely think of products and services as two mutually exclusive categories. In CMMI models, however, products and services are not disjoint categories: a *service* is considered to be a special variety of *product*. Any reference to *products* can be assumed to refer to *services* as well. If you find a need to refer to a category of products that are not services in a CMMI context, you may find it helpful to use the term “goods,” as in the commonly used and understood phrase “goods and services.” (For historical reasons, portions of CMMI models still use the phrase “products and services” on occasion. However, this use is always intended to explicitly remind the reader that services are *included* in the discussion.)

A second possible point of confusion is between *services* and *processes*, especially because both terms refer to entities that are by nature intangible

and non-storable, and because both concepts are intrinsically linked. However, in CMMI models, processes are *activities*, while services are a useful *result* of performing those activities. For example, an organization that provides training services performs training processes (activities) that are intended to leave the recipients of the training in a more knowledgeable state. This useful state of affairs (i.e., being more knowledgeable) is the *service* that the training provider delivers or attempts to deliver. If the training processes are performed but the recipients fail to become more knowledgeable (perhaps because the training is poorly designed, or the recipients don't have some necessary preliminary knowledge), then the service—the useful result—has not actually been delivered. Services are the results of processes (performed as part of a collection of resources), not the processes themselves.

A final possible point of confusion over the meaning of the word “service” will be apparent to those who have a background in information technology, especially those who are familiar with disciplines like service-oriented architecture (SOA) or software as a service (SaaS). In a software context, services are typically thought of as methods, components, or building blocks of a larger automated system, rather than as the results produced by that system. In CMMI models, services are useful intangible and non-storable results delivered through the operation of a service system, which may or may not have any automated components. To completely resolve this possible confusion, an understanding of the *service system* concept is necessary.

Service System

A *service* is delivered through the operation of a *service system*, which the glossary defines as an integrated and interdependent combination of component resources that satisfies service requirements. The use of the word “system” in “service system” can suggest to some that service systems are a variety of information technology, and that they must have hardware, software, and other conventional IT components. This interpretation is too restrictive. While it is possible for some components of a service system to be implemented with information technology, it is also possible to have a service system that uses little or no information technology at all.

In this context, the word “system” should be interpreted in the broader sense of “a regularly interacting or interdependent group of items forming a unified whole,” a typical dictionary definition. Also, systems created by people usually have an intended unifying purpose, as well as a capability to operate or behave in intended ways. Consider a package delivery system, a health care system, or an education system as examples of service systems with a wide variety of integrated and interdependent component resources.

Some users may still have trouble with this interpretation because they may think that the way they deliver services is not systematic, does not involve identifiable “components,” or is too small or difficult to view through the lens of a systems perspective. While this difficulty can in some cases be true for

service provider organizations with relatively immature practices, part of the difficulty can also be traced to an overly narrow interpretation of the word “resources” in the definition of service system.

The full extent of a service system encompasses *everything* required for service delivery, including work products, processes, tools, facilities, consumable items, and human resources. Some of these resources can belong to customers or suppliers, and some can be transient (in the sense that they are only part of the service system for a limited time). But all of these resources become part of a service system if they are needed in some way to enable service delivery.

Because of this broad range of included resource types and the relationships among them, a service system can be something large and complex, with extensive facilities and tangible components (e.g., a service system for health care, a service system for transportation). Alternatively, a service system could be something consisting primarily of people and processes (e.g., for an independent verification and validation service). Since every service provider organization using the CMMI-SVC model must have at a minimum both people and process resources, they should be able to apply the service system concept successfully.

Service providers who are not used to thinking of their methods, tools, and staff for service delivery from a broad systems perspective can need to expend some effort to reframe their concept of service delivery to accommodate this perspective. The benefits of doing so are great, however, because critical and otherwise unnoticed resources and dependencies between resources will become visible for the first time. This insight will enable the service provider organization to effectively improve its operations over time without being caught by surprises or wasting resources on incompletely addressing a problem.

Service Agreement

A *service agreement* is the foundation of the joint understanding between a service provider and customer of what to expect from their mutual relationship. The glossary defines a “service agreement” as a binding, written record of a promised exchange of value between a service provider and a customer. Service agreements can appear in a wide variety of forms, ranging from simple posted menus of services and their prices, to tickets or signs with fine print that refer to terms and conditions described elsewhere, to complex multi-part documents that are included as part of legal contracts. Whatever they may contain, it is essential that service agreements be recorded in a form that both the service provider and customer can access and understand so that misunderstandings are minimized.

The “promised exchange of value” implies that each party to the agreement commits to providing the other party or parties with something they need or want. A common situation is for the service provider to deliver needed services and for the customer to pay money in return, but many other types of arrangements are possible. For example, an operating level agreement (OLA) between organizations in the same enterprise may only require the

customer organization to notify the service provider organization when certain services are needed. Service agreements for public services provided by governments, municipal agencies, and non-profit organizations can simply document what services are available, and identify what steps end users must follow to get those services. In some cases, the only thing the service provider needs or wants from the customer or end user is specific information required to enable service delivery.

See the definition of “service agreement,” “service level agreement,” “customer,” and “end user” in the glossary.

Service Request

Even given a service agreement, customers and end users must be able to notify the service provider of their needs for specific instances of service delivery. In the CMMI-SVC model, these notifications are called “service requests,” and they can be communicated in every conceivable way, including face-to-face encounters, phone calls, all varieties of written media, and even non-verbal signals (e.g., pressing a button to call a bus to a bus stop).

Regardless of how it is communicated, a service request identifies one or more desired services that the request originator expects to fall within the scope of an existing service agreement. These requests are often generated over time by customers and end users as their needs develop. In this sense, service requests are *expected* intentional actions that are an essential part of service delivery; they are the primary triggering events that cause service delivery to occur. (Of course, it is possible for the originator of a request to be mistaken about whether or not the request is actually within the scope of the service agreement.)

Sometimes specific service requests can be incorporated directly into service agreements themselves. This incorporation of service requests in the service agreement is often the case for services that are to be performed repeatedly or continuously over time (e.g., a cleaning service with a specific expected cleaning schedule, a network management service that must provide 99.9% network availability for the life of the service agreement.) Even in these situations, ad-hoc service requests can also be generated when needed and the service provider should be prepared to deliver services in response to both types of requests.

Service Incident

Even with the best planning, monitoring, and delivery of services, unintended events can occur that are unwanted. Some instances of service delivery can have lower than expected or lower than acceptable degrees of performance or quality, or can be completely unsuccessful. The CMMI-SVC model refers to these difficulties as “service incidents.” The glossary defines a “service incident” as an indication of an actual or potential interference with a service. The single word “incident” is used in place of “service incident” when the context makes the meaning clear.

Like requests, incidents require some recognition and response by the service provider; but unlike requests, incidents are *unintended* events, although some types of incidents can be anticipated. Whether or not they are anticipated, incidents must be resolved in some way by the service provider. In some service types and service provider organizations, service requests and incidents are both managed and resolved through common processes, staff, and tools. The CMMI-SVC model is compatible with this kind of approach, but does not require it, as it is not appropriate for all types of services.

The use of the word “potential” in the definition of service incident is deliberate and significant; it means that incidents do not always involve actual interference with or failure of service delivery. Indications that a service *may* have been insufficient or unsuccessful are also incidents, as are indications that it may be insufficient or unsuccessful in the future. (Customer complaints are an almost universal example of this type of incident because they are always indications that service delivery may have been inadequate.) This aspect of incidents is often overlooked, but it is important: failure to address and resolve potential interference with services is likely to lead eventually to actual interference, and possibly to a failure to satisfy service agreements.

Project, Work Group, and Work

CMMI models must often refer to the organizational entities that are at the foundation of process improvement efforts. These entities are focal points in the organization for creating value, managing work, tailoring processes, and conducting appraisals. In CMMI-SVC, these entities are called “work groups,” while in CMMI-DEV and CMMI-ACQ these entities are called “projects.” The glossary defines both terms and their relationship to each other, but it does not explain why two different terms are needed.

Those who have prior experience using CMMI-DEV or CMMI-ACQ models, or who routinely think of their work as part of a project-style work arrangement, may wonder why the term “project” is not sufficient by itself. The CMMI glossary defines a “project” as a managed set of interrelated activities and resources, including people, that delivers one or more products or services to a customer or end user. The definition notes explain that a project has an intended beginning (i.e., project startup) and end, and that it typically operates according to a plan. These notes are characteristics of a project according to many definitions, so why is there an issue? Why might there be a difficulty with applying terms like “project planning” or “project management” in some service provider organizations?

One simple reason is that projects have an intended end as well as an intended beginning; such efforts are focused on accomplishing an objective by a certain time. While some services follow this same pattern, many are delivered over time without an expected end (e.g., typical municipal services, services from businesses that intend to offer them indefinitely). Service providers in these contexts are naturally reluctant to describe their service delivery work as a project under this definition.

In prior (V1.2) CMMI models, the definition of “project” was deliberately changed to eliminate this limitation (i.e., that projects have a definite or intended end), in part to allow the term to be applied easily to the full range of service types. However, the change raised more questions and objections than it resolved when interpreted by many users (even in some service contexts), and so the limited meaning has been restored in V1.3: projects now must have an intended end.

For organizations that do not structure their people and other resources into projects with intended ends, or that only do so for a portion of their work, the original problem remains. All of the common CMMI practices are useful whether or not your work is planned to have an intended end, but what can we call a fundamental organizational entity that implements CMMI practices if it is not a project? How can we refer to and apply the practices of process areas such as project planning when we are not discussing a project?

The CMMI V1.3 solution is to introduce some new terms that take advantage of two distinct senses of meaning for the English word “project”: as a collection of resources (including people), and as a collection of activities performed by people. CMMI-DEV and CMMI-ACQ continue to use the term “project” for both senses, because this use reflects the typical nature of development and acquisition efforts. CMMI-SVC replaces “project” with “work group” (when it refers strictly to a collection of resources including people) or with “work” (when it refers to a collection of activities, or a collection of activities *and* associated resources). The glossary defines a “work group” as a managed set of people and other resources that delivers one or more products or services to a customer or end user. The definition is silent on the expected lifetime of a work group. Therefore, a project (in the first sense) can be considered a type of work group, one whose work is planned to have an intended end.

Service provider organizations can therefore structure themselves into work groups (without time limits) or projects (with time limits) depending on the nature of the work, and many organizations will do both in different contexts. For example, development of a service system can be performed by a project, whereas service delivery can be performed by a work group.

The glossary also notes that a work group can contain work groups, can span organizational boundaries, and can appear at any level of an organization. It is possible for a work group to be defined by nothing more than members of an organization with a particular common purpose (e.g., all those who perform a particular task), whether or not that group is represented somewhere on an organization chart.

In the end, of course, organizations will use whatever terminology is comfortable, familiar, and useful to them, and the CMMI-SVC model does not require this approach to change. However, all CMMI models need a convenient way to refer clearly to the fundamental groupings of resources that organize work to achieve significant objectives. In contrast to other CMMI models, the CMMI-SVC model uses the term “work group” rather than “project” for this limited purpose, and uses the term “work” for other senses of the word “project” including combined senses. For example, a

“project plan” is called a “work plan” in CMMI-SVC. (In a few cases, the word “project” is retained in the CMMI-SVC model when it explicitly refers to a true project.)

Consistent with this usage, the titles of some important core process areas are different in CMMI-SVC compared to CMMI-DEV and CMMI-ACQ: Work Planning, Work Monitoring and Control, Integrated Work Management, and Quantitative Work Management (cf. Project Planning, Project Monitoring and Control, Integrated Project Management, and Quantitative Project Management). Despite these differences in terminology in different constellations, Integrated Work Management and Integrated Project Management cover essentially the same material and are considered to be the same core process area in all three CMMI constellations; the same is true for other equivalent process area pairings.

4 Relationships Among Process Areas

In this chapter we describe the key relationships among process areas to help you see the service provider's view of process improvement and how process areas depend on the implementation of other process areas.

The relationships among multiple process areas, including the information and artifacts that flow from one process area to another—illustrated by the figures and descriptions in this chapter—help you to see a larger view of process implementation and improvement.

Successful process improvement initiatives must be driven by the business objectives of the organization. For example, a common business objective is to reduce the time it takes to deliver a service. The process improvement objective derived from that might be to improve incident management processes. Those improvements rely on best practices in the Service Delivery and Incident Resolution and Prevention process areas.

Although we group process areas in this chapter to simplify the discussion of their relationships, process areas often interact and have an effect on one another regardless of their group, category, or level. For example, the Decision Analysis and Resolution process area (a Support process area at maturity level 3) contains specific practices that address the formal evaluation process used in the Service Continuity process area (a Service Establishment and Delivery process area at maturity level 3) to select functions that are essential to the organization and must be covered in the service continuity plan.

Being aware of the key relationships that exist among CMMI process areas will help you apply CMMI in a useful and productive way. Relationships among process areas are described in more detail in the references of each process area and specifically in the Related Process Areas section of each process area in Part Two. Refer to Chapter 2 for more information about references.

The process areas of the CMMI-SVC model have numerous interrelationships that are based on a transfer or sharing of information, work products, and other resources by their associated practices. This section focuses on identifying only the relationships encompassing the service-specific process areas. These relationships are best understood by functionally associating them into two distinct groups that span both maturity levels and process area categories:

- Establishing and delivering services
- Managing services

Process area relationships are illustrated in flow diagrams that focus on key dependencies for the sake of clarity. Not all possible interactions between process areas are shown and not all process areas are shown. The process areas that have been omitted from these diagrams (primarily the Process Management and Support process areas) have potential relationships with all of the process areas that are shown, and their inclusion would make it difficult to focus on the key CMMI-SVC relationships.

Relationships that Drive Service Establishment and Delivery

Figure 4.1 shows process areas associated with the establishment of service delivery capabilities as driven by requirements from service agreements with customers, as well as with service delivery.

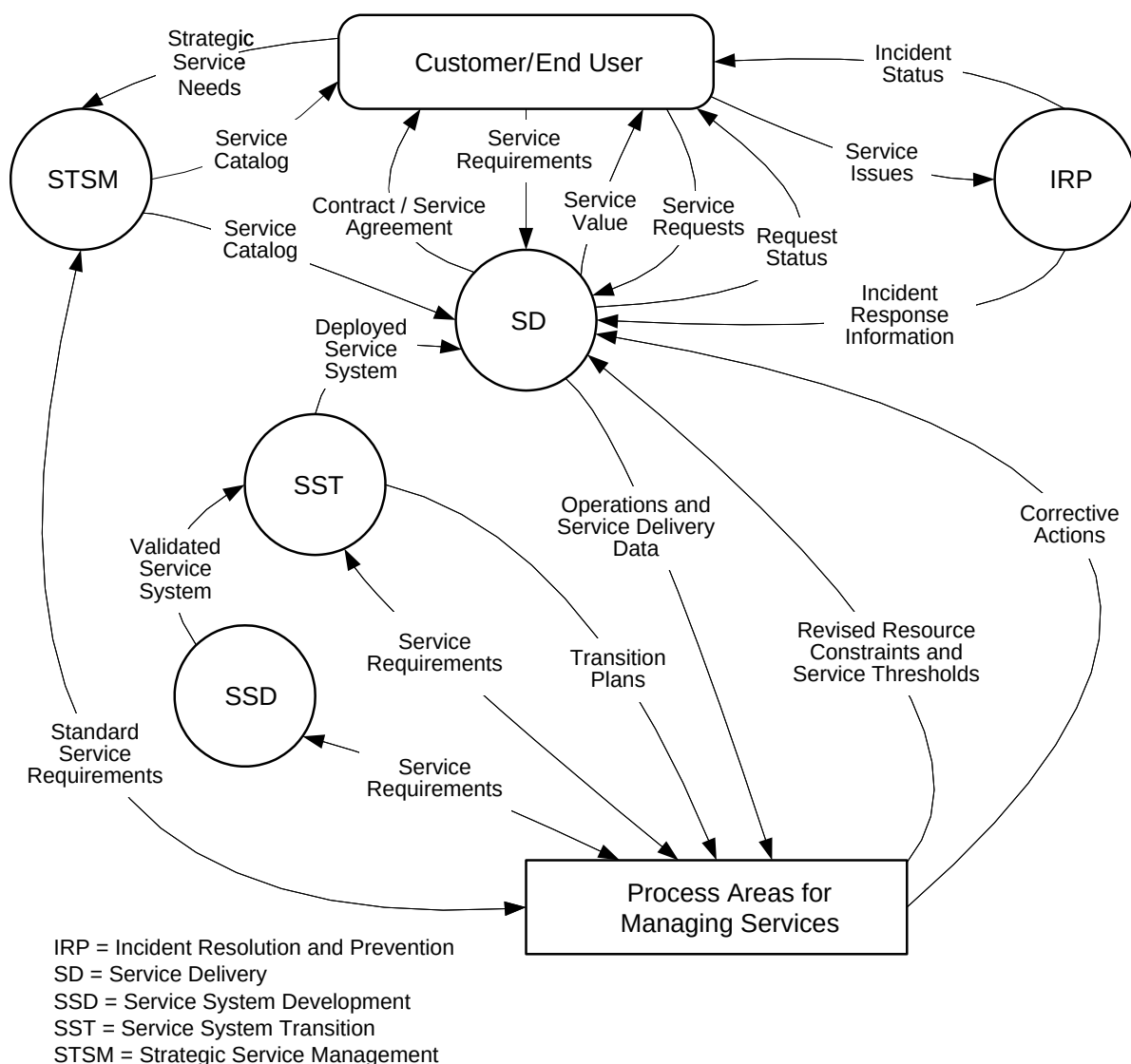


Figure 4.1: Key Process Area Relationships for Establishing and Delivering Services

All of the process areas shown in this diagram are in the Service Establishment and Delivery process area category. Note that the Service Delivery process area occupies a central role in these relationships.

Relationships that Drive Service Management

Figure 4.2 shows process areas associated with the management of services at the work group level. Most of the process areas shown in this diagram are in the Project and Work Management process area category, with the exception of Service Delivery. The reason that this diagram refers to “service management” rather than “work management” is that the Service Delivery process area contributes both to Project and Work Management as well as to Service Establishment and Delivery, but can only be part of a

single process area category in a CMMI model. The name “service management” better expresses the overall scope of the figure rather than the name of a single process area category.

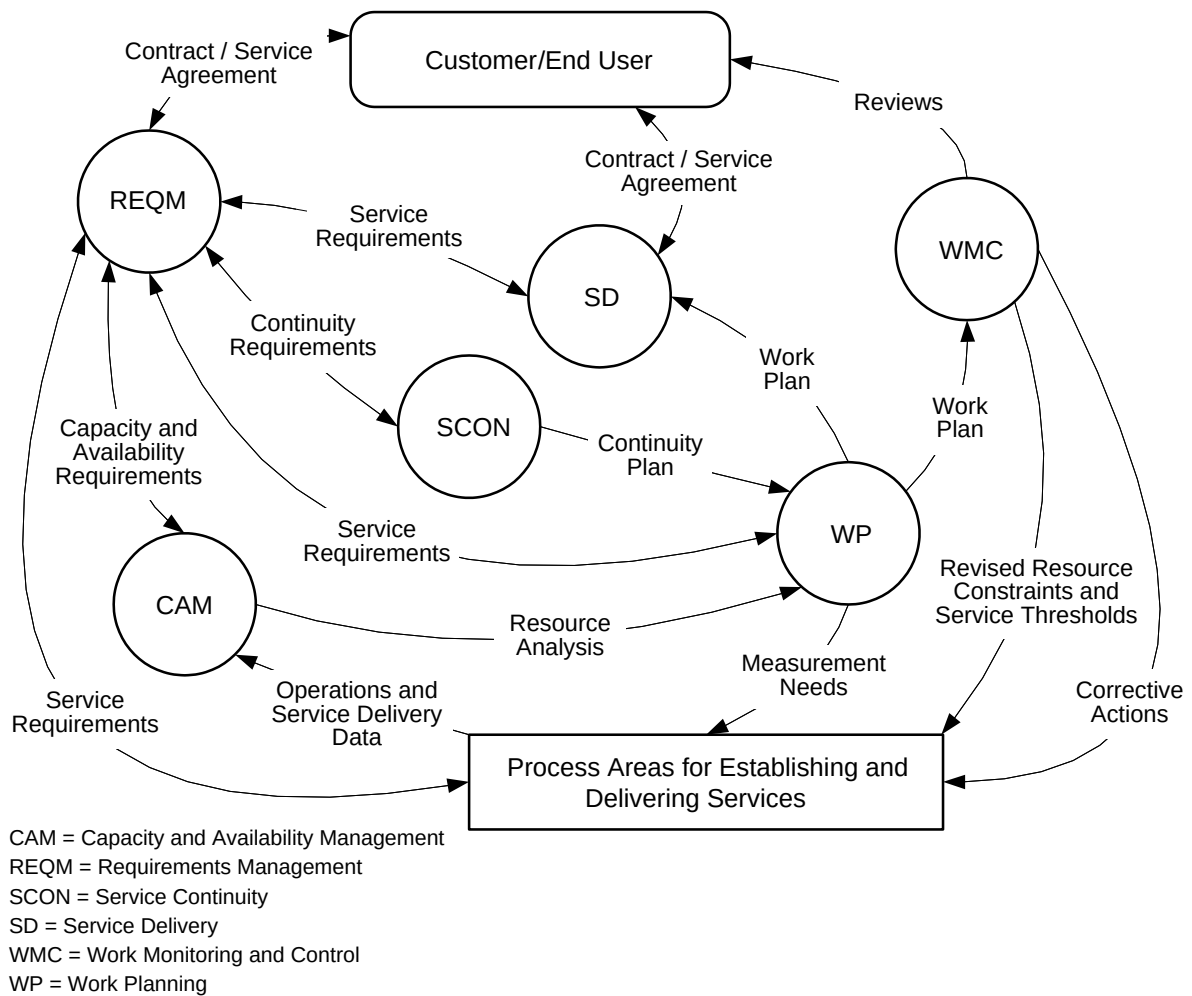


Figure 4.2: Key Process Area Relationships for Service Management

5 Using CMMI Models

The complexity of services today demands an integrated view of how organizations do business. CMMI can reduce the cost of process improvement across enterprises that depend on multiple functions or groups to achieve their objectives.

To achieve this integrated view, the CMMI Framework includes common terminology, common model components, common appraisal methods, and common training materials. This chapter describes how organizations can use the CMMI Product Suite not only to improve their quality, reduce their costs, and optimize their schedules, but also to gauge how well their process improvement program is working.

Adopting CMMI

Research has shown that the most powerful initial step to process improvement is to build organizational support through strong senior management sponsorship. To gain the sponsorship of senior management, it is often beneficial to expose them to the performance results experienced by others who have used CMMI to improve their processes [Gibson 2006].

For more information about CMMI performance results, see the SEI website at <http://www.sei.cmu.edu/cmmi/research/results/>.

The senior manager, once committed as the process improvement sponsor, must be actively involved in the CMMI-based process improvement effort. Activities performed by the senior management sponsor include but are not limited to the following:

- Influence the organization to adopt CMMI
- Choose the best people to manage the process improvement effort
- Monitor the process improvement effort personally
- Be a visible advocate and spokesperson for the process improvement effort
- Ensure that adequate resources are available to enable the process improvement effort to be successful

Given sufficient senior management sponsorship, the next step is establishing a strong, technically competent process group that represents relevant stakeholders to guide process improvement efforts [Ahern 2008].

For an organization with a mission to deliver quality services, the process group might include those who represent different disciplines across the organization and other selected members based on the business needs

driving improvement. For example, a systems administrator may focus on information technology support, whereas a marketing representative may focus on integrating customers' needs. Both members could make powerful contributions to the process group.

Once your organization decides to adopt CMMI, planning can begin with an improvement approach such as the IDEALSM (Initiating, Diagnosing, Establishing, Acting, and Learning) model [McFeeley 1996]. For more information about the IDEAL model, see the SEI website at <http://www.sei.cmu.edu/library/abstracts/reports/96hb001.cfm>.

Your Process Improvement Program

Use the CMMI Product Suite to help establish your organization's process improvement program. Using the product suite for this purpose can be a relatively informal process that involves understanding and applying CMMI best practices to your organization. Or, it can be a formal process that involves extensive training, creation of a process improvement infrastructure, appraisals, and more.

Selections that Influence Your Program

You must make three selections to apply CMMI to your organization for process improvement:

1. Select a part of the organization.
2. Select a model.
3. Select a representation.

Selecting the work groups to be involved in your process improvement program is critical. If you select a group that is too large, it may be too much for the initial improvement effort. The selection should also consider organizational, product, and work homogeneity (i.e., whether the group's members all are experts in the same discipline, whether they all work on the same product or business line, and so on).

Selecting an appropriate model is also essential to a successful process improvement program. The CMMI-DEV model focuses on activities for developing quality products and services. The CMMI-ACQ model focuses on activities for initiating and managing the acquisition of products and services. The CMMI-SVC model focuses on activities for providing quality services to the customer and end users. When selecting a model, appropriate consideration should be given to the primary focus of the organization, projects, or work groups as well as to the processes necessary to satisfy business objectives. The lifecycle processes (e.g., conception, design, manufacture, deployment, operations, maintenance, disposal) on which an organization concentrates should also be considered when selecting an appropriate model.

Select the representation (capability or maturity levels) that fits your concept of process improvement. Regardless of which you choose, you can select nearly any process area or group of process areas to guide improvement, although dependencies among process areas should be considered when making such a selection.

As process improvement plans and activities progress, other important selections must be made, including whether to use an appraisal, which appraisal method should be used, which work groups should be appraised, how training for staff should be secured, and which staff members should be trained.

CMMI Models

CMMI models describe best practices that organizations have found to be productive and useful to achieving their business objectives. Regardless of your organization, you must use professional judgment when interpreting CMMI best practices for your situation, needs, and business objectives.

This use of judgment is reinforced when you see words such as “adequate,” “appropriate,” or “as needed” in a goal or practice. These words are used for activities that may not be equally relevant in all situations. Interpret these goals and practices in ways that work for your organization.

Although process areas depict the characteristics of an organization committed to process improvement, you must interpret the process areas using an in-depth knowledge of CMMI, your organization, the business environment, and the specific circumstances involved.

As you begin using a CMMI model to improve your organization's processes, map your real world processes to CMMI process areas. This mapping enables you to initially judge and later track your organization's level of conformance to the CMMI model you are using and to identify opportunities for improvement.

To interpret practices, it is important to consider the overall context in which these practices are used and to determine how well the practices satisfy the goals of a process area in that context. CMMI models do not prescribe nor imply processes that are right for any organization or work group. Instead, CMMI describes minimal criteria necessary to plan and implement processes selected by the organization for improvement based on business objectives.

CMMI practices purposely use nonspecific phrases such as “relevant stakeholders,” “as appropriate,” and “as necessary” to accommodate the needs of different organizations and work groups. The specific needs of a work group can also differ at various points in the work lifecycle.

Using CMMI Appraisals

Many organizations find value in measuring their progress by conducting an appraisal and earning a maturity level rating or a capability level achievement profile. These types of appraisals are typically conducted for one or more of the following reasons:

- To determine how well the organization's processes compare to CMMI best practices and identify areas where improvement can be made
- To inform external customers and suppliers about how well the organization's processes compare to CMMI best practices
- To meet the contractual requirements of one or more customers

Appraisals of organizations using a CMMI model must conform to the requirements defined in the *Appraisal Requirements for CMMI* (ARC) [SEI 2011b] document. Appraisals focus on identifying improvement opportunities and comparing the organization's processes to CMMI best practices.

Appraisal teams use a CMMI model and ARC-conformant appraisal method to guide their evaluation of the organization and their reporting of conclusions. The appraisal results are used (e.g., by a process group) to plan improvements for the organization.

Appraisal Requirements for CMMI

The *Appraisal Requirements for CMMI* (ARC) document describes the requirements for several types of appraisals. A full benchmarking appraisal is defined as a *Class A* appraisal method. Less formal methods are defined as *Class B* or *Class C* methods. The ARC document was designed to help improve consistency across appraisal methods and to help appraisal method developers, sponsors, and users understand the tradeoffs associated with various methods.

Depending on the purpose of the appraisal and the nature of the circumstances, one class may be preferred over the others. Sometimes self assessments, initial appraisals, quick-look or mini appraisals, or external appraisals are appropriate; at other times a formal benchmarking appraisal is appropriate.

A particular appraisal method is declared an ARC Class A, B, or C appraisal method based on the sets of ARC requirements that the method developer addressed when designing the method.

More information about the ARC is available on the SEI website at <http://www.sei.cmu.edu/cmmi/tools/appraisals/>.

SCAMPI Appraisal Methods

The SCAMPI A appraisal method is the generally accepted method used for conducting ARC Class A appraisals using CMMI models. The *SCAMPI A*

Method Definition Document (MDD) defines rules for ensuring the consistency of SCAMPI A appraisal ratings [SEI 2011a]. For benchmarking against other organizations, appraisals must ensure consistent ratings. The achievement of a specific maturity level or the satisfaction of a process area must mean the same thing for different appraised organizations.

The SCAMPI family of appraisals includes Class A, B, and C appraisal methods. The SCAMPI A appraisal method is the officially recognized and most rigorous method. It is the only method that can result in benchmark quality ratings. SCAMPI B and C appraisal methods provide organizations with improvement information that is less formal than the results of a SCAMPI A appraisal, but nonetheless helps the organization to identify improvement opportunities.

More information about SCAMPI methods is available on the SEI website at <http://www.sei.cmu.edu/cmmi/tools/appraisals/>.

Appraisal Considerations

Choices that affect a CMMI-based appraisal include the following:

- CMMI model
- Appraisal scope, including the organizational unit to be appraised, the CMMI process areas to be investigated, and the maturity level or capability levels to be appraised
- Appraisal method
- Appraisal team leader and team members
- Appraisal participants selected from the appraisal entities to be interviewed
- Appraisal outputs (e.g., ratings, instantiation-specific findings)
- Appraisal constraints (e.g., time spent on site)

The SCAMPI MDD allows the selection of predefined options for use in an appraisal. These appraisal options are designed to help organizations align CMMI with their business needs and objectives.

CMMI appraisal plans and results should always include a description of the appraisal options, model scope, and organizational scope selected. This documentation confirms whether an appraisal meets the requirements for benchmarking.

For organizations that wish to appraise multiple functions or groups, the integrated approach of CMMI enables some economy of scale in model and appraisal training. One appraisal method can provide separate or combined results for multiple functions.

The following appraisal principles for CMMI are the same as those principles used in appraisals for other process improvement models:

- Senior management sponsorship¹³
- A focus on the organization's business objectives
- Confidentiality for interviewees
- Use of a documented appraisal method
- Use of a process reference model (e.g., a CMMI model)
- A collaborative team approach
- A focus on actions for process improvement

CMMI Related Training

Whether your organization is new to process improvement or is already familiar with process improvement models, training is a key element in the ability of organizations to adopt CMMI. An initial set of courses is provided by the SEI and its Partner Network, but your organization may wish to supplement these courses with its own instruction. This approach allows your organization to focus on areas that provide the greatest business value.

The SEI and its Partner Network offer the introductory course, *Introduction to CMMI for Services*. The SEI also offers advanced training to those who plan to become more deeply involved in CMMI adoption or appraisal—for example, those who will guide improvement as part of a process group, those who will lead SCAMPI appraisals, and those who will teach the *Introduction to CMMI for Services* course.

Current information about CMMI related training is available on the SEI website at <http://www.sei.cmu.edu/training/>.

¹³ Experience has shown that the most critical factor influencing successful process improvement and appraisals is senior management sponsorship.

Part Two:

**Generic Goals and Generic Practices,
and the Process Areas**

GENERIC GOALS AND GENERIC PRACTICES

Overview

This section describes in detail all the generic goals and generic practices of CMMI—model components that directly address process institutionalization. As you address each process area, refer to this section for the details of all generic practices.

Generic practice elaborations appear after generic practices to provide guidance on how the generic practice can be applied uniquely to process areas.

Process Institutionalization

Institutionalization is an important concept in process improvement. When mentioned in the generic goal and generic practice descriptions, institutionalization implies that the process is ingrained in the way the work is performed and there is commitment and consistency to performing (i.e., executing) the process.

An institutionalized process is more likely to be retained during times of stress. When the requirements and objectives for the process change, however, the implementation of the process may also need to change to ensure that it remains effective. The generic practices describe activities that address these aspects of institutionalization.

The degree of institutionalization is embodied in the generic goals and expressed in the names of the processes associated with each goal as indicated in Table 6.1.

Table 6.1 Generic Goals and Process Names

<i>Generic Goal</i>	<i>Progression of Processes</i>
GG 1	Performed process
GG 2	Managed process
GG 3	Defined process

The progression of process institutionalization is characterized in the following descriptions of each process.

Performed Process

A *performed* process is a process that accomplishes the work necessary to satisfy the specific goals of a process area.

Managed Process

A *managed process* is a *performed process* that is planned and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.

The process can be instantiated by a work group, or organizational function. Management of the process is concerned with institutionalization and the achievement of other specific objectives established for the process, such as cost, schedule, and quality objectives. The control provided by a managed process helps to ensure that the established process is retained during times of stress.

The requirements and objectives for the process are established by the organization. The status of the work products and services are visible to management at defined points (e.g., at major milestones, on completion of major tasks). Commitments are established among those who perform the work and the relevant stakeholders and are revised as necessary. Work products are reviewed with relevant stakeholders and are controlled. The work products and services satisfy their specified requirements.

A critical distinction between a *performed process* and a *managed process* is the extent to which the process is managed. A managed process is planned (the plan can be part of a more encompassing plan) and the execution of the process is managed against the plan. Corrective actions are taken when the actual results and execution deviate significantly from the plan. A *managed process* achieves the objectives of the plan and is institutionalized for consistent execution.

Defined Process

A *defined process* is a *managed process* that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines; has a maintained process description; and contributes process related experiences to the organizational process assets.

Organizational process assets are artifacts that relate to describing, implementing, and improving processes. These artifacts are assets because they are developed or acquired to meet the business objectives of the organization and they represent investments by the organization that are expected to provide current and future business value.

The organization's set of standard processes, which are the basis of the defined process, are established and improved over time. Standard processes describe the fundamental process elements that are expected in the defined processes. Standard processes also describe the relationships (e.g., the ordering, the interfaces) among these process elements. The organization-level infrastructure to support current and future use of the organization's set of standard processes is established and improved over time. (See the definition of "standard process" in the glossary.)

A work group's defined process provides a basis for planning, performing, and improving the work tasks and activities. The work can have more than one defined process (e.g., one for developing the product and another for testing the product).

A defined process clearly states the following:

- Purpose
- Inputs
- Entry criteria
- Activities
- Roles
- Measures
- Verification steps
- Outputs
- Exit criteria

A critical distinction between a *managed process* and a *defined process* is the scope of application of the process descriptions, standards, and procedures. For a *managed process*, the process descriptions, standards, and procedures are applicable to a particular work group, or organizational function. As a result, the managed processes of two work groups in one organization can be different.

Another critical distinction is that a *defined process* is described in more detail and is performed more rigorously than a *managed process*. This distinction means that improvement information is easier to understand, analyze, and use. Finally, management of the defined process is based on the additional insight provided by an understanding of the interrelationships of the process activities and detailed measures of the process, its work products, and its services.

Relationships Among Processes

The generic goals evolve so that each goal provides a foundation for the next. Therefore, the following conclusions can be made:

- A *managed process* is a *performed process*.
- A *defined process* is a *managed process*.

Thus, applied sequentially and in order, the generic goals describe a process that is increasingly institutionalized from a *performed process* to a *defined process*.

Achieving GG 1 for a process area is equivalent to saying you achieve the specific goals of the process area.

Achieving GG 2 for a process area is equivalent to saying you manage the execution of processes associated with the process area. There is a policy that indicates you will perform the process. There is a plan for performing it. There are resources provided, responsibilities assigned, training on how to perform it, selected work products from performing the process are

controlled, and so on. In other words, the process is planned and monitored just like any work activity or support activity.

Achieving GG 3 for a process area is equivalent to saying that an organizational standard process exists that can be tailored to result in the process you will use. Tailoring might result in making no changes to the standard process. In other words, the process used and the standard process can be identical. Using the standard process “as is” is tailoring because the choice is made that no modification is required.

Each process area describes multiple activities, some of which are repeatedly performed. You may need to tailor the way one of these activities is performed to account for new capabilities or circumstances. For example, you may have a standard for developing or obtaining organizational training that does not consider web-based training. When preparing to develop or obtain a web-based course, you may need to tailor the standard process to account for the particular challenges and benefits of web-based training.

Generic Goals and Generic Practices

This section describes all of the generic goals and generic practices, as well as their associated subpractices, notes, examples, and references. The generic goals are organized in numerical order, GG 1 through GG 3. The generic practices are also organized in numerical order under the generic goal they support.

GG 1 Achieve Specific Goals

The specific goals of the process area are supported by the process by transforming identifiable input work products into identifiable output work products.

GP 1.1 Perform Specific Practices

Perform the specific practices of the process area to develop work products and provide services to achieve the specific goals of the process area.

The purpose of this generic practice is to produce the work products and deliver the services that are expected by performing (i.e., executing) the process. These practices can be done informally without following a documented process description or plan. The rigor with which these practices are performed depends on the individuals managing and performing the work and can vary considerably.

GG 2 Institutionalize a Managed Process***The process is institutionalized as a managed process.*****GP 2.1 Establish an Organizational Policy*****Establish and maintain an organizational policy for planning and performing the process.***

The purpose of this generic practice is to define the organizational expectations for the process and make these expectations visible to those members of the organization who are affected. In general, senior management is responsible for establishing and communicating guiding principles, direction, and expectations for the organization.

Not all direction from senior management will bear the label “policy.” The existence of appropriate organizational direction is the expectation of this generic practice, regardless of what it is called or how it is imparted.

CAR Elaboration

This policy establishes organizational expectations for identifying and systematically addressing causal analysis of selected outcomes.

CM Elaboration

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

DAR Elaboration

This policy establishes organizational expectations for selectively analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria. The policy should also provide guidance on which decisions require a formal evaluation process.

IRP Elaboration

This policy establishes organizational expectations for establishing an approach to incident resolution and prevention; identifying, controlling, and addressing incidents; and for selected incidents, determining workarounds or addressing underlying causes.

IWM Elaboration

This policy establishes organizational expectations for establishing and maintaining the defined process for the work from startup throughout the work lifecycle, using the defined process in managing the work, and coordinating and collaborating with relevant stakeholders.

MA Elaboration

This policy establishes organizational expectations for aligning measurement objectives and activities with identified information needs and work group, organizational, or business objectives and for providing measurement results.

OPD Elaboration

This policy establishes organizational expectations for establishing and maintaining a set of standard processes for use by the organization, making organizational process assets available across the organization, and establishing rules and guidelines for teams.

OPF Elaboration

This policy establishes organizational expectations for determining process improvement opportunities for the processes being used and for planning, implementing, and deploying process improvements across the organization.

OPM Elaboration

This policy establishes organizational expectations for analyzing the organization's business performance using statistical and other quantitative techniques to determine performance shortfalls, and identifying and deploying process and technology improvements that contribute to meeting quality and process performance objectives.

OPP Elaboration

This policy establishes organizational expectations for establishing and maintaining process performance baselines and process performance models for the organization's set of standard processes.

OT Elaboration

This policy establishes organizational expectations for identifying the strategic training needs of the organization and providing that training.

PPQA Elaboration

This policy establishes organizational expectations for objectively evaluating whether processes and associated work products adhere to applicable process descriptions, standards, and procedures; and ensuring that noncompliance is addressed.

This policy also establishes organizational expectations for process and product quality assurance being in place for all work. Process and product quality assurance must possess sufficient independence from work group management to provide objectivity in identifying and reporting noncompliance issues.

QWM Elaboration

This policy establishes organizational expectations for using statistical and other quantitative techniques and historical data when: establishing quality and process performance objectives, composing the defined process for the work, selecting subprocess attributes critical to understanding process performance, monitoring subprocess and work performance, and performing root cause analysis to address process performance deficiencies. In particular, this policy establishes organizational expectations for use of process performance measures, baselines, and models.

REQM Elaboration

This policy establishes organizational expectations for managing requirements and identifying inconsistencies between the requirements and work plans and work products.

RSKM Elaboration

This policy establishes organizational expectations for defining a risk management strategy and identifying, analyzing, and mitigating risks.

SAM Elaboration

This policy establishes organizational expectations for establishing, maintaining, and satisfying supplier agreements.

SCON Elaboration

This policy establishes organizational expectations for establishing a service continuity plan that enables resumption of key services following a significant disruption in service delivery, providing training in the execution of the plan, and verifying and validating the plan.

SD Elaboration

This policy establishes organizational expectations for defining a service delivery approach, establishing service agreements, processing service requests, and delivering services.

SSD Addition**SSD Elaboration**

This policy establishes organizational expectations for the following:

- Collecting stakeholder needs, formulating service and service system component requirements, and analyzing and validating those requirements
- Performing the iterative cycle in which service system solutions are selected, service system and service system component designs are developed, interface compatibility is managed, service system designs are implemented, and service system components are integrated
- Establishing and maintaining verification and validation methods, procedures, criteria, and environments; performing peer reviews; and verifying selected work products.

SST Elaboration

This policy establishes organizational expectations for planning, implementing, and managing the transition of service system components into the delivery environment.

STSM Elaboration

This policy establishes organizational expectations for establishing and maintaining a set of standard services for use by the organization and making standard service descriptions available throughout the organization.

WMC Elaboration

This policy establishes organizational expectations for monitoring work progress and performance against the work plan and managing corrective action to closure when actual execution or results deviate significantly from the plan.

WP Elaboration

This policy establishes organizational expectations for estimating planning parameters, making internal and external commitments, and developing the plan for managing the work.

GP 2.2 Plan the Process***Establish and maintain the plan for performing the process.***

The purpose of this generic practice is to determine what is needed to perform the process and to achieve the established objectives, to prepare a plan for performing the process, to prepare a process description, and to get agreement on the plan from relevant stakeholders.

The practical implications of applying a generic practice vary for each process area.

For example, the planning described by this generic practice as applied to the Work Monitoring and Control process area can be carried out in full by the processes associated with the Work Planning process area. However, this generic practice, when applied to the Work Planning process area, sets an expectation that the work planning process itself be planned.

Therefore, this generic practice can either reinforce expectations set elsewhere in CMMI or set new expectations that should be addressed.

Refer to the Work Planning process area for more information about establishing and maintaining plans that define work activities.

Establishing a plan includes documenting the plan and a process description. Maintaining the plan includes updating it to reflect corrective actions or changes in requirements or objectives.

The plan for performing the process typically includes the following:

- Process description
- Standards and requirements for the work products and services of the process
- Specific objectives for the execution of the process and its results (e.g., quality, time scale, cycle time, use of resources)
- Dependencies among the activities, work products, and services of the process
- Resources (e.g., funding, people, tools) needed to perform the process
- Assignment of responsibility and authority
- Training needed for performing and supporting the process
- Work products to be controlled and the level of control to be applied
- Measurement requirements to provide insight into the execution of the process, its work products, and its services
- Involvement of relevant stakeholders
- Activities for monitoring and controlling the process
- Objective evaluation activities of the process
- Management review activities for the process and the work products

Subpractices

1. Define and document the plan for performing the process.

This plan can be a stand-alone document, embedded in a more comprehensive document, or distributed among multiple documents. In the case of the plan being distributed among multiple documents, ensure that a coherent picture of who does what is preserved. Documents can be hardcopy or softcopy.

2. Define and document the process description.

The process description, which includes relevant standards and procedures, can be included as part of the plan for performing the process or can be included in the plan by reference.

3. Review the plan with relevant stakeholders and get their agreement.

This review of the plan includes reviewing that the planned process satisfies the applicable policies, plans, requirements, and standards to provide assurance to relevant stakeholders.

4. Revise the plan as necessary.

CAM Elaboration

This plan for performing the capacity and availability management process can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

CAR Elaboration

This plan for performing the causal analysis and resolution process can be included in (or referenced by) the work plan, which is described in the Work Planning process area. This plan differs from the action proposals and associated action items described in several specific practices in this

process area. The plan called for in this generic practice addresses the work group's overall causal analysis and resolution process (perhaps tailored from a standard process maintained by the organization). In contrast, the process action proposals and associated action items address the activities needed to address a specific root cause under study.

CM Elaboration

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

DAR Elaboration

This plan for performing the decision analysis and resolution process can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

IRP Elaboration

This plan for performing the incident resolution and prevention process can be included in (or referenced by) the work plan, which is described in the Work Planning process area. This plan typically is based on an estimation of the volume and type of service incidents.

IWM Elaboration

This plan for performing the integrated work management process unites the planning for the work planning and monitor and control processes. The planning for performing the planning related practices in Integrated Work Management is addressed as part of planning the work planning process. This plan for performing the monitor-and-control related practices in Integrated Work Management can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

MA Elaboration

This plan for performing the measurement and analysis process can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

OPD Elaboration

This plan for performing the organizational process definition process can be part of (or referenced by) the organization's process improvement plan.

OPF Elaboration

This plan for performing the organizational process focus process, which is often called "the process improvement plan," differs from the process action plans described in specific practices in this process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area, from establishing organizational process needs through incorporating process related experiences into organizational process assets.

OPM Elaboration

This plan for performing the organizational performance management process differs from the deployment plans described in a specific practice in this process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area, from maintaining business objectives to evaluating improvement effects. In contrast, the deployment plans called for in the specific practice would address the planning needed for the deployment of selected improvements.

OPP Elaboration

This plan for performing the organizational process performance process can be included in (or referenced by) the organization's process improvement plan, which is described in the Organizational Process Focus process area. Or it may be documented in a separate plan that describes only the plan for the organizational process performance process.

OT Elaboration

This plan for performing the organizational training process differs from the tactical plan for organizational training described in a specific practice in this process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area, from establishing strategic training needs through assessing the effectiveness of organizational training. In contrast, the organizational training tactical plan called for in the specific practice of this process area addresses the periodic planning for the delivery of training offerings.

PPQA Elaboration

Examples of resources provided include the following tools:

- Evaluation tools
- Noncompliance tracking tools

QWM Elaboration

This plan for performing the quantitative work management process can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

REQM Elaboration

This plan for performing the requirements management process can be part of (or referenced by) the work plan as described in the Work Planning process area.

RSKM Elaboration

This plan for performing the risk management process can be included in (or referenced by) the work plan, which is described in the Work Planning process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area. In particular, this plan provides the overall approach for risk mitigation, but is distinct from mitigation plans (including contingency plans) for specific

risks. In contrast, the risk mitigation plans called for in the specific practices of this process area addresses more focused items such as the levels that trigger risk handling activities.

SAM Elaboration

Portions of this plan for performing the supplier agreement management process can be part of (or referenced by) the work plan as described in the Work Planning process area. Often, however, some portion of the plan resides outside of the work group with a group such as contract management.

SCON Elaboration

This plan for performing the service continuity process can be included in (or referenced by) the work plan, which is described in the Work Planning process area. Alternatively, this plan can be included as part of a broader business continuity plan maintained at the organizational level.

In either case, the plan for performing the service continuity process differs from the service continuity plans described in a specific practice in this process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area, from identifying and prioritizing essential functions through analyzing results of verification and validation. In contrast, the service continuity plans called for in one of the specific practices of this process area address how to restore key services following a significant disruption in service delivery.

SD Elaboration

This plan for performing the service delivery process can be included in (or referenced by) the work plan, which is described in the Work Planning process area.

SSD Addition

SSD Elaboration

This plan for performing the service system development process can be part of (or referenced by) the work plan as described in the Work Planning process area.

SST Elaboration

Overall planning for service system transition can be included in (or referenced by) the work plan, which is described in the Work Planning process area. In addition, planning associated with the transition of a particular service system is typically addressed in a service system transition plan.

This plan for performing the service system transition process differs from the plans for service system transition described in a specific practice in this process area. The plan called for in this generic practice addresses the comprehensive planning for all of the specific practices in this process area, from analyzing service system transition needs through assessing and

controlling the impacts of the transition. In contrast, the service system transition plans called for in the specific practice of this process area address planning for specific transitions of the service system.

STSM Elaboration

This plan for performing the strategic service management process differs from the plans for standard services described in the specific practices of this process area. The plan called for in this generic practice addresses comprehensive planning for all the specific practices in the process area.

WMC Elaboration

This plan for performing the work monitoring and control process can be part of (or referenced by) the work plan, as described in the Work Planning process area.

WP Elaboration

Refer to Table 6.2 in Generic Goals and Generic Practices for more information about the relationship between generic practice 2.2 and the Work Planning process area.

GP 2.3 Provide Resources

Provide adequate resources for performing the process, developing the work products, and providing the services of the process.

The purpose of this generic practice is to ensure that the resources necessary to perform the process as defined by the plan are available when they are needed. Resources include adequate funding, appropriate physical facilities, skilled people, and appropriate tools.

The interpretation of the term “adequate” depends on many factors and can change over time. Inadequate resources may be addressed by increasing resources or by removing requirements, constraints, and commitments.

CAM Elaboration

Examples of resources provided include the following:

- Remote analysis tools
- Monitoring tools

CAR Elaboration

Examples of resources provided include the following:

- Database management systems
- Process modeling tools
- Statistical analysis packages
- Methods and analysis techniques (e.g., Ishikawa or fishbone diagrams, Pareto analysis, histograms, process capability studies, control charts)

CM Elaboration

Examples of resources provided include the following:

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

DAR Elaboration

Examples of resources provided include the following:

- Simulators and modeling tools
- Prototyping tools
- Tools for conducting surveys

IRP Elaboration

Examples of resources provided include the following:

- Help desk tools
- Remote analysis tools
- Automated monitoring tools
- Incident management systems

IWM Elaboration

Examples of resources provided include the following:

- Problem tracking and reporting packages
- Groupware
- Video conferencing
- Integrated decision databases
- Integrated product support environments

MA Elaboration

Staff with appropriate expertise provide support for measurement and analysis activities. A measurement group with such a role may exist.

Examples of resources provided include the following:

- Statistical packages
- Packages that support data collection over networks

OPD Elaboration

A process group typically manages organizational process definition activities. This group typically is staffed by a core of professionals whose primary responsibility is coordinating organizational process improvement.

This group is supported by process owners and people with expertise in various disciplines such as the following:

- Project management
- Service management
- The appropriate service disciplines
- Configuration management
- Quality assurance

Examples of resources provided include the following:

- Database management systems
- Process modeling tools
- Web page builders and browsers

OPF Elaboration

Examples of resources provided include the following:

- Database management systems
- Process improvement tools
- Web page builders and browsers
- Groupware
- Quality improvement tools (e.g., cause-and-effect diagrams, affinity diagrams, Pareto charts)

OPM Elaboration

Examples of resources provided include the following tools:

- Simulation packages
- Prototyping tools
- Statistical packages
- Dynamic systems modeling
- Subscriptions to online technology databases and publications
- Process modeling tools

OPP Elaboration

Special expertise in statistical and other quantitative techniques may be needed to establish process performance baselines for the organization's set of standard processes.

Examples of resources provided include the following:

- Database management systems
- System dynamics models
- Process modeling tools
- Statistical analysis packages
- Problem tracking packages

OT Elaboration

Examples of resources provided include the following:

- Subject matter experts
- Curriculum designers
- Instructional designers
- Instructors
- Training administrators

Special facilities may be required for training. When necessary, the facilities required for the activities in the Organizational Training process area are developed or purchased.

Examples of resources provided include the following:

- Instruments for analyzing training needs
- Workstations to be used for training
- Instructional design tools
- Packages for developing presentation materials

PPQA Elaboration

Examples of resources provided include the following:

- Evaluation tools
- Noncompliance tracking tools

QWM Elaboration

Special expertise in statistics and its use in analyzing process performance may be needed to define the analytic techniques used in quantitative management. Special expertise in statistics can also be needed for analyzing and interpreting the measures resulting from statistical analyses; however, teams need sufficient expertise to support a basic understanding of their process performance as they perform their daily work.

Examples of other resources provided include the following:

- Statistical analysis packages
- Statistical process and quality control packages
- Scripts and tools that assist teams in analyzing their own process performance with minimal need for additional expert assistance

REQM Elaboration

Examples of resources provided include the following:

- Requirements tracking tools
- Traceability tools

RSKM Elaboration

Examples of resources provided include the following:

- Risk management databases
- Risk mitigation tools
- Prototyping tools
- Modeling and simulation tools

SAM Elaboration

Examples of resources provided include the following:

- Preferred supplier lists
- Requirements tracking tools
- Project management and scheduling programs

SCON Elaboration

Service continuity relies on obtaining special as well as adequate resources. Remote locations, secure networks, facilities, and equipment should be identified, procured, and prepared in advance to ensure continued service system operations in the event of a significant disruption. Special training facilities and related resources may be needed to prepare those who are responsible for implementing the service continuity plan. Finally, special testing facilities, equipment, and tools may need to be developed or purchased for use in verifying and validating service continuity preparations.

Examples of resources provided include the following:

- Backup communication mechanisms and networks
- File backup and restore utilities
- Workstations to be used for training
- Modeling and simulation tools
- Test management tools

SD Elaboration

Service delivery requires the operation of an appropriate service system that includes a trained staff, an infrastructure, tools, processes, consumables, and other resources. In addition, the operation of the service system imposes a continuing need for adequate resources. For example, over time components of the service system may need to be upgraded, replaced, or retired; service delivery staff may need to be retrained, augmented, rotated, or reduced; and consumables may need to be replenished to ensure that the service is delivered in accordance with service agreements.

Some of the components of the service system may need to be developed or purchased, and this constraint may require obtaining resources as described in the Service System Development and Supplier Agreement Management process areas.

Examples of resources provided include the following:

- Request management systems
- Automated monitoring tools

SSD Addition

SSD Elaboration

Examples of resources provided include the following:

- Requirements specification tools
- Simulation and modeling tools
- Prototyping tools
- Scenario definition and tracking tools
- Design specification tools
- Fabrication and assembly tools
- Test management tools
- Test case generation tools
- Monitoring tools
- Test facilities and environments

SST Elaboration

Examples of resources provided include the following:

- Transition support staff
- Installation and deployment tools
- Mechanisms for back out and restore

STSM Elaboration

Senior managers, strategic planners, service portfolio managers, product managers, or product line managers typically manage strategic service management practices.

Examples of resources provided include the following:

- Sources of data on strategic needs and capabilities
- Document management or configuration management tools
- Service management techniques

WMC Elaboration

Examples of resources provided include the following:

- Cost tracking systems
- Effort reporting systems
- Action item tracking systems
- Project management and scheduling programs

WP Elaboration

Special expertise, equipment, and facilities in work planning may be required.

Special expertise in work planning can include the following:

- Experienced estimators
- Schedulers
- Technical experts in applicable areas (e.g., product domain, technology)

Examples of resources provided include the following:

- Spreadsheet programs
- Estimating models
- Project planning and scheduling packages

GP 2.4 Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process.

The purpose of this generic practice is to ensure that there is accountability for performing the process and achieving the specified results throughout the life of the process. The people assigned must have the appropriate authority to perform the assigned responsibilities.

Responsibility can be assigned using detailed job descriptions or in living documents, such as the plan for performing the process. Dynamic assignment of responsibility is another legitimate way to implement this

generic practice, as long as the assignment and acceptance of responsibility are ensured throughout the life of the process.

Subpractices

1. Assign overall responsibility and authority for performing the process.
2. Assign responsibility and authority for performing the specific tasks of the process.
3. Confirm that the people assigned to the responsibilities and authorities understand and accept them.

IRP Elaboration

Responsibility is assigned for both first-tier service incident handling (e.g., by a help desk) and for second-tier handling (e.g., by support groups organized by service, platform, function, technology).

PPQA Elaboration

Responsibility is assigned to those who can perform process and product quality assurance evaluations with sufficient independence and objectivity to guard against subjectivity or bias.

SCON Elaboration

Responsibility is assigned to a backup management team for the organization (or work group) to take over management responsibilities in the event of a significant disruption.

SD Elaboration

Responsibility is assigned for establishing service agreements, accepting service requests, communicating status information (e.g., by a help desk), operating and maintaining the service system, processing service requests, and resolving service incidents (e.g., by support groups organized by service, platform, function, technology).

SSD Addition

SSD Elaboration

For service systems having a complex design; a mix of people, hardware, and software; or components from multiple suppliers, appointing a lead or chief architect that oversees the technical solution for the service system and has authority over design decisions helps to maintain consistency in service system design and evolution.

SST Elaboration

Responsibility is assigned for planning, implementing, and managing the transition. In addition, stakeholder notification activities are explicitly assigned to ensure open communication and buy-in. Rollback and back-out assignments are made in the event that the transition is not successful.

GP 2.5 Train People***Train the people performing or supporting the process as needed.***

The purpose of this generic practice is to ensure that people have the necessary skills and expertise to perform or support the process.

Appropriate training is provided to those who will be performing the work. Overview training is provided to orient people who interact with those who perform the work.

Examples of methods for providing training include self study; self-directed training; self-paced, programmed instruction; formalized on-the-job training; mentoring; and formal and classroom training.

Training supports the successful execution of the process by establishing a common understanding of the process and by imparting the skills and knowledge needed to perform the process.

Refer to the Organizational Training process area for more information about developing skills and knowledge of people so they can perform their roles effectively and efficiently.

CAM Elaboration

Examples of training topics include the following:

- Roles, responsibilities, and authority of the capacity and availability management staff
- Capacity and availability management standards, procedures, and methods

CAR Elaboration

Examples of training topics include the following:

- Quality management methods (e.g., root cause analysis)

CM Elaboration

Examples of training topics include the following:

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

DAR Elaboration

Examples of training topics include the following:

- Formal decision analysis
- Methods for evaluating alternative solutions against criteria

IRP Elaboration

Examples of training topics include the following:

- Service incident criteria
- Interacting with those who report service incidents and those who are affected by them
- Incident management system
- Analysis techniques (e.g., Ishikawa or fishbone diagrams, Pareto analysis, histograms)

IWM Elaboration

Examples of training topics include the following:

- Tailoring the organization's set of standard processes to meet the needs of the work
- Procedures for managing the work based on the defined process for the work
- Using the organization's measurement repository
- Using organizational process assets
- Integrated management
- Intergroup coordination
- Group problem solving
- Building the work group's shared vision
- Team building

MA Elaboration

Examples of training topics include the following:

- Statistical techniques
- Data collection, analysis, and reporting processes
- Development of goal related measurements (e.g., Goal Question Metric)

OPD Elaboration

Examples of training topics include the following:

- CMMI and other process and process improvement reference models
- Planning, managing, and monitoring processes
- Process modeling and definition
- Developing a tailorable standard process
- Developing work environment standards
- Ergonomics

OPF Elaboration

Examples of training topics include the following:

- CMMI and other process improvement reference models
- Planning and managing process improvement
- Tools, methods, and analysis techniques
- Process modeling
- Facilitation techniques
- Change management

OPM Elaboration

Examples of training topics include the following:

- Cost benefit analysis
- Planning, designing, and conducting pilots
- Technology transition
- Change management

OPP Elaboration

Examples of training topics include the following:

- Process and process improvement modeling
- Statistical and other quantitative methods (e.g., estimating models, Pareto analysis, control charts)

OT Elaboration

Examples of training topics include the following:

- Knowledge and skills needs analysis
- Instructional design
- Instruction techniques (e.g., train the trainer)
- Refresher training on subject matter

PPQA Elaboration

Examples of training topics include the following:

- Application domain
- Customer relations
- Process descriptions, standards, procedures, and methods for the work
- Quality assurance objectives, process descriptions, standards, procedures, methods, and tools

QWM Elaboration

Examples of training topics include the following:

- Basic quantitative (including statistical) analyses that help in analyzing process performance, using historical data, and identifying when corrective action is warranted
- Process modeling and analysis
- Process measurement data selection, definition, and collection

REQM Elaboration

Examples of training topics include the following:

- Application domain
- Requirements definition, analysis, review, and management
- Requirements management tools
- Configuration management
- Negotiation and conflict resolution

RSKM Elaboration

Examples of training topics include the following:

- Risk management concepts and activities (e.g., risk identification, evaluation, monitoring, mitigation)
- Measure selection for risk mitigation

SAM Elaboration

Examples of training topics include the following:

- Regulations and business practices related to negotiating and working with suppliers
- Acquisition planning and preparation
- Commercial off-the-shelf product acquisition
- Supplier evaluation and selection
- Negotiation and conflict resolution
- Supplier management
- Testing and transition of acquired products
- Receiving, storing, using, and maintaining acquired products

SCON Elaboration

Examples of training topics include the following:

- Service system and its components
- Business functions and resources used to support the operation of the service system (and thus service delivery)
- Contents of the service continuity plan
- Relevant local, state, and federal disaster preparedness activities

SD Elaboration

Examples of training topics include the following:

- Roles, responsibilities, and authority of the service delivery staff
- Service agreement, service requests, and service delivery standards, procedures, and methods
- Request management system
- Other service system components

SSD Addition

SSD Elaboration

Examples of training topics include the following:

- Specialized knowledge in a particular service domain
- Requirements definition, analysis, elicitation, specification, modeling, and tracking
- Design methods
- Common service system component and interface design patterns
- Standards (e.g., product, safety, human factors, security, delivery, environmental)
- Integration methods, tools, and facilities
- Verification and validation principles, standards, methods, tools, and facilities
- Peer review preparation and procedures
- Meeting facilitation

SST Elaboration

Examples of training topics include the following:

- Transition planning and monitoring
- Transition notification strategies
- Rollback and back-out approaches
- Post-deployment review process

STSM Elaboration

Examples of training topics include the following:

- Strategic planning techniques such as scenario planning, SWOT, and needs analysis
- Market research techniques
- Product planning and management
- Portfolio management
- Marketing communication

WMC Elaboration

Examples of training topics include the following:

- Work monitoring and control
- Risk management
- Data management

WP Elaboration

Examples of training topics include the following:

- Estimating
- Budgeting
- Negotiating
- Identifying and analyzing risks
- Managing data
- Planning
- Scheduling

GP 2.6 Control Work Products

Place selected work products of the process under appropriate levels of control.

The purpose of this generic practice is to establish and maintain the integrity of the selected work products of the process (or their descriptions) throughout their useful life.

The selected work products are specifically identified in the plan for performing the process, along with a specification of the appropriate level of control.

Different levels of control are appropriate for different work products and for different points in time. For some work products, it may be sufficient to maintain version control so that the version of the work product in use at a given time, past or present, is known and changes are incorporated in a controlled manner. Version control is usually under the sole control of the work product owner (which can be an individual, group, or team).

Sometimes, it can be critical that work products be placed under formal or baseline configuration management. This type of control includes defining and establishing baselines at predetermined points. These baselines are formally reviewed and approved, and serve as the basis for further development of the designated work products.

Refer to the Configuration Management process area for more information about establishing and maintaining the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

Additional levels of control between version control and formal configuration management are possible. An identified work product can be under various levels of control at different points in time.

CAM Elaboration

Examples of work products placed under control include the following:

- Capacity and availability management records
- Capacity and availability management reports

CAR Elaboration

Examples of work products placed under control include the following:

- Action proposals
- Action proposals selected for implementation
- Causal analysis and resolution records

CM Elaboration

Levels of control should be sufficient to meet business needs, mitigate the risk of failure, and address service criticality.

Examples of work products placed under control include the following:

- Access lists
- Change status reports
- Change request database copies
- CCB meeting minutes
- Archived baselines
- Key points of contact for service delivery

DAR Elaboration

Examples of work products placed under control include the following:

- Guidelines for when to apply a formal evaluation process
- Evaluation reports containing recommended solutions

IRP Elaboration

Examples of work products placed under control include the following:

- Incident management records
- Incident resolution and prevention reports
- Action proposals
- Workaround description and instructions
- Incident database copies

IWM Elaboration

Examples of work products placed under control include the following:

- The defined process for the work
- Work plans
- Other plans that affect the work
- Integrated plans
- Actual process and product measurements collected from the work
- Shared vision
- Team structure
- Team charters

MA Elaboration

Examples of work products placed under control include the following:

- Measurement objectives
- Specifications of base and derived measures
- Data collection and storage procedures
- Base and derived measurement data sets
- Analysis results and draft reports
- Data analysis tools

OPD Elaboration

Examples of work products placed under control include the following:

- Organization's set of standard processes
- Descriptions of lifecycle models
- Tailoring guidelines for the organization's set of standard processes
- Definitions of the common set of product and process measures
- Organization's measurement data
- Rules and guidelines for structuring and forming teams

OPF Elaboration

Examples of work products placed under control include the following:

- Process improvement proposals
- Organization's approved process action plans
- Training materials used for deploying organizational process assets
- Guidelines for deploying the organization's set of standard processes on new work or work groups
- Plans for the organization's process appraisals

OPM Elaboration

Examples of work products placed under control include the following:

- Documented lessons learned from improvement validation
- Deployment plans
- Revised improvement measures, objectives, priorities
- Updated process documentation and training material

OPP Elaboration

Examples of work products placed under control include the following:

- Organization's quality and process performance objectives
- Definitions of the selected measures of process performance
- Baseline data on the organization's process performance
- Process performance models

OT Elaboration

Examples of work products placed under control include the following:

- Organizational training tactical plan
- Training records
- Training materials and supporting artifacts
- Instructor evaluation forms

PPQA Elaboration

Examples of work products placed under control include the following:

- Noncompliance reports
- Evaluation logs and reports

QWM Elaboration

Examples of work products placed under control include the following:

- Subprocesses to be included in the defined process for the work
- Operational definitions of the measures, their collection points in the subprocesses, and how the integrity of the measures will be determined
- Collected measurements

REQM Elaboration

Examples of work products placed under control include the following:

- Requirements
- Requirements traceability matrix

RSKM Elaboration

Examples of work products placed under control include the following:

- Risk management strategy
- Identified risk items
- Risk mitigation plans

SAM Elaboration

Examples of work products placed under control include the following:

- Statements of work
- Supplier agreements
- Memoranda of agreement
- Subcontracts
- Preferred supplier lists

SCON Elaboration

Examples of work products placed under control include the following:

- Service continuity plan
- Material used for training staff in the service continuity plan
- Training records
- Verification and validation procedures and criteria
- Verification and validation reports

SD Elaboration

Examples of work products placed under control include the following:

- Service agreements
- Service delivery and request management reports
- Request management database

SSD Addition

SSD Elaboration

Examples of work products placed under control include the following:

- Stakeholder requirements
- Service system architecture
- Service, service system, service system component, and interface requirements
- Service system, service system component, and interface designs
- Criteria for design and service system component reuse
- Skill specifications and staffing solutions
- Implemented designs (e.g., operating procedures, fabricated consumable components)
- Integrated service system component evaluations
- Service system component integration strategy
- Integration procedures and criteria
- Verification and validation procedures and criteria
- Verification and validation reports
- Peer review training material
- Peer review data
- User, installation, delivery, incident management, and maintenance documentation

SST Elaboration

Examples of work products placed under control include the following:

- Transition plan
- Service system analysis reports
- Deployment reports and records
- Transition assessments and post-deployment review reports

STSM Elaboration

Examples of work products placed under control include the following:

- Organization's set of standard service descriptions
- Descriptions of service levels
- Tailoring guidelines for the organization's set of standard services

WMC Elaboration

Examples of work products placed under control include the following:

- Work schedules with status
- Work measurement data and analysis
- Earned value reports

WP Elaboration

Examples of work products placed under control include the following:

- Work breakdown structure
- Work plan
- Data management plan
- Stakeholder involvement plan

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the process as planned.

The purpose of this generic practice is to establish and maintain the expected involvement of relevant stakeholders during the execution of the process.

Involve relevant stakeholders as described in an appropriate plan for stakeholder involvement. Involve stakeholders appropriately in activities such as the following:

- Planning
- Decisions
- Commitments
- Communications
- Coordination
- Reviews
- Appraisals
- Requirements definitions
- Resolution of problems and issues

Refer to the Work Planning process area for more information about planning stakeholder involvement.

The objective of planning stakeholder involvement is to ensure that interactions necessary to the process are accomplished, while not allowing excessive numbers of affected groups and individuals to impede process execution.

Examples of stakeholders that might serve as relevant stakeholders for specific tasks, depending on context, include individuals, teams, management, customers, suppliers, end users, operations and support staff, other work groups, and government regulators.

Subpractices

1. Identify stakeholders relevant to this process and their appropriate involvement.

Relevant stakeholders are identified among the suppliers of inputs to, the users of outputs from, and the performers of the activities in the process. Once the relevant stakeholders are identified, the appropriate level of their involvement in process activities is planned.

2. Share these identifications with work planners or other planners as appropriate.
3. Involve relevant stakeholders as planned.

CAM Elaboration

Examples of activities for stakeholder involvement include the following:

- Reviewing capacity and availability management reports and resolving issues
- Working closely with stakeholders when it is not possible to directly influence the demand for the use of resources

CAR Elaboration

Examples of activities for stakeholder involvement include the following:

- Conducting causal analysis
- Assessing action proposals

CM Elaboration

Examples of activities for stakeholder involvement include the following:

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

DAR Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing guidelines for which issues are subject to a formal evaluation process
- Defining the issue to be addressed
- Establishing evaluation criteria
- Identifying and evaluating alternatives
- Selecting evaluation methods
- Selecting solutions

IRP Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing an approach to incident resolution and prevention
- Identifying service incidents and recording information about them
- Analyzing service incidents to determine the best course of action
- Reviewing the result of actions for resolving service incidents

IWM Elaboration

Examples of activities for stakeholder involvement include the following:

- Resolving issues about the tailoring of organizational process assets
- Resolving issues among the work plan and other plans that affect the work
- Reviewing work progress and performance to align with current and projected needs, objectives, and requirements
- Creating the work group's shared vision
- Defining the team structure for the work group
- Populating teams

MA Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing measurement objectives and procedures
- Assessing measurement data
- Providing meaningful feedback to those who are responsible for providing the raw data on which the analysis and results depend

OPD Elaboration

Examples of activities for stakeholder involvement include the following:

- Reviewing the organization's set of standard processes
- Reviewing the organization's lifecycle models
- Resolving issues related to the tailoring guidelines
- Assessing definitions of the common set of process and product measures
- Reviewing work environment standards
- Establishing and maintaining empowerment mechanisms
- Establishing and maintaining organizational rules and guidelines for structuring and forming teams

OPF Elaboration

Examples of activities for stakeholder involvement include the following:

- Coordinating and collaborating on process improvement activities with process owners, those who are or will be performing the process, and support organizations (e.g., training staff, quality assurance representatives)
- Establishing the organizational process needs and objectives
- Appraising the organization's processes
- Implementing process action plans
- Coordinating and collaborating on the execution of pilots to test selected improvements
- Deploying organizational process assets and changes to organizational process assets
- Communicating the plans, status, activities, and results related to planning, implementing, and deploying process improvements

OPM Elaboration

Examples of activities for stakeholder involvement include the following:

- Reviewing improvement proposals that could contribute to meeting business objectives
- Providing feedback to the organization on the readiness, status, and results of the improvement deployment activities

The feedback typically involves the following:

- Informing the people who submit improvement proposals about the disposition of their proposals
- Regularly communicating the results of comparing business performance against the business objectives
- Regularly informing relevant stakeholders about the plans and status for selecting and deploying improvements
- Preparing and distributing a summary of improvement selection and deployment activities

OPP Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing the organization's quality and process performance objectives and their priorities
- Reviewing and resolving issues on the organization's process performance baselines
- Reviewing and resolving issues on the organization's process performance models

OT Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing a collaborative environment for discussion of training needs and training effectiveness to ensure that the organization's training needs are met
- Identifying training needs
- Reviewing the organizational training tactical plan
- Assessing training effectiveness

PPQA Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing criteria for the objective evaluations of processes and work products
- Evaluating processes and work products
- Resolving noncompliance issues
- Tracking noncompliance issues to closure

QWM Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing work objectives
- Resolving issues among the quality and process performance objectives for the work
- Selecting analytic techniques to be used
- Evaluating the process performance of selected subprocesses
- Identifying and managing the risks in achieving the quality and process performance objectives for the work
- Identifying what corrective action should be taken

REQM Elaboration

Examples of activities for stakeholder involvement include the following:

- Resolving issues on the understanding of requirements
- Assessing the impact of requirements changes
- Communicating bidirectional traceability
- Identifying inconsistencies among requirements, work plans, and work products

RSKM Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing a collaborative environment for free and open discussion of risk
- Reviewing the risk management strategy and risk mitigation plans
- Participating in risk identification, analysis, and mitigation activities
- Communicating and reporting risk management status

SAM Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing criteria for evaluation of potential suppliers
- Reviewing potential suppliers
- Establishing supplier agreements
- Resolving issues with suppliers
- Reviewing supplier performance

SCON Elaboration

Examples of activities for stakeholder involvement include the following:

- Identifying essential functions and resources that support service delivery
- Reviewing the service continuity plan
- Reviewing training materials
- Verifying and validating products

SD Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing service agreements
- Submitting service requests
- Reviewing service request management reports and resolving issues
- Reviewing the result of actions for resolving service requests

SSD Addition

SSD Elaboration

Examples of activities for stakeholder involvement include the following:

- Reviewing and assessing the adequacy of requirements in meeting needs, expectations, constraints, and interfaces
- Establishing operational concepts and scenarios
- Establishing service and service system requirements
- Assessing cost, schedule, intended resource needs, and risk
- Developing alternative solutions and selection criteria
- Obtaining approval on external interface specifications and design descriptions
- Developing the service system architecture
- Assessing the make, buy, or reuse alternatives for service system components
- Implementing the design
- Reviewing interface descriptions for completeness
- Establishing the service system integration strategy, procedures, and criteria
- Integrating and assembling service system components
- Selecting the service system components to be verified and validated
- Establishing the verification and validation methods, procedures, and criteria
- Reviewing results of service system component verification and validation
- Resolving issues with customers or end users identified during verification and validation

SST Elaboration

Examples of activities for stakeholder involvement include the following:

- Planning and monitoring service system transition
- Notifying stakeholders about transition status and issues
- Post-deployment review

STSM Elaboration

Examples of activities for stakeholder involvement include the following:

- Confirming business objectives
- Reviewing the organization's set of standard services
- Reviewing the descriptions of standard services
- Reviewing the organization's service levels
- Resolving issues on tailoring guidelines

WMC Elaboration

Examples of activities for stakeholder involvement include the following:

- Assessing the work against the plan
- Reviewing commitments and resolving issues
- Reviewing work risks
- Reviewing data management activities
- Reviewing work status or progress
- Managing corrective actions to closure

WP Elaboration

Examples of activities for stakeholder involvement include the following:

- Establishing estimates
- Reviewing and resolving issues on the completeness and correctness of work risks
- Reviewing data management plans
- Establishing work plans
- Reviewing work plans and resolving issues on work and resource issues

GP 2.8 Monitor and Control the Process

Monitor and control the process against the plan for performing the process and take appropriate corrective action.

The purpose of this generic practice is to perform the direct day-to-day monitoring and controlling of the process. Appropriate visibility into the process is maintained so that appropriate corrective action can be taken when necessary. Monitoring and controlling the process can involve measuring appropriate attributes of the process or work products produced by the process.

Refer to the Measurement and Analysis process area for more information about developing and sustaining a measurement capability used to support management information needs.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the work progress and performance so that appropriate corrective actions can be taken when the work progress and performance deviates significantly from the plan.

Subpractices

1. Evaluate actual progress and performance against the plan for performing the process.
The evaluations are of the process, its work products, and its services.
2. Review accomplishments and results of the process against the plan for performing the process.

3. Review activities, status, and results of the process with the immediate level of management responsible for the process and identify issues.

These reviews are intended to provide the immediate level of management with appropriate visibility into the process based on the day-to-day monitoring and controlling of the process, and are supplemented by periodic and event-driven reviews with higher level management as described in GP 2.10.

4. Identify and evaluate the effects of significant deviations from the plan for performing the process.
5. Identify problems in the plan for performing the process and in the execution of the process.
6. Take corrective action when requirements and objectives are not being satisfied, when issues are identified, or when progress differs significantly from the plan for performing the process.

Inherent risks should be considered before any corrective action is taken.

Corrective action can include the following:

- Taking remedial action to repair defective work products or services
- Changing the plan for performing the process
- Adjusting resources, including people, tools, and other resources
- Negotiating changes to the established commitments
- Securing change to the requirements and objectives that must be satisfied
- Terminating the effort

7. Track corrective action to closure.

CAM Elaboration

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

- Total number of customer hours lost per month to interruptions of normal service from causes associated with capacity and availability management
- Number of hours lost per customer per month to interruptions of normal service from causes associated with capacity and availability management
- Percentage of service response time requirements not met due to causes associated with capacity and availability management
- Accuracy of forecasts of trends in resource use

CAR Elaboration

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

- Number of outcomes analyzed
- Change in quality or process performance per instance of the causal analysis and resolution process
- Schedule of activities for implementing a selected action proposal

CM Elaboration

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

- Number of changes to configuration items
- Number of configuration audits conducted
- Schedule of CCB or audit activities

DAR Elaboration

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

- Cost-to-benefit ratio of using formal evaluation processes
- Schedule for the execution of a trade study

IRP Elaboration

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

- Capacity, service system performance, and availability data that signal potential service incidents
- Number of service incidents received
- Time for resolving service incidents compared to the resolution times defined in the service level agreement
- Number of transfers between support groups before a service incident is resolved
- Schedule for implementing an action proposal to prevent a class of service incidents from reoccurring

IWM Elaboration

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

- Number of changes to the defined process for the work
- Schedule and effort to tailor the organization's set of standard processes
- Interface coordination issue trends (i.e., number identified and number closed)
- Schedule for work tailoring activities
- Work group's shared vision usage and effectiveness
- Team structure usage and effectiveness
- Team charters usage and effectiveness

MA Elaboration

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

- Percentage of work groups using progress and performance measures
- Percentage of measurement objectives addressed
- Schedule for collection and review of measurement data

OPD Elaboration

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

- Percentage of work groups using the process architectures and process elements of the organization's set of standard processes
- Defect density of each process element of the organization's set of standard processes
- Schedule for development of a process or process change

OPF Elaboration

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

- Number of process improvement proposals submitted, accepted, or implemented
- CMMI maturity level or capability level earned
- Schedule for deployment of an organizational process asset
- Percentage of work groups using the current organization's set of standard processes (or tailored version of the current set)
- Issue trends associated with implementing the organization's set of standard processes (i.e., number of issues identified, number closed)
- Progress toward achievement of process needs and objectives

OPM Elaboration

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

- Change in quality and process performance related to business objectives
- Schedule for implementing and validating an improvement
- Schedule for activities to deploy a selected improvement

OPP Elaboration

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

- Trends in the organization's process performance with respect to changes in work products and task attributes (e.g., size growth, effort, schedule, quality)
- Schedule for collecting and reviewing measures to be used for establishing a process performance baseline

OT Elaboration

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

- Number of training courses delivered (e.g., planned versus actual)
- Post-training evaluation ratings
- Training program quality survey ratings
- Schedule for delivery of training
- Schedule for development of a course

PPQA Elaboration

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

- Variance of objective process evaluations planned and performed
- Variance of objective work product evaluations planned and performed
- Schedule for objective evaluations

QWM Elaboration

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

- Profile of subprocess attributes whose process performance provide insight about the risk to, or are key contributors to, achieving work objectives (e.g., number selected for monitoring through statistical techniques, number currently being monitored, number whose process performance is stable)
- Number of special causes of variation identified
- Schedule of data collection, analysis, and reporting activities in a measurement and analysis cycle as it relates to quantitative management activities

REQM Elaboration

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

- Requirements volatility (percentage of requirements changed)
- Schedule for coordination of requirements
- Schedule for analysis of a proposed requirements change

RSKM Elaboration

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

- Number of risks identified, managed, tracked, and controlled
- Risk exposure and changes to the risk exposure for each assessed risk, and as a summary percentage of management reserve
- Change activity for risk mitigation plans (e.g., processes, schedule, funding)
- Occurrence of unanticipated risks
- Risk categorization volatility
- Comparison of estimated versus actual risk mitigation effort and impact
- Schedule for risk analysis activities
- Schedule of actions for a specific mitigation

SAM Elaboration

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

- Number of changes made to the requirements for the supplier
- Cost and schedule variance in accordance with the supplier agreement
- Schedule for selecting a supplier and establishing an agreement

SCON Elaboration

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

- Number of changes made to the list of functions and resources identified as essential to service delivery
- Cost, schedule, and effort expended for ensuring service continuity
- Percentage of those who are trained in the service continuity plan that must be trained again
- Service continuity plan verification and validation problem report status (i.e., how long each problem report has been open)

SD Elaboration

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

- Time taken to prepare the service agreement
- Number of service requests received
- Time taken to resolve service requests compared to the times defined in the service level agreement
- Number of transfers between support groups before a service request is resolved

SSD Addition

SSD Elaboration

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

- Cost, schedule, and effort expended for rework
- Defect density of requirements specifications
- Schedule for activities to develop a set of requirements
- Percentage of requirements addressed in the service system or service system component design
- Size and complexity of the service system, service system components, interfaces, and documentation
- Defect density of design and integration work products
- Integration evaluation problem report trends (e.g., number written, number closed)
- Integration evaluation problem report aging (i.e., how long each problem report has been open)
- Verification and validation profiles (e.g., the number of verifications and validations planned and performed, the number of defects found)
- Number of defects detected by defect category
- Verification and validation problem report trends (e.g., number written, number closed)
- Verification and validation problem report status (i.e., how long each problem report has been open)
- Schedule for conduct of specific requirements, design, integration, verification, and validation activities

SST Elaboration

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

- Planned versus actual transition time
- Number of transition related service incidents received
- Number of unexpected back-out and rollback instances, including magnitude of disruption to service system delivery
- Results of post-deployment review and stakeholder surveys

STSM Elaboration

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

- Percentage of contracts using the organization's set of standard services
- Number of customer requests that breach defined service levels
- Frequency of use of particular services
- Schedule for development of a service description change

WMC Elaboration

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

- Number of open and closed corrective actions
- Schedule with status for monthly financial data collection, analysis, and reporting
- Number and types of reviews performed
- Review schedule (planned versus actual and slipped target dates)
- Schedule for collection and analysis of monitoring data

WP Elaboration

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

- Number of revisions to the plan
- Cost, schedule, and effort variance per plan revision
- Schedule for development and maintenance of program plans

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the process and selected work products against the process description, standards, and procedures, and address noncompliance.

The purpose of this generic practice is to provide credible assurance that the process and selected work products are implemented as planned and adhere to the process description, standards, and procedures. (See the definition of “objectively evaluate” in the glossary.)

Refer to the Process and Product Quality Assurance process area for more information about objectively evaluating processes and work products.

People not directly responsible for managing or performing the activities of the process typically evaluate adherence. In many cases, adherence is evaluated by people in the organization, but external to the process or work group, or by people external to the organization. As a result, credible assurance of adherence can be provided even during times when the process is under stress (e.g., when the effort is behind schedule, when the effort is over budget).

CAR Elaboration

Examples of activities reviewed include the following:

- Determining causes of outcomes
- Addressing causes of defects

Examples of work products reviewed include the following:

- Action proposals selected for implementation
- Causal analysis and resolution records

CM Elaboration

Examples of activities reviewed include the following:

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

Examples of work products reviewed include the following:

- Archives of baselines
- Change request database

DAR Elaboration

Examples of activities reviewed include the following:

- Evaluating alternatives using established criteria and methods

Examples of work products reviewed include the following:

- Guidelines for when to apply a formal evaluation process
- Evaluation reports containing recommended solutions

IRP Elaboration

Examples of activities reviewed include the following:

- Establishing an approach to incident resolution and prevention
- Identifying service incidents and recording information about them
- Communicating the status of service incidents

Examples of work products reviewed include the following:

- Service incident database
- Workarounds
- Action proposals
- Service incident records

IWM Elaboration

Examples of activities reviewed include the following:

- Establishing, maintaining, and using the defined process for the work
- Coordinating and collaborating with relevant stakeholders
- Using the work group's shared vision
- Organizing teams

Examples of work products reviewed include the following:

- The defined process for the work
- Work plans
- Other plans that affect the work
- Work environment standards
- Shared vision statements
- Team structure
- Team charters

MA Elaboration

Examples of activities reviewed include the following:

- Aligning measurement and analysis activities
- Providing measurement results

Examples of work products reviewed include the following:

- Specifications of base and derived measures
- Data collection and storage procedures
- Analysis results and draft reports

OPD Elaboration

Examples of activities reviewed include the following:

- Establishing organizational process assets
- Determining rules and guidelines for structuring and forming teams

Examples of work products reviewed include the following:

- Organization's set of standard processes
- Descriptions of lifecycle models
- Tailoring guidelines for the organization's set of standard processes
- Organization's measurement data
- Empowerment rules and guidelines for people and teams

OPF Elaboration

Examples of activities reviewed include the following:

- Determining process improvement opportunities
- Planning and coordinating process improvement activities
- Deploying the organization's set of standard processes to work groups at their startup

Examples of work products reviewed include the following:

- Process improvement plans
- Process action plans
- Process deployment plans
- Plans for the organization's process appraisals

OPM Elaboration

Examples of activities reviewed include the following:

- Analyzing process performance data to determine the organization's ability to meet identified business objectives
- Selecting improvements using quantitative analysis
- Deploying improvements
- Measuring effectiveness of the deployed improvements using statistical and other quantitative techniques

Examples of work products reviewed include the following:

- Improvement proposals
- Deployment plans
- Revised improvement measures, objectives, priorities, and deployment plans
- Updated process documentation and training material

OPP Elaboration

Examples of activities reviewed include the following:

- Establishing process performance baselines and models

Examples of work products reviewed include the following:

- Process performance baselines
- Organization's quality and process performance objectives
- Definitions of the selected measures of process performance

OT Elaboration

Examples of activities reviewed include the following:

- Identifying training needs and making training available
- Providing necessary training

Examples of work products reviewed include the following:

- Organizational training tactical plan
- Training materials and supporting artifacts
- Instructor evaluation forms

PPQA Elaboration

Examples of activities reviewed include the following:

- Objectively evaluating processes and work products
- Tracking and communicating noncompliance issues

Examples of work products reviewed include the following:

- Noncompliance reports
- Evaluation logs and reports

QWM Elaboration

Examples of activities reviewed include the following:

- Quantitatively managing the work using quality and process performance objectives
- Managing selected subprocesses within the defined process for the work

Examples of work products reviewed include the following:

- Compositions of the defined process for the work
- Operational definitions of the measures
- Process performance analyses reports
- Collected measurements

REQM Elaboration

Examples of activities reviewed include the following:

- Managing requirements
- Ensuring alignment among work plans, work products, and requirements

Examples of work products reviewed include the following:

- Requirements
- Requirements traceability matrix

RSKM Elaboration

Examples of activities reviewed include the following:

- Establishing and maintaining a risk management strategy
- Identifying and analyzing risks
- Mitigating risks

Examples of work products reviewed include the following:

- Risk management strategy
- Risk mitigation plans

SAM Elaboration

Examples of activities reviewed include the following:

- Establishing and maintaining supplier agreements
- Satisfying supplier agreements

Examples of work products reviewed include the following:

- Plan for supplier agreement management
- Supplier agreements

SCON Elaboration

Examples of activities reviewed include the following:

- Establishing the service continuity plan
- Conducting training in the service continuity plan
- Verifying and validating the service continuity plan

Examples of work products reviewed include the following:

- Service continuity plan
- Training materials
- Verification and validation methods, procedures, and criteria

SD Elaboration

Examples of activities reviewed include the following:

- Establishing service agreements
- Processing service request
- Maintaining the service system

Examples of work products reviewed include the following:

- Service agreements
- Service delivery approach

SSD Addition**SSD Elaboration**

Examples of activities reviewed include the following:

- Collecting stakeholder needs
- Formulating and analyzing service, service system, and component requirements
- Selecting service system solutions
- Developing service system and service system component designs
- Ensuring interface compatibility
- Implementing service system designs
- Integrating and assembling service system components
- Verifying and validating service systems
- Performing peer reviews

Examples of work products reviewed include the following:

- Service, service system, and component requirements
- Interface requirements
- Service system architecture
- Service system, service system component, and interface designs
- Criteria for design and service system component reuse
- Skill specifications and staffing solutions
- Implemented designs (e.g., operating procedures, fabricated consumable components)
- Integrated service system component evaluations
- Service system component integration strategy
- Integration procedures and criteria
- Verification and validation procedures and criteria
- Verification and validation reports
- Peer review training material
- Peer review data
- User, installation, delivery, incident management, and maintenance documentation

SST Elaboration

Examples of activities reviewed include the following:

- Transition planning
- Transition training
- Deployment activities, including validation and assessment

Examples of work products reviewed include the following:

- Service system transition plan
- Installation records
- Post-deployment review report

STSM Elaboration

Establishing organizational standard services is an example of an activity to be reviewed.

Examples of work products reviewed include the following:

- Organization's set of standard services
- Descriptions of standard services
- Descriptions of service levels
- Tailoring guidelines for the organization's set of standard services

WMC Elaboration

Examples of activities reviewed include the following:

- Monitoring work progress and performance against the work plan
- Managing corrective actions to closure

Examples of work products reviewed include the following:

- Records of work progress and performance
- Project review results

WP Elaboration

Examples of activities reviewed include the following:

- Establishing estimates
- Developing the work plan
- Obtaining commitments to the work plan

Examples of work products reviewed include the following:

- Work breakdown structure
- Work plan
- Data management plan
- Stakeholder involvement plan

GP 2.10 Review Status with Higher Level Management

Review the activities, status, and results of the process with higher level management and resolve issues.

The purpose of this generic practice is to provide higher level management with the appropriate visibility into the process.

Higher level management includes those levels of management in the organization above the immediate level of management responsible for the process. In particular, higher level management can include senior management. These reviews are for managers who provide the policy and overall guidance for the process and not for those who perform the direct day-to-day monitoring and controlling of the process.

Different managers have different needs for information about the process. These reviews help ensure that informed decisions on the planning and performing of the process can be made. Therefore, these reviews are expected to be both periodic and event driven.

IRP Elaboration

Higher level management is kept informed of the status of significant service incidents, including results of workarounds and prevention activities.

OPF Elaboration

These reviews are typically in the form of a briefing presented to the management steering committee by the process group and the process action teams.

Examples of presentation topics include the following:

- Status of improvements being developed by process action teams
- Results of pilots
- Results of deployments
- Schedule status for achieving significant milestones (e.g., readiness for an appraisal, progress toward achieving a targeted organizational maturity level or capability level profile)

OPM Elaboration

These reviews are typically in the form of a briefing presented to higher level management by those responsible for performance improvement.

Examples of presentation topics include the following:

- Improvement areas identified from analysis of current performance compared to business objectives
- Results of process improvement elicitation and analysis activities
- Results from validation activities (e.g., pilots) compared to expected benefits
- Performance data after deployment of improvements
- Deployment cost, schedule, and risk
- Risks of not achieving business objectives

REQM Elaboration

Proposed changes to commitments to be made external to the organization are reviewed with higher level management to ensure that all commitments can be accomplished.

RSKM Elaboration

Reviews of work risk status are held on a periodic and event-driven basis, with appropriate levels of management, to provide visibility into the potential for work risk exposure and appropriate corrective action.

Typically, these reviews include a summary of the most critical risks, key risk parameters (such as likelihood and consequence of the risks), and the status of risk mitigation efforts.

SCON Elaboration

These reviews are typically in the form of a briefing presented to higher level management.

Examples of presentation topics include the following:

- Identification of significant changes in the business functions and resources essential to service delivery
- Status of preparations for service continuity including training activities
- Verification and validation issues and results

SST Elaboration

Higher level management is kept informed of the status of transitions, including successful and unsuccessful transition attempts and deployment results.

GG 3 Institutionalize a Defined Process

The process is institutionalized as a defined process.

GP 3.1 Establish a Defined Process

Establish and maintain the description of a defined process.

The purpose of this generic practice is to establish and maintain a description of the process that is tailored from the organization's set of standard processes to address the needs of a specific instantiation. The organization should have standard processes that cover the process area, as well as have guidelines for tailoring these standard processes to meet the needs of a work group or organizational function. With a defined process, variability in how the processes are performed across the organization is reduced and process assets, data, and learning can be effectively shared.

Refer to the Integrated Work Management process area for more information about establishing the defined process for the work.

Refer to the Organizational Process Definition process area for more information about establishing standard processes and establishing tailoring criteria and guidelines.

The descriptions of the defined processes provide the basis for planning, performing, and managing the activities, work products, and services associated with the process.

Subpractices

1. Select from the organization's set of standard processes those processes that cover the process area and best meet the needs of the work group or organizational function.
2. Establish the defined process by tailoring the selected processes according to the organization's tailoring guidelines.
3. Ensure that the organization's process objectives are appropriately addressed in the defined process.
4. Document the defined process and the records of the tailoring.
5. Revise the description of the defined process as necessary.

GP 3.2 Collect Process Related Experiences

Collect process related experiences derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.

The purpose of this generic practice is to collect process related experiences, including information and artifacts derived from planning and performing the process. Examples of process related experiences include work products, measures, measurement results, lessons learned, and process improvement suggestions. The information and artifacts are collected so that they can be included in the organizational process assets and made available to those who are (or who will be) planning and performing the same or similar processes. The information and artifacts are stored in the organization's measurement repository and the organization's process asset library.

Examples of relevant information include the effort expended for the various activities, defects injected or removed in a particular activity, and lessons learned.

Refer to the Integrated Work Management process area for more information about contributing to organizational process assets.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Subpractices

1. Store process and product measures in the organization's measurement repository.

The process and product measures are primarily those measures that are defined in the common set of measures for the organization's set of standard processes.

2. Submit documentation for inclusion in the organization's process asset library.
3. Document lessons learned from the process for inclusion in the organization's process asset library.
4. Propose improvements to the organizational process assets.

CAR Elaboration

Examples of process related experiences include the following:

- Action proposals
- Number of action proposals that are open and for how long
- Action proposal status reports

CM Elaboration

Examples of process related experiences include the following:

- Trends in the status of configuration items
- Configuration audit results
- Change request aging reports

DAR Elaboration

Examples of process related experiences include the following:

- Number of alternatives considered
- Evaluation results
- Recommended solutions to address significant issues

IRP Elaboration

Examples of process related experiences include the following:

- Trends in time required to resolve service incidents
- Number of times the incident management system is accessed and for what purpose (e.g., identify workaround for known incident)
- Results of applying workarounds and implementing action proposals

IWM Elaboration

Examples of work process related experiences include the following:

- Defined process for the work
- Number of tailoring options exercised by the work group to create its defined process
- Interface coordination issue trends (i.e., number identified, number closed)
- Number of times the process asset library is accessed for assets related to work planning by work group members
- Records of expenses related to holding face-to-face meetings versus holding meetings using collaborative equipment such as teleconferencing and videoconferencing
- Work group's shared vision
- Team charters

OPD Elaboration

Examples of process related experiences include the following:

- Submission of lessons learned to the organization's process asset library
- Submission of measurement data to the organization's measurement repository
- Status of the change requests submitted to modify the organization's standard process
- Record of non-standard tailoring requests

OPF Elaboration

Examples of work process related experiences include the following:

- Criteria used to prioritize candidate process improvements
- Appraisal findings that address strengths and weaknesses of the organization's processes
- Status of improvement activities against the schedule
- Records of tailoring the organization's set of standard processes and implementing them on identified work activities

OPM Elaboration

Examples of process related experiences include the following:

- Lessons learned captured from analysis of process performance data compared to business objectives
- Documented measures of the costs and benefits resulting from implementing and deploying improvements
- Report of a comparison of similar development processes to identify the potential for improving efficiency

OPP Elaboration

Examples of work process related experiences include the following:

- Process performance baselines
- Percentage of measurement data that is rejected because of inconsistencies with the process performance measurement definitions

OT Elaboration

Examples of process related experiences include the following:

- Results of training effectiveness surveys
- Training program performance assessment results
- Course evaluations
- Training requirements from an advisory group

PPQA Elaboration

Examples of process related experiences include the following:

- Evaluation logs
- Quality trends
- Noncompliance reports
- Status reports of corrective actions
- Cost of quality reports for the work

QWM Elaboration

Examples of process related experiences include the following:

- Records of quantitative management data from the work, including results from the periodic review of the actual performance of the subprocesses selected for management against established interim objectives for the work
- Suggested improvements to process performance models

REQM Elaboration

Examples of process related experiences include the following:

- Requirements traceability matrix
- Number of unfunded requirements changes after baselining
- Lessons learned in resolving ambiguous requirements

RSKM Elaboration

Examples of process related experiences include the following:

- Risk parameters
- Risk categories
- Risk status reports

SAM Elaboration

Examples of process related experiences include the following:

- Results of supplier reviews
- Trade studies used to select suppliers
- Revision history of supplier agreements
- Supplier performance reports

SCON Elaboration

Examples of process related experiences include the following:

- Revision history for the list of threats and vulnerabilities that could significantly disrupt the delivery of services
- Risk exposure to significant service disruption
- Changes to risk exposure
- Costs associated with service continuity activities
- Verification and validation analysis reports

SD Elaboration

Examples of process related experiences include the following:

- Number of issues raised over terms in the service agreement (following its implementation)
- Measures of service system component use, availability, and performance
- Trends in lead time for responding to service requests
- Reviews of the results of service request responses

SSD Addition

SSD Elaboration

Examples of process related experiences include the following:

- List of requirements for a service or service system that are ambiguous
- Number of requirements introduced at each phase of the work lifecycle
- Lessons learned from the requirements allocation process
- Results of make, buy, or reuse analyses
- Design defect density
- Results of applying new methods and tools
- Records of the receipt of service system components, exception reports, confirmation of configuration status, and results of readiness checking
- Percentage of total development effort spent in service system integration (actual to date plus estimate to complete)
- Defects found in the service system and test environment during service system integration, verification, and validation
- Peer review records that include conduct time and average preparation time

SST Elaboration

Examples of process related experiences include the following:

- Deployment assessment artifacts
- Post deployment review results and lessons learned

STSM Elaboration

Examples of process related experiences include the following:

- Customer requests for new services
- Customer questions to clarify service descriptions
- Status of change requests submitted to modify the organization's standard services
- Record of non-standard tailoring requests

WMC Elaboration

Examples of process related experiences include the following:

- Records of significant deviations
- Criteria for what constitutes a deviation
- Corrective action results

WP Elaboration

Examples of process related experiences include the following:

- Work data library structure
- Work attribute estimates
- Risk impacts and probability of occurrence

Applying Generic Practices

Generic practices are components that can be applied to all process areas. Think of generic practices as reminders. They serve the purpose of reminding you to do things right and are expected model components.

For example, consider the generic practice, “Establish and maintain the plan for performing the process” (GP 2.2). When applied to the Work Planning process area, this generic practice reminds you to plan the activities involved in creating the plan for the work. When applied to the Organizational Training process area, this same generic practice reminds you to plan the activities involved in developing the skills and knowledge of people in the organization.

Process Areas that Support Generic Practices

While generic goals and generic practices are the model components that directly address the institutionalization of a process across the organization, many process areas likewise address institutionalization by supporting the implementation of the generic practices. Knowing these relationships will help you effectively implement the generic practices.

Such process areas contain one or more specific practices that when implemented can also fully implement a generic practice or generate a work product that is used in the implementation of a generic practice.

An example is the Configuration Management process area and GP 2.6, “Place selected work products of the process under appropriate levels of control.” To implement the generic practice for one or more process areas, you might choose to implement the Configuration Management process area, all or in part, to implement the generic practice.

Another example is the Organizational Process Definition process area and GP 3.1, “Establish and maintain the description of a defined process.” To implement this generic practice for one or more process areas, you should first implement the Organizational Process Definition process area, all or in part, to establish the organizational process assets that are needed to implement the generic practice.

Table 6.2 describes (1) the process areas that support the implementation of generic practices and (2) the recursive relationships between generic practices and their closely related process areas. Both types of

relationships are important to remember during process improvement to take advantage of the natural synergies that exist between the generic practices and their related process areas.

Table 6.2 Generic Practice and Process Area Relationships

<i>Generic Practice</i>	<i>Roles of Process Areas in Implementation of the Generic Practice</i>	<i>How the Generic Practice Recursively Applies to its Related Process Area(s)¹⁴</i>
GP 2.2 Plan the Process	Work Planning: The work planning process can implement GP 2.2 in full for all but possibly the organizational process areas and Work Planning itself.	GP 2.2 applied to the work planning process can be characterized as “plan the plan” and covers planning work planning activities.
GP 2.3 Provide Resources GP 2.4 Assign Responsibility	Work Planning: The part of the work planning process that implements Work Planning SP 2.4, “Plan the Work Resources,” supports the implementation of GP 2.3 and GP 2.4 for all but possibly the organizational process areas and perhaps initially for Work Planning itself by identifying needed processes, roles, and responsibilities to ensure the proper staffing, facilities, equipment, and other assets needed for the work are secured.	
GP 2.5 Train People	Organizational Training: The organizational training process supports the implementation of GP 2.5 as applied to all process areas by making the training that addresses strategic or organization-wide training needs available to those who will perform or support the process. Work Planning: The part of the work planning process that implements Work Planning SP 2.5, “Plan Needed Knowledge and Skills,” and the organizational training process, supports the implementation of GP 2.5 in full for all but possibly the organizational process areas.	GP 2.5 applied to the organizational training process covers training for performing the organizational training activities, which addresses the skills required to manage, create, and accomplish the training.
GP 2.6 Control Work Products	Configuration Management: The configuration management process can implement GP 2.6 in full for all process areas.	GP 2.6 applied to the configuration management process covers change and version control for the work products produced by configuration management activities.

¹⁴ When the relationship between a generic practice and a process area is less direct, the risk of confusion is reduced; therefore, we do not describe all recursive relationships in the table (e.g., for generic practices 2.3, 2.4, and 2.10).

<i>Generic Practice</i>	<i>Roles of Process Areas in Implementation of the Generic Practice</i>	<i>How the Generic Practice Recursively Applies to its Related Process Area(s)¹⁴</i>
GP 2.7 Identify and Involve Relevant Stakeholders	Work Planning: The part of the work planning process that implements Work Planning SP 2.6, “Plan Stakeholder Involvement,” can implement the stakeholder identification part (first two subpractices) of GP 2.7 in full for all but possibly the organizational process areas. Work Monitoring and Control: The part of the work monitoring and control process that implements Work Monitoring and Control SP 1.5, “Monitor Stakeholder Involvement,” can aid in implementing the third subpractice of GP 2.7 for all but possibly the organizational process areas. Integrated Work Management: The part of the integrated work management process that implements Integrated Work Management SP 2.1, “Manage Stakeholder Involvement,” can aid in implementing the third subpractice of GP 2.7 for all but possibly the organizational process areas.	GP 2.7 applied to the work planning process covers the involvement of relevant stakeholders in work planning activities. GP 2.7 applied to the work monitoring and control process covers the involvement of relevant stakeholders in work monitoring and control activities. GP 2.7 applied to the integrated work management process covers the involvement of relevant stakeholders in integrated work management activities.
GP 2.8 Monitor and Control the Process	Work Monitoring and Control: The work monitoring and control process can implement GP 2.8 in full for all but possibly the organizational process areas. Measurement and Analysis: For all processes, the Measurement and Analysis process area provides general guidance about measuring, analyzing, and recording information that can be used in establishing measures for monitoring performance of the process.	GP 2.8 applied to the work monitoring and control process covers the monitoring and controlling of the monitor and control activities for the work.
GP 2.9 Objectively Evaluate Adherence	Process and Product Quality Assurance: The process and product quality assurance process can implement GP 2.9 in full for all process areas (except perhaps for Process and Product Quality Assurance itself).	GP 2.9 applied to the process and product quality assurance process covers the objective evaluation of quality assurance activities and selected work products.

<i>Generic Practice</i>	<i>Roles of Process Areas in Implementation of the Generic Practice</i>	<i>How the Generic Practice Recursively Applies to its Related Process Area(s)¹⁴</i>
GP 2.10 Review Status with Higher Level Management	Work Monitoring and Control: The part of the work monitoring and control process that implements Work Monitoring and Control SP 1.6, "Conduct Progress Reviews," and SP 1.7, "Conduct Milestone Reviews," supports the implementation of GP 2.10 for all but possibly the organizational process areas, perhaps in full, depending on higher level management involvement in these reviews.	
GP 3.1 Establish a Defined Process	Integrated Work Management: The part of the integrated work management process that implements Integrated Work Management SP 1.1, "Establish the Defined Process for the Work," can implement GP 3.1 in full for all but possibly the organizational process areas. Organizational Process Definition: For all processes, the organizational process definition process establishes the organizational process assets needed to implement GP 3.1.	GP 3.1 applied to the integrated work management process covers establishing defined processes for integrated work management activities.
GP 3.2 Collect Process Related Experiences	Integrated Work Management: The part of the integrated work management process that implements Integrated Work Management SP 1.7, "Contribute to Organizational Process Assets," can implement GP 3.2 in part or in full for all but possibly the organizational process areas. Organizational Process Focus: The part of the organizational process focus process that implements Organizational Process Focus SP 3.4, "Incorporate Experiences into Organizational Process Assets," can implement GP 3.2 in part or in full for all process areas. Organizational Process Definition: For all processes, the organizational process definition process establishes the organizational process assets needed to implement GP 3.2.	GP 3.2 applied to the integrated work management process covers collecting process related experiences derived from planning and performing integrated work management activities.

Given the dependencies that generic practices have on these process areas, and given the more holistic view that many of these process areas provide, these process areas are often implemented early, in whole or in part, before or concurrent with implementing the associated generic practices.

There are also a few situations where the result of applying a generic practice to a particular process area would seem to make a whole process area redundant, but, in fact, it does not. It can be natural to think that applying GP 3.1, “Establish a Defined Process,” to the Work Planning and Work Monitoring and Control process areas gives the same effect as the first specific goal of Integrated Work Management, “Use the Defined Process for the Work.”

Although it is true that there is some overlap, the application of the generic practice to these two process areas provides defined processes covering work planning and work monitoring and control activities. These defined processes do not necessarily cover support activities (e.g., configuration management), other work management processes (e.g., integrated work management), or other processes. In contrast, the defined process for the work, provided by the Integrated Work Management process area, covers all appropriate processes.

CAPACITY AND AVAILABILITY MANAGEMENT

A Project and Work Management Process Area at Maturity Level 3

Purpose

The purpose of Capacity and Availability Management (CAM) is to ensure effective service system performance and ensure that resources are provided and used effectively to support service requirements.

Introductory Notes

The Capacity and Availability Management process area involves establishing and maintaining capacity and availability at a justifiable cost and with an efficient use of resources. Capacity and availability management activities can be performed at different levels of the organization, including across different services.

The Capacity and Availability Management process area involves the following activities:

- Establishing and maintaining a capacity and availability management strategy
- Providing and allocating resources appropriately
- Monitoring, analyzing, understanding, and reporting on current and future demand for services, use of resources, capacity, service system performance, and service availability
- Determining corrective actions to ensure appropriate capacity and availability while balancing costs against resources needed and supply against demand

“Capacity” is the degree to which one thing can support, hold, process, or produce another thing. In the context of services, capacity can refer to the maximum amount of service delivery or maximum number of service requests that a service system can handle successfully within a fixed period of time. Capacity is a quality attribute. The definition and measurement of capacity can differ for different types of services and service systems and can be defined in the service agreement. In addition, capacity definitions and measures can be derived from service agreements, rather than reflected there. If the service agreement has no explicit capacity requirements, it may still imply derived capacity requirements for the service or service system. For some services, capacity can be the maximum size, volume, or throughput of service system components.

Examples of capacity include the following:

- Number of vehicles requiring maintenance that can be received on the maintenance premises within a 24-hour period
- Number of loan application forms that can be processed within an 8-hour period
- Size or volume of a disk drive
- Square feet of floor space that can be cleaned per hour
- Number of pounds that a loader can hold at one time
- Total amount of fluid that can be absorbed by a service system component
- Number of calls per day that can be handled by a call center
- Number of appraisals that can be performed per year

As part of establishing the capacity and availability management strategy, the following are determined:

- Resources appropriate to manage
- Aspects of the service system that affect service availability and should be measured, monitored, analyzed, and managed

Examples of resources include staff, hardware, power, and available space.

“Availability” is the degree to which something is accessible and usable when needed. In the context of services, availability can refer to the set of times, places, and other circumstances in which services are to be delivered, service requests are to be honored, or other aspects of a service agreement are to be valid. Availability is a quality attribute. Different work groups can have different definitions and measurements of availability for different types of services and service systems and for various perspectives of availability (e.g., business perspective, end-user perspective, customer perspective, service provider perspective). The definition of availability requires an understanding of how service system components support service requirements for availability, which can be defined in the service agreement. In addition, availability requirements and measures can both depend on and affect other closely related quality attribute requirements, such as maintainability, reliability, sustainability, and security.

Examples of service system components for which availability can be a concern include the following:

- Anesthesia equipment
- Cafeteria staff
- Maintenance supplies
- Transportation components (e.g., cabs, buses, trucks, drivers)
- Call center staff
- Lead appraisers

Availability is one of the most visible indicators of service quality in the eyes of the end user and customer. For some services, understanding the

relationships among attributes such as reliability and maintainability and availability is important to managing availability.

Availability of services can depend on the following:

- Availability of service system components
- Resilience of the service system to failure
- Quality of the maintenance performed on the service system
- Quality of the support provided to the service system
- Effectiveness of service processes
- Security practices

“Capacity management” is focused on how best to provide resources to meet service requirements. “Availability management” is focused on delivering a sustained level of availability to meet service requirements. However, at a high level, many of the best practices for capacity management and availability management are similar enough to be combined, and they become closely coupled. Capacity management provides the means for achieving sustained availability to meet service requirements. (For some services, it provides spare capacity and resilience as well.)

The simultaneous production and consumption of services is one of the unique characteristics of services. This characteristic presents some challenges for managing the capacity and availability of services. If the capacity and availability to provide the service is not present when demand occurs, the customer must wait, resulting in costs of one kind or another (e.g., lower customer satisfaction, lost business as customers give up on waiting, financial penalties). Costs can also be associated with excess capacity when estimated demand does not occur (e.g., cost of staff on the payroll sitting idle, purchasing costs of excess capacity).

Examples of capacity management challenges include the following:

- Providing enough and the right kind of hotel rooms to meet demand without double booking or ending up with empty hotel rooms
- Providing enough baggage handlers for the volume of travelers at an airport without having excess or idle baggage handlers

Examples of availability management challenges include the following:

- Ensuring that landscaping services are delivered, landscaping equipment is maintained, and landscaping staff are able to take days off (e.g., holidays, annual leave) as defined in relevant agreements
- Monitoring the reliability of landscaping equipment and staff (e.g., the absentee rate among landscaping staff members)
- Determining corrective action when service availability drops below levels in the service agreement

Capacity and availability management includes establishing service system representations and using these representations for the following:

- Supporting negotiation of appropriate service agreements
- Planning
- Making decisions
- Considering corrective actions
- Providing and allocating resources to meet current and future service requirements

“Service system representations,” such as models, simulations, diagrams, maps, and prototypes, provide insight into how a service system will behave given specific work volumes and varieties. These representations can be built using spreadsheets, commercial off-the-shelf (COTS) tools (e.g., simulation packages), or tools developed in house. For some services, the representations can be known as historical baselines, trend analyses, analytical models, analysis of waiting times in queues, simulation models, statistical models (e.g., regression models, time series models), causal models (e.g., probabilistic networks), or application sizing.

The scope of capacity and availability management can be one service system or multiple service systems. If the service provider is operating multiple service systems, capacity and availability management processes can be performed independently on each discrete service system but the organization may realize reduced value.

Related Process Areas

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

Refer to the Service Continuity process area for more information about establishing and maintaining plans to ensure continuity of services during and following any significant disruption of normal operations.

Refer to the Service Delivery process area for more information about maintaining the service system.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

Refer to the Strategic Service Management process area for more information about establishing strategic needs and plans for standard services.

Refer to the Measurement and Analysis process area for more information about specifying measures.

Refer to the Work Planning process area for more information about establishing the service strategy and developing a work plan.

Specific Goal and Practice Summary

- SG 1 Prepare for Capacity and Availability Management
- SP 1.1 Establish a Capacity and Availability Management Strategy
 - SP 1.2 Select Measures and Analytic Techniques
 - SP 1.3 Establish Service System Representations
- SG 2 Monitor and Analyze Capacity and Availability
- SP 2.1 Monitor and Analyze Capacity
 - SP 2.2 Monitor and Analyze Availability
 - SP 2.3 Report Capacity and Availability Management Data

Specific Practices by Goal

SG 1 Prepare for Capacity and Availability Management

Preparation for capacity and availability management is conducted.

Preparation for capacity and availability management includes the following activities:

- Establishing and maintaining a strategy for managing capacity and availability to meet service requirements
- Selecting measures and analytic techniques to support availability and capacity management objectives
- Establishing and maintaining service system representations to understand current capacity, availability, and service system performance (i.e., describe what the normal capacity, availability, and service levels are)

Thresholds are established and maintained to define exception conditions in the service system, recognize breaches or near breaches of service requirements, and identify service incidents. In addition to understanding the capacity and availability of the current service system, capacity, availability, and service levels are estimated based on trends in service resource use, service system performance, and expected service requirements.

SP 1.1 Establish a Capacity and Availability Management Strategy

Establish and maintain a strategy for capacity and availability management.

A strategy for capacity and availability management is based on service requirements, failure and change request trend analysis, current resource use, and service system performance. Service system representations can help to develop a strategy for capacity and availability management. A strategy can address the minimum, maximum, and average use of services (i.e., service resources) over the short, medium, and long term as appropriate for the duration of the service.

It may be appropriate for some services to identify, plan for, and manage the availability of surge capacity or “reach-back” resources to respond to sudden, unexpected increases in demand. For some service types, the

management of the obsolescence of certain resources and services factor into the strategy for capacity and availability management.

Service system design documentation can help to determine resources and aspects of the service system to be measured, monitored, analyzed, and managed. However, design documents may not be available or may not accurately and comprehensively reflect all aspects of the live service environment that affect capacity and availability. Therefore, it is important to monitor and analyze *actual* capacity and availability data. Service strategies, information from day-to-day service delivery and monitoring, and service requirements from current service agreements can assist with these determinations.

Refer to the Service Delivery process area for more information about establishing service agreements.

Refer to the Service System Transition process area for more information about preparing for service system transition.

Refer to the Strategic Service Management process area for more information about establishing standard services.

The strategy for capacity and availability management can reflect factors such as constraints due to limited customer funding and the customer's acceptance of certain risks related to capacity and availability.

The service provider may not be able to influence or control demand and resource adjustments but is still required to formulate a strategy that best meets service requirements. If the service provider can influence or control demand and resource adjustments, the strategy can be more sophisticated than in situations in which the service provider cannot exercise such influence or control.

Example Work Products

1. Capacity and availability management strategy

Subpractices

1. Document resource and service use, performance, and availability.
2. Estimate future resource and service capacity and availability requirements.
3. Develop a capacity strategy that meets service requirements, meets the demand for resources and services, and addresses how resources are provided, used, and allocated.
4. Develop an availability strategy that meets service requirements and addresses delivering a sustained level of availability.

It may be appropriate for some services to include in the strategy an availability testing schedule, a service system maintenance strategy, and planned service outages.

Refer to the Service Continuity process area for more information about preparing for service continuity.

Refer to the Service Delivery process area for more information about maintaining the service system.

Refer to the Service System Transition process area for more information about preparing for service system transition.

5. Document monetized costs and benefits of the strategy and any assumptions.
6. Periodically revise the strategy.

It may also be necessary to revise the strategy on an event-driven basis.

SP 1.2 Select Measures and Analytic Techniques

Select measures and analytic techniques to be used in managing the capacity and availability of the service system.

The measures specified for managing capacity and availability can require the collection of business data, financial data, service data, technical data, service resource use data, performance data, and other data about the capacity and availability of the service system. Measurement objectives and the selection of measures and analytic techniques for capacity and availability management are largely influenced by the service agreement and specific properties of the service system.

Considerations for selection of measures also include which activities are being supported, reporting requirements, and how the information will be used. Supplier agreements should reflect or support the selected measures and analytic techniques as appropriate.

Refer to the Service Delivery process area for more information about establishing service agreements.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities.

Refer to the Supplier Agreement Management process area for more information about establishing supplier agreements.

Examples of availability measures include the following:

- Percentage available within agreed hours (this availability can be overall service availability or service component availability)
- Percentage unavailable within agreed hours (this unavailability can be overall service unavailability or service component unavailability)
- Duration of downtime due to failure (typically minutes, hours, or hours per week)
- Failure frequency
- Scope of impact (e.g., number of users who were affected, number of minutes that users lost productivity, number of transactions or vital business functions not processed or carried out, number of application services impeded)
- Response time of the service system to service incidents, transaction response times, and service response times (this response time can be a capacity measure or availability measure)
- Reliability (e.g., number of service breaks, mean time between failures, mean time between service incidents)

Examples of capacity measures are as follows:

- Use of service resources that are limited
- Use of service components
- Unused service resources that are limited
- Unused service components
- Throughput (e.g., number of concurrent users, number of transactions to be processed)
- Queue length (maximum and average)
- Number of a particular type of resource or one or more specific resources in use a selected number of times (this use can be monitored by calendar time)

Example Work Products

1. Operational definitions of capacity and availability measures
2. Traceability of capacity and availability measures to service requirements
3. Tools to support collection and analysis of capacity and availability data
4. Target measures or ranges to be met for selected measured attributes

Subpractices

1. Identify measures from organizational process assets that support capacity and availability management objectives.
2. Identify and specify additional measures that may be needed to support achieving capacity and availability management objectives for the service.

3. Analyze the relationship between identified measures and service requirements, and derive objectives that state specific target measures or ranges to be met for each measured attribute.

This analysis can provide input to the descriptions of standard services and service levels.

Refer to the Strategic Service Management process area for more information about establishing standard services.

SP 1.3 Establish Service System Representations

Establish and maintain service system representations to support capacity and availability management.

Service system representations provide insight into how the service system will behave given specific work volumes and varieties. These insights are used to support decision making about resource allocation, changes to the service system, service agreements, and other aspects of service management and delivery.

For many services, demand fluctuates widely. Managing services in the face of widely fluctuating demand is one of the unique challenges characteristic of services. Depending on the patterns of fluctuation, the representations can focus on small or medium time intervals (e.g., by hour of the day for work shift scheduling, day of the week, month of the year) or longer time intervals (e.g., seasons of the year, bi-annually, annually).

Estimated growth of the use of service resources is formulated using collected capacity and availability data, estimated service requirements, and service system representations.

Measurement objectives and specific properties of the service system determine the nature and extent of a service system representation. (The service agreement has a major influence on the measurement objectives.) Experience, historical data, modeling expertise, and current resource use can also influence the nature of a service system representation.

Refer to the Measurement and Analysis process area for more information about establishing measurement objectives and specifying analysis procedures.

Representations can be used to analyze the impact of change requests that are likely to affect availability and capacity. Representations can also be used to characterize the range of future demand that can be met and the impact of required service levels on the service system. Before representations of future behavior or service system performance can be established, descriptions of the normal use of service resources and service system performance should be established.

Examples of service system representations that support capacity and availability management include the following:

- Graphical representations showing a mix of two types of health care provider resources in a hospital with specific constraints and parameters indicating what might be the best allocation of the two resources
- Analysis of waiting lines for bank tellers
- Vehicle scheduling programs
- Simulation modeling of transaction arrival rates against a specific configuration of resources (e.g., bank tellers, network servers)
- Trend analysis of the availability, reliability, and maintainability of service system components
- Impact analysis of service system component failure
- Load testing to generate expected demand on a service system resource and ensure that service system components can perform according to the service agreement
- Fault tree analysis and single point of failure analysis

Service system representations can be established to provide input to support development of the service agreement and descriptions of standard services and service levels.

Refer to the Service Delivery process area for more information about establishing service agreements.

Refer to the Strategic Service Management process area for more information about establishing standard services.

Service system representations can be established during design of the service system. However, even if great care is taken during the design and development of the service system to ensure that it can meet service requirements over a wide range of operating conditions, service management and delivery should sustain the required levels of service system performance and quality during transition and operation.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

Service system representations are maintained throughout the service lifecycle.

Service system representations are generally not the same as the process performance baselines and models established in Organizational Process Performance (OPP) at levels 4 and 5. Several things distinguish representations from process performance baselines and models:

- OPP process performance models and baselines involve the use of statistical techniques to assist in developing an understanding of the performance or predicted performance of processes. Service system representations are not typically required to be developed in this way.

- Representations established in CAM are not required to be based on data collected from using the organization's set of standard processes.
- The focus of OPP is on process performance baselines and models. In addition to process data, the focus of CAM's service system representations includes non-process data, people, and other parts of the service system such as infrastructure and automated systems.
- Service system representations are established to support capacity and availability analysis specifically. This scope is narrower than the scope of OPP practices.

Refer to the Organizational Process Performance process area for more information about establishing performance baselines and models.

Although not *required* for capacity and availability management, representations provide opportunities to use statistical techniques such as statistical process control. These techniques can be used to quantitatively manage service system performance and quality and to improve service system capability.

Refer to the Quantitative Work Management process area for more information about quantitatively managing the work to achieve the established quality and process performance objectives for the work.

Example Work Products

1. Representations of resource and service use
2. Representations of service levels
3. Data on the use of resources and services
4. Data on current service levels delivered
5. Thresholds that define exception conditions and breaches

Subpractices

1. Collect measurements on the use of resources and services and the current service levels delivered.
2. Establish and maintain descriptions of the normal use of service resources and service system performance.

For some services, it may be advisable to establish general systems flow charts to identify the service system and its processes before determining the service system's current capacity, which can require determining the capacity of service system components.

3. Establish and maintain service system representations from collected measurements and analyses.

For some services, it may be advisable to estimate the capacity of the service system at peak work volumes.

4. Review and get agreement with relevant stakeholders about the descriptions of the normal use of service resources, service system performance, and service system representations.

5. Make available the descriptions of the normal use of service resources, service system performance, and service system representations.
6. Establish and maintain thresholds associated with demand, workload, use of service resources, and service system performance to define exception conditions in the service system and breaches or near breaches of service requirements.

Thresholds are typically set below the level at which an exception condition or breach of service requirement occurs to allow corrective action to prevent the breach of service requirement, over-use of resources, or poor service system performance.

SG 2 Monitor and Analyze Capacity and Availability

Capacity and availability are monitored and analyzed to manage resources and demand.

The contribution of each service system component to meeting service requirements is analyzed to successfully manage the capacity and availability of services. The efficient use of resources is managed according to the capacity and availability management strategy, which is developed to meet service requirements. It might not be possible for a service organization to influence demand for services and the requirement to do so is not implied by the phrase “manage resources and demand.” Efficient use of resources can include both reactive and proactive responses. Proactive responses are possible in situations in which the service provider can influence demand.

Actual capacity and availability data are monitored regularly. This actual data are also compared regularly with thresholds, descriptions of normal and expected use, and business objectives. These comparisons identify exception conditions in the service system, breaches or near-breaches of service requirements, and changes in the patterns of use of service system resources that can indicate trends. For example, regular monitoring of actual service resource use against estimated service resource use might reveal a pending breach of service requirements.

SP 2.1 Monitor and Analyze Capacity

Monitor and analyze capacity against thresholds.

The use of each service resource is documented as well as the use of each resource by each service (i.e., the extent or degree of use by each service for a given service resource). The impact of service component failures on resources is analyzed.

It can be appropriate for some services to monitor use of surge capacity or “reach-back” resources and determine whether corrective actions are needed such as adjustments to resources provided, adjustments to thresholds, or adjustments to descriptions of the normal use of service resources and service system performance.

The need for corrective actions can be identified as a result of monitoring and analyzing capacity and availability or in response to service incidents, change requests, changes to service requirements (current and future) or to

improve service system performance or prevent breaches of the service agreement.

Refer to the Measurement and Analysis process area for more information about specifying data collection and storage procedures.

Example Work Products

1. Service resource use data
2. Growth analysis of service use
3. List of resources not used as estimated

Subpractices

1. Monitor the use of service resources against thresholds, descriptions of normal use, and service system performance.

Refer to the Work Monitoring and Control process area for more information about monitoring work planning parameters.

2. Monitor service response times.
3. Identify breaches of thresholds and exception conditions.

Breaches of thresholds and exception conditions can constitute or indicate an incident.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

Refer to the Service Delivery process area for more information about operating the service system.

4. Determine the corrective action to be taken.

Corrective actions include adjustments to resources and services to prevent performance problems or improve service performance. Adjustments can be automated, performed manually, or both.

Examples of corrective actions include the following:

- Rebalancing workload among resources
- Improving service system processes to allow for greater productivity, efficiency, and effectiveness
- Improving service system design such as making use of new technologies to allow for greater productivity, efficiency, or effectiveness
- Adding capacity to the service system such as adding nurses, servers, or phone lines
- Tuning to optimize and improve capacity or service system performance
- Adjusting service requirements
- Improving the use of service resources through demand management techniques

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

5. Estimate future changes (either growth or reduction) in the use of resources and services.

Methods and tools for estimating service system behavior include trend analysis, analytical modeling, simulation modeling, baseline models, and application sizing.

Estimates of growth in the use of resources can be based on collected capacity and availability data, estimated service requirements, and service system representations.

6. Store capacity and availability data, specifications, analysis results, and monitoring data.

SP 2.2 Monitor and Analyze Availability

Monitor and analyze availability against targets.

To prevent the failure of service system components and support the availability of the system, the service system must be monitored. At a minimum, availability is monitored. Other quality attributes can be appropriate to monitor depending on the type of service provided. Reliability and maintainability are other quality attributes that can be appropriate to monitor for many types of service systems. Resilience of the service system to service component failure can also be monitored and the impacts of specific failures on service system availability can be identified.

Example Work Products

1. Alarm data
2. Availability data
3. Reliability data
4. Maintainability data

Subpractices

1. Monitor availability, reliability, and maintainability against their requirements.

2. Analyze trends in availability, reliability, and maintainability.

For some services, it may be advisable to perform failure trend analysis as well.

3. Identify breaches of availability, reliability, and maintainability requirements.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

4. Determine the corrective actions to be taken.

Refer to the Service Delivery process area for more information about maintaining the service system.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

SP 2.3 Report Capacity and Availability Management Data***Report capacity and availability management data to relevant stakeholders.***

Reports are provided to relevant stakeholders that summarize information about capacity and availability. These reports support monitoring against the service agreement and service reviews. How data are reported strongly influences how much benefit is derived from capacity and availability management.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

Service agreements and supplier agreements can define the information to be reported, to whom it should be delivered, and how it is provided (e.g., format, detail, distribution, media). The information should be appropriate to the audience, which means it should be understandable (e.g., not overly technical) and it may need to address multiple perspectives. These perspectives can include business, end user, customer, or service provider perspectives.

Capacity and availability reports can be regular or ad hoc, depending on what is in the service agreement. For some services, reporting can be greatly simplified by the use of databases offering automated reporting features. Organizational reporting standards should be followed and standard tools and techniques should be used when they exist to support the integration and consolidation of information in the reports.

Refer to the Service Delivery process area for more information about establishing service agreements.

Refer to the Organizational Process Definition process area for more information about establishing standard processes.

Refer to the Supplier Agreement Management process area for more information about establishing supplier agreements.

Availability is often reported as a percentage. In addition to reporting availability, some service providers also report on reliability (e.g., reliability of the service, reliability of service system components) because it is required in the service agreement. The service agreement can also require reporting on maintainability and other quality attributes.

Example Work Products

1. Service system performance reports
2. Service resource use reports
3. Service resource use projections
4. Service availability reports

Subpractices

1. Report the performance and use of resources and services.
2. Report exception conditions in the service system and breaches of service requirements.
3. Report data from monitoring against growth estimates in resource and service use.
4. Report the availability, reliability, and maintainability of resources and services.

CAUSAL ANALYSIS AND RESOLUTION

A Support Process Area at Maturity Level 5

Purpose

The purpose of Causal Analysis and Resolution (CAR) is to identify causes of selected outcomes and take action to improve process performance.

Introductory Notes

Causal analysis and resolution improves quality and productivity by preventing the introduction of defects or problems and by identifying and appropriately incorporating the causes of superior process performance.

The Causal Analysis and Resolution process area involves the following activities:

- Identifying and analyzing causes of selected outcomes. The selected outcomes can represent defects and problems that can be prevented from happening in the future or successes that can be implemented in work groups or the organization.
- Taking actions to complete the following:
 - Remove causes and prevent the recurrence of those types of defects and problems in the future
 - Proactively analyze data to identify potential problems and prevent them from occurring
 - Incorporate the causes of successes into the process to improve future process performance

Reliance on detecting defects and problems after they have been introduced is not cost effective. It is more effective to prevent defects and problems by integrating Causal Analysis and Resolution activities into each phase of the work lifecycle.

Since similar outcomes may have been previously encountered in other work or in earlier phases or tasks of the current work activity, Causal Analysis and Resolution activities are mechanisms for communicating lessons learned among work groups.

Types of outcomes encountered are analyzed to identify trends. Based on an understanding of the defined process and how it is implemented, root causes of these outcomes and future implications of them are determined.

Since it is impractical to perform causal analysis on all outcomes, targets are selected by tradeoffs on estimated investments and estimated returns of quality, productivity, and cycle time.

Measurement and analysis processes should already be in place. Existing defined measures can be used, though in some instances new

measurement definitions, redefinitions, or clarified definitions may be needed to analyze the effects of a process change.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Causal Analysis and Resolution activities provide a mechanism for work groups to evaluate their processes at the local level and look for improvements that can be implemented.

When improvements are judged to be effective, the information is submitted to the organizational level for potential deployment in the organizational processes.

The specific practices of this process area apply to a process that is selected for quantitative management. Use of the specific practices of this process area can add value in other situations, but the results may not provide the same degree of impact to the organization's quality and process performance objectives.

Related Process Areas

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Refer to the Organizational Performance Management process area for more information about selecting and implementing improvements for deployment.

Refer to the Quantitative Work Management process area for more information about quantitatively managing the work to achieve the established quality and process performance objectives for the work.

Specific Goal and Practice Summary

SG 1 Determine Causes of Selected Outcomes

SP 1.1 Select Outcomes for Analysis

SP 1.2 Analyze Causes

SG 2 Address Causes of Selected Outcomes

SP 2.1 Implement Action Proposals

SP 2.2 Evaluate the Effect of Implemented Actions

SP 2.3 Record Causal Analysis Data

Specific Practices by Goal

SG 1 Determine Causes of Selected Outcomes

Root causes of selected outcomes are systematically determined.

A root cause is an initiating element in a causal chain which leads to an outcome of interest.

SP 1.1 Select Outcomes for Analysis

Select outcomes for analysis.

This activity could be triggered by an event (reactive) or could be planned periodically, such as at the beginning of a new phase or task (proactive).

Example Work Products

1. Data to be used in the initial analysis
2. Initial analysis results data
3. Outcomes selected for further analysis

Subpractices

1. Gather relevant data.

Examples of relevant data include the following:

- Defects reported by customers or end users
- Defects reported by service teams
- Defects found in service verification
- Productivity measures that are higher than expected
- Project management problem reports requiring corrective action
- Process capability problems
- Resource throughput, utilization, or response time measurements
- Help desk calls, by time and incident category
- Inadequate availability of the service system
- Service fulfillment or service satisfaction problems

2. Determine which outcomes to analyze further.

When determining which outcomes to analyze further, consider their source, impact, frequency of occurrence, similarity, the cost of analysis, the time and resources needed, safety considerations, etc.

Examples of methods for selecting outcomes include the following:

- Pareto analysis
- Histograms
- Box and whisker plots for attributes
- Failure mode and effects analysis (FMEA)
- Cause and effects analysis (e.g., design failure mode and effects analysis for the service system being developed, process failure mode and effects analysis for service system development or service delivery)

3. Formally define the scope of the analysis, including a clear definition of the improvement needed or expected, stakeholders affected, target affected, etc.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal

evaluation process that evaluates identified alternatives against established criteria.

SP 1.2 Analyze Causes

Perform causal analysis of selected outcomes and propose actions to address them.

The purpose of this analysis is to define actions that will address selected outcomes by analyzing relevant outcome data and producing action proposals for implementation.

Example Work Products

1. Root cause analysis results
2. Action proposal

Subpractices

1. Conduct causal analysis with those who are responsible for performing the task.

Causal analysis is performed, typically in meetings, with those who understand the selected outcome under study. Those who have the best understanding of the selected outcome are typically those who are responsible for performing the task. The analysis is most effective when applied to real time data, as close as possible to the event which triggered the outcome.

Examples of when to perform causal analysis include the following:

- When a stable subprocess does not meet its specified quality and process performance objectives, or when a subprocess needs to be stabilized
- During the task, if and when problems warrant a causal analysis meeting
- When a work product exhibits an unexpected deviation from its requirements
- When process performance exceeds expectations
- At the start of a new phase or task

Refer to the Quantitative Work Management process area for more information about performing root cause analysis.

2. Analyze selected outcomes to determine their root causes.

Analysis of process performance baselines and models can aid in the identification of potential root causes.

Depending on the type and number of outcomes, it can be beneficial to look at the outcomes in several ways to ensure all potential root causes are investigated. Consider looking at individual outcomes as well as grouping the outcomes.

Examples of methods to determine root causes include the following:

- Cause-and-effect (fishbone) diagrams
- Check sheets

3. Combine selected outcomes into groups based on their root causes.

In some cases, outcomes can be influenced by multiple root causes.

Examples of cause groups or categories include the following:

- Inadequate training and skills
- Breakdown of communication
- Not accounting for all details of a task
- Making mistakes in manual procedures (e.g., keyboard entry)
- Process deficiency

Where appropriate, look for trends or symptoms in or across groupings.

4. Create an action proposal that documents actions to be taken to prevent the future occurrence of similar outcomes or to incorporate best practices into processes.

Process performance models can support cost benefit analysis of action proposals through prediction of impacts and return on investment.

Examples of proposed preventative actions include changes to the following:

- The process in question
- Training
- Tools
- Methods
- Work products

Examples of incorporating best practices include the following:

- Creating activity checklists, which reinforce training or communications related to common problems and techniques for preventing them
- Changing a process so that error-prone steps do not occur
- Automating all or part of a process
- Reordering process activities
- Adding process steps, such as task kickoff meetings to review common problems as well as actions to prevent them

An action proposal usually documents the following:

- Originator of the action proposal
- Description of the outcome to be addressed
- Description of the cause
- Cause category
- Phase identified
- Description of the action
- Time, cost, and other resources required to implement the action proposal
- Expected benefits from implementing the action proposal
- Estimated cost of not fixing the problem
- Action proposal category

SG 2 Address Causes of Selected Outcomes***Root causes of selected outcomes are systematically addressed.***

Work groups operating according to a well-defined process systematically analyze where improvements are needed and implement process changes to address root causes of selected outcomes.

SP 2.1 Implement Action Proposals***Implement selected action proposals developed in causal analysis.***

Action proposals describe tasks necessary to address root causes of analyzed outcomes to prevent or reduce the occurrence or recurrence of negative outcomes, or incorporate realized successes. Action plans are developed and implemented for selected action proposals. Only changes that prove to be of value should be considered for broad implementation.

Example Work Products

1. Action proposals selected for implementation
2. Action plans

Subpractices

1. Analyze action proposals and determine their priorities.

Criteria for prioritizing action proposals include the following:

- Implications of not addressing the outcome
- Cost to implement process improvements to address the outcome
- Expected impact on quality

Process performance models can be used to help identify interactions among multiple action proposals.

2. Select action proposals to be implemented.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

3. Create action plans for implementing the selected action proposals.

Examples of information provided in an action plan include the following:

- Person responsible for implementation
- Detailed description of the improvement
- Description of the affected areas
- People who are to be kept informed of status
- Schedule
- Cost expended
- Next date that status will be reviewed
- Rationale for key decisions
- Description of implementation actions

4. Implement action plans.

To implement action plans, the following tasks should be performed:

- Make assignments.
- Coordinate the people doing the work.
- Review the results.
- Track action items to closure.

Experiments may be conducted for particularly complex changes.

Examples of experiments include the following:

- Using a temporarily modified process
- Using a new tool

Actions may be assigned to members of the causal analysis team, members of the work group, or other members of the organization.

5. Look for similar causes that may exist in other processes and work products and take action as appropriate.

SP 2.2 Evaluate the Effect of Implemented Actions

Evaluate the effect of implemented actions on process performance.

Refer to the Quantitative Work Management process area for more information about selecting measures and analytic techniques.

Once the changed process is deployed across the work group, the effect of changes is evaluated to verify that the process change has improved process performance.

Example Work Products

1. Analysis of process performance and change in process performance

Subpractices

1. Measure and analyze the change in process performance of the affected processes or subprocesses for the work.

This subpractice determines whether the selected change has positively influenced process performance and by how much.

An example of a change in the process performance of a service would be a change in the predicted ability of the design to meet the quality and process performance objectives.

Another example would be a change in the cost of delivering the service after a change in the subprocess for integrating revised service system components. This change in performance would be determined through monitoring the delivered service before and after the improvement has been made and comparing these differences statistically (e.g., through hypothesis testing). On a statistical process control chart, this change in process performance would be represented by an improvement in the mean, a reduction in variation, or both.

Statistical and other quantitative techniques (e.g., hypothesis testing) can be used to compare the before and after baselines to assess the statistical significance of the change.

2. Determine the impact of the change on achieving the quality and process performance objectives for the work.

This subpractice determines whether the selected change has positively influenced the ability of the work group to meet its quality and process performance objectives by understanding how changes in the process performance data have affected the objectives. Process performance models can aid in the evaluation through prediction of impacts and return on investment.

3. Determine and document appropriate actions if the process or subprocess improvements did not result in expected benefits.

SP 2.3 Record Causal Analysis Data

Record causal analysis and resolution data for use across work groups and the organization.

Example Work Products

1. Causal analysis and resolution records
2. Organizational improvement proposals

Subpractices

1. Record causal analysis data and make the data available so that other work groups can make appropriate process changes and achieve similar results.

Record the following:

- Data on outcomes that were analyzed
- Rationale for decisions
- Action proposals from causal analysis meetings
- Action plans resulting from action proposals
- Cost of analysis and resolution activities
- Measures of changes to the process performance of the defined process resulting from resolutions

2. Submit process improvement proposals for the organization when the implemented actions are effective for the working group as appropriate.

When improvements are judged to be effective, the information can be submitted to the organizational level for potential inclusion in the organizational processes.

Refer to the Organizational Performance Management process area for more information about selecting improvements.

CONFIGURATION MANAGEMENT

A Support Process Area at Maturity Level 2

Purpose

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

Introductory Notes

The Configuration Management process area involves the following activities:

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

The work products placed under configuration management include the products that are delivered to the customer, designated internal work products, acquired products, tools, and other items used in creating and describing these work products. (See the definition of “configuration management” in the glossary.)

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

- Service system architecture documentation and design data
- Drawings
- Product specifications
- Software
- Test tools and test scripts
- Compilers
- Product data files
- Product technical publications
- Service agreements
- Authorized versions of controlled software and associated licensing information and documentation
- Repositories of asset information
- Plans
- Process descriptions
- Requirements

Acquired products may need to be placed under configuration management by both the supplier and the acquirer. Provisions for conducting configuration management should be established in supplier agreements. Methods to ensure that data are complete and consistent should be established and maintained.

Refer to the Supplier Agreement Management process area for more information about establishing supplier agreements.

Configuration management of work products can be performed at several levels of granularity. Configuration items can be decomposed into configuration components and configuration units. Only the term “configuration item” is used in this process area. Therefore, in these practices, “configuration item” may be interpreted as “configuration component” or “configuration unit” as appropriate. (See the definition of “configuration item” in the glossary.)

Baselines provide a stable basis for the continuing evolution of configuration items.

Baselines are added to the configuration management system as they are developed. Changes to baselines and the release of work products built from the configuration management system are systematically controlled and monitored via the configuration control, change management, and configuration auditing functions of configuration management.

This process area applies not only to configuration management on work group products but also to configuration management of organizational work products such as standards, procedures, reuse libraries, and other shared supporting assets.

Configuration management is focused on the rigorous control of the managerial and technical aspects of work products, including the delivered product or service.

This process area covers the practices for performing the configuration management function and is applicable to all work products that are placed under configuration management.

For product lines and standard services, configuration management can involve additional considerations due to the sharing of core assets across services and service systems and across multiple versions of core assets and service system components. (See the definition of “product line” in the glossary.)

Related Process Areas

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan and managing corrective action to closure.

Refer to the Work Planning process area for more information about developing a work plan.

Specific Goal and Practice Summary

SG 1 Establish Baselines

- SP 1.1 Identify Configuration Items
- SP 1.2 Establish a Configuration Management System
- SP 1.3 Create or Release Baselines

SG 2 Track and Control Changes

- SP 2.1 Track Change Requests
- SP 2.2 Control Configuration Items

SG 3 Establish Integrity

- SP 3.1 Establish Configuration Management Records
- SP 3.2 Perform Configuration Audits

Specific Practices by Goal

SG 1 Establish Baselines

Baselines of identified work products are established.

Specific practices to establish baselines are covered by this specific goal. The specific practices under the Track and Control Changes specific goal serve to maintain the baselines. The specific practices of the Establish Integrity specific goal document and audit the integrity of the baselines.

SP 1.1 Identify Configuration Items

Identify configuration items, components, and related work products to be placed under configuration management.

Configuration identification is the selection and specification of the following:

- Products delivered to the customer
- Designated internal work products
- Acquired products
- Tools and other capital assets of the work environment
- Other items used in creating and describing these work products

Configuration items can include hardware, equipment, and tangible assets as well as software and documentation. Documentation can include requirements specifications and interface documents. Other documents that serve to identify the configuration of the product or service, such as test results, may also be included.

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

Example Work Products

1. Identified configuration items

Subpractices

1. Select configuration items and work products that compose them based on documented criteria.

Example criteria for selecting configuration items at the appropriate work product level include the following:

- Work products that can be used by two or more groups
- Work products that are expected to change over time either because of errors or changes in requirements
- Work products that are dependent on each other (i.e., a change in one mandates a change in the others)
- Work products critical to the success of the work

Examples of work products that may be part of a configuration item include the following:

- Design
- Test plans and procedures
- Test results
- Interface descriptions
- Drawings
- Source code
- Tools (e.g., compilers)
- Process descriptions
- Requirements
- The declared business case, logic, or value

2. Assign unique identifiers to configuration items.
3. Specify the important characteristics of each configuration item.

Example characteristics of configuration items include author, document or file type, programming language for software code files, and the purpose the configuration item serves.

4. Specify when each configuration item is placed under configuration management.

Example criteria for determining when to place work products under configuration management include the following:

- When the work product is ready for test
- Stage of the project or service lifecycle
- Degree of control desired on the work product
- Cost and schedule limitations
- Stakeholder requirements

5. Identify the owner responsible for each configuration item.
6. Specify relationships among configuration items.

Incorporating the types of relationships (e.g., parent-child, dependency) that exist among configuration items into the configuration management structure (e.g., configuration management database) assists in managing the effects and impacts of changes.

SP 1.2 Establish a Configuration Management System

Establish and maintain a configuration management and change management system for controlling work products.

A configuration management system includes the storage media, procedures, and tools for accessing the system. A configuration management system can consist of multiple subsystems with different

implementations that are appropriate for each configuration management environment.

In some service domains, CM is focused on document versions and change control.

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

Example Work Products

1. Configuration management system with controlled work products
2. Configuration management system access control procedures
3. Change request database

Subpractices

1. Establish a mechanism to manage multiple levels of control.

The level of control is typically selected based on work objectives, risk, and resources. Control levels can vary in relation to the project or service lifecycle, type of system under development, and specific work requirements.

Example levels of control include the following:

- Uncontrolled: Anyone can make changes.
- Work-in-progress: Authors control changes.
- Released: A designated authority authorizes and controls changes and relevant stakeholders are notified when changes are made.

Levels of control can range from informal control that simply tracks changes made when configuration items are being developed to formal configuration control using baselines that can only be changed as part of a formal configuration management process.

2. Provide access control to ensure authorized access to the configuration management system.
3. Store and retrieve configuration items in a configuration management system.
4. Share and transfer configuration items between control levels in the configuration management system.
5. Store and recover archived versions of configuration items.
6. Store, update, and retrieve configuration management records.
7. Create configuration management reports from the configuration management system.
8. Preserve the contents of the configuration management system.

Examples of preservation functions of the configuration management system include the following:

- Backup and restoration of configuration management files
- Archive of configuration management files
- Recovery from configuration management errors

9. Revise the configuration management structure as necessary.

SP 1.3 Create or Release Baselines

Create or release baselines for internal use and for delivery to the customer.

A baseline is represented by the assignment of an identifier to a configuration item or a collection of configuration items and associated entities at a distinct point in time. As a product or service evolves, multiple baselines can be used to control development and testing. (See the definition of “baseline” in the glossary.)

Examples of types of baselines include the following:

- Stakeholder requirements
- Identified risks
- Current service levels and resource use
- Operational plan
- Schedules

Example Work Products

1. Baselines
2. Description of baselines

Subpractices

1. Obtain authorization from the CCB before creating or releasing baselines of configuration items.
2. Create or release baselines only from configuration items in the configuration management system.
3. Document the set of configuration items that are contained in a baseline.
4. Make the current set of baselines readily available.

SG 2 Track and Control Changes

Changes to the work products under configuration management are tracked and controlled.

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

SP 2.1 Track Change Requests***Track change requests for configuration items.***

Change requests address not only new or changed requirements but also failures and defects in work products.

Change requests are analyzed to determine the impact that the change will have on the work product, related work products, the budget, and the schedule.

Example Work Products

1. Change requests

Subpractices

1. Initiate and record change requests in the change request database.
2. Analyze the impact of changes and fixes proposed in change requests.

Changes are evaluated through activities that ensure that they are consistent with all technical and work requirements.

Changes are evaluated for their impact beyond immediate work or contract requirements. Changes to an item used in multiple products can resolve an immediate issue while causing a problem in other applications.

Changes are evaluated for their impact on release plans.

3. Categorize and prioritize change requests.

Emergency requests are identified and referred to an emergency authority if appropriate.

Changes are allocated to future baselines.

4. Review change requests to be addressed in the next baseline with relevant stakeholders and get their agreement.

Conduct the change request review with appropriate participants. Record the disposition of each change request and the rationale for the decision, including success criteria, a brief action plan if appropriate, and needs met or unmet by the change. Perform the actions required in the disposition and report results to relevant stakeholders.

5. Track the status of change requests to closure.

Change requests brought into the system should be handled in an efficient and timely manner. Once a change request has been processed, it is critical to close the request with the appropriate approved action as soon as it is practical. Actions left open result in larger than necessary status lists, which in turn result in added costs and confusion.

SP 2.2 Control Configuration Items***Control changes to configuration items.***

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

Example Work Products

1. Revision history of configuration items
2. Archives of baselines

Subpractices

1. Control changes to configuration items throughout the life of the product or service.
2. Obtain appropriate authorization before changed configuration items are entered into the configuration management system.

For example, authorization can come from the CCB, the project or service manager, or the customer.

3. Check in and check out configuration items in the configuration management system for incorporation of changes in a manner that maintains the correctness and integrity of configuration items.

Examples of check-in and check-out steps include the following:

- Confirming that the revisions are authorized
- Updating the configuration items
- Archiving the replaced baseline and retrieving the new baseline
- Commenting on the changes made to the item
- Tying changes to related work products such as requirements, service agreements, operational plans, and schedules

4. Perform reviews to ensure that changes have not caused unintended effects on the baselines (e.g., ensure that changes have not compromised the safety or security of the system).
5. Record changes to configuration items and reasons for changes as appropriate.

If a proposed change to the work product is accepted, a schedule is identified for incorporating the change into the work product and other affected areas.

Configuration control mechanisms can be tailored to categories of changes. For example, the approval considerations could be less stringent for component changes that do not affect other components.

Changed configuration items are released after review and approval of configuration changes. Changes are not official until they are released.

SG 3 Establish Integrity***Integrity of baselines is established and maintained.***

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

SP 3.1 Establish Configuration Management Records***Establish and maintain records describing configuration items.*****Example Work Products**

1. Revision history of configuration items
2. Change log
3. Change request records
4. Status of configuration items
5. Differences between baselines

Subpractices

1. Record configuration management actions in sufficient detail so the content and status of each configuration item is known and previous versions can be recovered.
2. Ensure that relevant stakeholders have access to and knowledge of the configuration status of configuration items.

Examples of activities for communicating configuration status include the following:

- Providing access permissions to authorized end users
- Making baseline copies readily available to authorized end users
- Automatically alerting relevant stakeholders when items are checked in or out or changed, or of decisions made regarding change requests

3. Specify the latest version of baselines.
4. Identify the version of configuration items that constitute a particular baseline.
5. Describe differences between successive baselines.
6. Revise the status and history (i.e., changes, other actions) of each configuration item as necessary.

SP 3.2 Perform Configuration Audits***Perform configuration audits to maintain the integrity of configuration baselines.***

Configuration audits confirm that the resulting baselines and documentation conform to a specified standard or requirement. Configuration item related records can exist in multiple databases or configuration management systems. In such instances, configuration audits should extend to these other databases as appropriate to ensure accuracy, consistency, and completeness of configuration item information. (See the definition of “configuration audit” in the glossary.)

Examples of audit types include the following:

- Functional configuration audits (FCAs): Audits conducted to verify that the development of a configuration item has been completed satisfactorily, that the item has achieved the functional and quality attribute characteristics specified in the functional or allocated baseline, and that its operational and support documents are complete and satisfactory.
- Physical configuration audits (PCAs): Audits conducted to verify that a configuration item, as built, conforms to the technical documentation that defines and describes it.
- Configuration management audits: Audits conducted to confirm that configuration management records and configuration items are complete, consistent, and accurate.

Example Work Products

1. Configuration audit results
2. Action items

Subpractices

1. Assess the integrity of baselines.
2. Confirm that configuration management records correctly identify configuration items.
3. Review the structure and integrity of items in the configuration management system.
4. Confirm the completeness, correctness, and consistency of items in the configuration management system.

Completeness, correctness, and consistency of the configuration management system's content are based on requirements as stated in the plan and the disposition of approved change requests.

5. Confirm compliance with applicable configuration management standards and procedures.
6. Track action items from the audit to closure.

DECISION ANALYSIS AND RESOLUTION

A Support Process Area at Maturity Level 3

Purpose

The purpose of Decision Analysis and Resolution (DAR) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Introductory Notes

The Decision Analysis and Resolution process area involves establishing guidelines to determine which issues should be subject to a formal evaluation process and applying formal evaluation processes to these issues.

A formal evaluation process is a structured approach to evaluating alternative solutions against established criteria to determine a recommended solution.

A formal evaluation process involves the following actions:

- Establishing the criteria for evaluating alternatives
- Identifying alternative solutions
- Selecting methods for evaluating alternatives
- Evaluating alternative solutions using established criteria and methods
- Selecting recommended solutions from alternatives based on evaluation criteria

Rather than using the phrase “alternative solutions to address issues” each time, in this process area, one of two shorter phrases are used: “alternative solutions” or “alternatives.”

A formal evaluation process reduces the subjective nature of a decision and provides a higher probability of selecting a solution that meets multiple demands of relevant stakeholders.

While the primary application of this process area is to technical concerns, formal evaluation processes can be applied to many nontechnical issues, particularly when work is being planned. Issues that have multiple alternative solutions and evaluation criteria lend themselves to a formal evaluation process.

Typical examples of formal evaluation processes include the following:

- Trade studies of equipment or software
- Comparisons of potential service capabilities to develop

During planning, specific issues requiring a formal evaluation process are identified. Typical issues include selection among architectural or design alternatives, use of reusable or commercial off-the-shelf (COTS) components, supplier selection, engineering support environments or associated tools, test environments, delivery alternatives, and logistics and production. A formal evaluation process can also be used to address a make-or-buy decision, the development of manufacturing processes, the selection of distribution locations, and other decisions.

Guidelines are created for deciding when to use formal evaluation processes to address unplanned issues. Guidelines often suggest using formal evaluation processes when issues are associated with medium-to-high-impact risks or when issues affect the ability to achieve work objectives.

Defining an issue well helps to define the scope of alternatives to be considered. The right scope (i.e., not too broad, not too narrow) will aid in making an appropriate decision for resolving the defined issue.

Formal evaluation processes can vary in formality, type of criteria, and methods employed. Less formal decisions can be analyzed in a few hours, use few criteria (e.g., effectiveness, cost to implement), and result in a one- or two-page report. More formal decisions can require separate plans, months of effort, meetings to develop and approve criteria, simulations, prototypes, piloting, and extensive documentation.

Both numeric and non-numeric criteria can be used in a formal evaluation process. Numeric criteria use weights to reflect the relative importance of criteria. Non-numeric criteria use a subjective ranking scale (e.g., high, medium, low). More formal decisions can require a full trade study.

A formal evaluation process identifies and evaluates alternative solutions. The eventual selection of a solution can involve iterative activities of identification and evaluation. Portions of identified alternatives can be combined, emerging technologies can change alternatives, and the business situation of suppliers can change during the evaluation period.

A recommended alternative is accompanied by documentation of selected methods, criteria, alternatives, and rationale for the recommendation. The documentation is distributed to relevant stakeholders; it provides a record of the formal evaluation process and rationale, which are useful to other work groups that encounter a similar issue.

While some of the decisions made throughout the work involve the use of a formal evaluation process, others do not. As mentioned earlier, guidelines should be established to determine which issues should be subject to a formal evaluation process.

Related Process Areas

Refer to the Integrated Work Management process area for more information about establishing the defined process for the work.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Specific Goal and Practice Summary

SG 1 Evaluate Alternatives

- SP 1.1 Establish Guidelines for Decision Analysis
- SP 1.2 Establish Evaluation Criteria
- SP 1.3 Identify Alternative Solutions
- SP 1.4 Select Evaluation Methods
- SP 1.5 Evaluate Alternative Solutions
- SP 1.6 Select Solutions

Specific Practices by Goal

SG 1 Evaluate Alternatives

Decisions are based on an evaluation of alternatives using established criteria.

Issues requiring a formal evaluation process can be identified at any time. The objective should be to identify issues as early as possible to maximize the time available to resolve them.

SP 1.1 Establish Guidelines for Decision Analysis

Establish and maintain guidelines to determine which issues are subject to a formal evaluation process.

Not every decision is significant enough to require a formal evaluation process. The choice between the trivial and the truly important is unclear without explicit guidance. Whether a decision is significant or not is dependent on the work and circumstances and is determined by established guidelines.

Typical guidelines for determining when to require a formal evaluation process include the following:

- A decision is directly related to issues that are medium-to-high-impact risk.
- A decision is related to changing work products under configuration management.
- A decision would cause schedule delays over a certain percentage or amount of time.
- A decision affects the ability of the work group to achieve its objectives.
- The costs of the formal evaluation process are reasonable when compared to the decision's impact.
- A legal obligation exists during a solicitation.
- When competing quality attribute requirements would result in significantly different solutions for the service system

Refer to the Risk Management process area for more information about evaluating, categorizing, and prioritizing risks.

Examples of activities for which you may use a formal evaluation process include the following:

- Selecting elements to include in standard service descriptions
- Selecting, terminating, or renewing suppliers
- Selecting training for work group members
- Selecting an approach for ongoing support (e.g., disaster recovery, service levels)

Example Work Products

1. Guidelines for when to apply a formal evaluation process

Subpractices

1. Establish guidelines for when to use a formal evaluation process.
2. Incorporate the use of guidelines into the defined process as appropriate.

Refer to the Integrated Work Management process area for more information about establishing the defined process for the work.

SP 1.2 Establish Evaluation Criteria

Establish and maintain criteria for evaluating alternatives and the relative ranking of these criteria.

Evaluation criteria provide the basis for evaluating alternative solutions. Criteria are ranked so that the highest ranked criteria exert the most influence on the evaluation.

This process area is referenced by many other process areas in the model, and many contexts in which a formal evaluation process can be used. Therefore, in some situations you may find that criteria have already been defined as part of another process. This specific practice does not suggest that a second development of criteria be conducted.

A well-defined statement of the issue to be addressed and the decision to be made focuses the analysis to be performed. Such a statement also aids in defining evaluation criteria that minimize the possibility that decisions will be second guessed or that the reason for making the decision will be forgotten. Decisions based on criteria that are explicitly defined and established remove barriers to stakeholder buy-in.

Example Work Products

1. Documented evaluation criteria
2. Rankings of criteria importance

Subpractices

1. Define the criteria for evaluating alternative solutions.

Criteria should be traceable to requirements, scenarios, business case assumptions, business objectives, or other documented sources.

Types of criteria to consider include the following:

- Technology limitations
- Environmental impact
- Risks
- Business value
- Impact on priorities
- Total ownership and lifecycle costs

2. Define the range and scale for ranking the evaluation criteria.

Scales of relative importance for evaluation criteria can be established with non-numeric values or with formulas that relate the evaluation parameter to a numeric weight.

3. Rank the criteria.

The criteria are ranked according to the defined range and scale to reflect the needs, objectives, and priorities of the relevant stakeholders.

4. Assess the criteria and their relative importance.

5. Evolve the evaluation criteria to improve their validity.

6. Document the rationale for the selection and rejection of evaluation criteria.

Documentation of selection criteria and rationale may be needed to justify solutions or for future reference and use.

SP 1.3 Identify Alternative Solutions

Identify alternative solutions to address issues.

A wider range of alternatives can surface by soliciting as many stakeholders as practical for input. Input from stakeholders with diverse skills and backgrounds can help teams identify and address assumptions, constraints, and biases. Brainstorming sessions can stimulate innovative alternatives through rapid interaction and feedback.

Sufficient candidate solutions may not be furnished for analysis. As the analysis proceeds, other alternatives should be added to the list of potential candidate solutions. The generation and consideration of multiple alternatives early in a decision analysis and resolution process increases the likelihood that an acceptable decision will be made and that consequences of the decision will be understood.

Example Work Products

1. Identified alternatives

Subpractices

1. Perform a literature search.

A literature search can uncover what others have done both inside and outside the organization. Such a search can provide a deeper understanding of the problem,

alternatives to consider, barriers to implementation, existing trade studies, and lessons learned from similar decisions.

2. Identify alternatives for consideration in addition to the alternatives that may be provided with the issue.

Evaluation criteria are an effective starting point for identifying alternatives. Evaluation criteria identify priorities of relevant stakeholders and the importance of technical, logistical, or other challenges.

Combining key attributes of existing alternatives can generate additional and sometimes stronger alternatives.

Solicit alternatives from relevant stakeholders. Brainstorming sessions, interviews, and working groups can be used effectively to uncover alternatives.

3. Document proposed alternatives.

SP 1.4 Select Evaluation Methods

Select evaluation methods.

Methods for evaluating alternative solutions against established criteria can range from simulations to the use of probabilistic models and decision theory. These methods should be carefully selected. The level of detail of a method should be commensurate with cost, schedule, performance, and risk impacts.

While many problems may require only one evaluation method, some problems may require multiple methods. For example, simulations may augment a trade study to determine which design alternative best meets a given criterion.

Example Work Products

1. Selected evaluation methods

Subpractices

1. Select methods based on the purpose for analyzing a decision and on the availability of the information used to support the method.

For example, the methods used for evaluating a solution when requirements are weakly defined may be different from the methods used when the requirements are well defined.

Typical evaluation methods include the following:

- Modeling and simulation
- Engineering studies
- Manufacturing studies
- Testing
- Cost studies
- Business opportunity studies
- Surveys
- Extrapolations based on field experience and prototypes
- User review and comment
- Judgment provided by an expert or group of experts (e.g., Delphi method)

2. Select evaluation methods based on their ability to focus on the issues at hand without being overly influenced by side issues.

Results of simulations can be skewed by random activities in the solution that are not directly related to the issues at hand.

3. Determine the measures needed to support the evaluation method.

Consider the impact on cost, schedule, performance, and risks.

SP 1.5 Evaluate Alternative Solutions

Evaluate alternative solutions using established criteria and methods.

Evaluating alternative solutions involves analysis, discussion, and review. Iterative cycles of analysis are sometimes necessary. Supporting analyses, experimentation, prototyping, piloting, or simulations may be needed to substantiate scoring and conclusions.

Often, the relative importance of criteria is imprecise and the total effect on a solution is not apparent until after the analysis is performed. In cases where the resulting scores differ by relatively small amounts, the best selection among alternative solutions may not be clear. Challenges to criteria and assumptions should be encouraged.

Example Work Products

1. Evaluation results

Subpractices

1. Evaluate proposed alternative solutions using the established evaluation criteria and selected methods.
2. Evaluate assumptions related to the evaluation criteria and the evidence that supports the assumptions.
3. Evaluate whether uncertainty in the values for alternative solutions affects the evaluation and address these uncertainties as appropriate.

For instance, if the score varies between two values, is the difference significant enough to make a difference in the final solution set? Does the variation in score

represent a high-impact risk? To address these concerns, simulations may be run, further studies may be performed, or evaluation criteria may be modified, among other things.

4. Perform simulations, modeling, prototypes, and pilots as necessary to exercise the evaluation criteria, methods, and alternative solutions.

Untested criteria, their relative importance, and supporting data or functions can cause the validity of solutions to be questioned. Criteria and their relative priorities and scales can be tested with trial runs against a set of alternatives. These trial runs of a select set of criteria allow for the evaluation of the cumulative impact of criteria on a solution. If trials reveal problems, different criteria or alternatives might be considered to avoid biases.

5. Consider new alternative solutions, criteria, or methods if proposed alternatives do not test well; repeat evaluations until alternatives do test well.

6. Document the results of the evaluation.

Document the rationale for the addition of new alternatives or methods and changes to criteria, as well as the results of interim evaluations.

SP 1.6 Select Solutions

Select solutions from alternatives based on evaluation criteria.

Selecting solutions involves weighing results from the evaluation of alternatives. Risks associated with the implementation of solutions should be assessed.

Example Work Products

1. Recommended solutions to address significant issues

Subpractices

1. Assess the risks associated with implementing the recommended solution.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Decisions must often be made with incomplete information. There can be substantial risk associated with the decision because of having incomplete information.

When decisions must be made according to a specific schedule, time and resources may not be available for gathering complete information. Consequently, risky decisions made with incomplete information can require re-analysis later. Identified risks should be monitored.

2. Document and communicate to relevant stakeholders the results and rationale for the recommended solution.

It is important to record both why a solution is selected and why another solution was rejected.

INCIDENT RESOLUTION AND PREVENTION

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of Incident Resolution and Prevention (IRP) is to ensure timely and effective resolution of service incidents and prevention of service incidents as appropriate.

Introductory Notes

The Incident Resolution and Prevention process area involves the following activities:

- Identifying and analyzing service incidents
- Initiating specific actions to address incidents
- Monitoring the status of incidents, tracking progress of incident status, and escalating as necessary
- Identifying and analyzing the underlying causes of incidents
- Identifying workarounds that enable service to continue
- Initiating specific actions to either address the underlying causes of incidents or to provide workarounds
- Communicating the status of incidents to relevant stakeholders
- Validating the complete resolution of incidents with relevant stakeholders

The term “incident” is used to mean “service incident” in this process area and in other areas of the model where the context makes the meaning clear. The term “service incident” is used in the glossary and in other parts of the model to clearly differentiate this specially defined term from the everyday use of the word “incident.” (See the definition of “service incident” in the glossary.)

Incidents are events that, if not addressed, eventually can cause the service provider organization to break its service commitments. Hence, the service provider organization should address incidents in a timely and effective manner according to the terms of the service agreement.

Addressing an incident can include the following activities:

- Removing an underlying cause or causes
- Minimizing the impact of an incident
- Monitoring the condition or series of events causing the incident
- Providing a workaround

Incidents can cause or be indications of interruptions or potential interruptions to a service.

Examples of interruptions to a service include a software application that is down during normal operating hours, an elevator that is stuck, a hotel room that is double booked, and baggage that is lost in an airport.

Examples of potential interruptions to a service include a broken component in resilient equipment, a line at a counter of a supermarket with more than three people in it, and an understaffed call center.

Customer complaints are a special type of potential interruption. A complaint indicates that the customer perceives that a service does not meet his or her expectations, even if the customer is in error about what the agreement calls for. Therefore, complaints should be handled as incidents and are within the scope of the Incident Resolution and Prevention process area.

All incidents have one or more underlying causes, regardless of whether the service provider is aware of the cause or not. For example, each system outage has an underlying cause, whether it is a memory leak, a corrupt database, or an operator error.

An underlying cause of an incident is a condition or event that contributes to the occurrence of one or more incidents. Not all underlying causes result in incidents immediately. For example, a defect in an infrequently used part of a system may not result in an incident for a long time.

Underlying causes can be any of the following:

- Root causes that are within the service provider's control and can and should be removed
- Positive or negative conditions of a service that may or may not be removed
- Conditions that the service provider cannot change (e.g., weather conditions)

Underlying causes and root causes (as described in the Causal Analysis and Resolution process area) are not synonymous. A root cause is a type of underlying cause that begins a chain of causes for some outcome of interest. We don't normally look for the cause of a root cause and we normally expect to achieve the greatest reduction in the occurrence of incidents when we address a root cause.

Sometimes, we are unable to address a root cause for practical or budgetary reasons, and so instead we can focus on other non-root underlying causes. It doesn't always make business sense to remove all underlying causes either. Under some circumstances, addressing incidents with workarounds or simply resolving incidents on a case-by-case basis can be more effective.

Effective practices for incident resolution start with developing a process for addressing incidents with the customers, end users, and other relevant stakeholders who report incidents. Organizations can have a collection of

known incidents, underlying causes of incidents, and workarounds, as well as separate but related activities designed to create the actions for addressing selected incidents and underlying causes. Processing all incidents and analyzing selected incidents and their underlying causes to define approaches to addressing those incidents are two reinforcing activities that can be performed in parallel or in sequence.

Thus, the Incident Resolution and Prevention process area has three specific goals. The Prepare for Incident Resolution and Prevention goal helps to ensure an approach is established for timely resolution of incidents and effective prevention of incidents when possible. The specific practices of the goal to Identify, Control, and Address Individual Incidents are used to treat and close incidents as they occur, often by applying workarounds or other actions defined in the goal to Analyze and Address Causes and Impacts of Selected Incidents.

Related Process Areas

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

Refer to the Service Delivery process area for more information about establishing service agreements.

Refer to the Causal Analysis and Resolution process area for more information about determining causes of selected outcomes.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Specific Goal and Practice Summary

SG 1 Prepare for Incident Resolution and Prevention

- SP 1.1 Establish an Approach to Incident Resolution and Prevention
- SP 1.2 Establish an Incident Management System

SG 2 Identify, Control, and Address Individual Incidents

- SP 2.1 Identify and Record Incidents
- SP 2.2 Analyze Individual Incident Data
- SP 2.3 Resolve Incidents
- SP 2.4 Monitor the Status of Incidents to Closure
- SP 2.5 Communicate the Status of Incidents

SG 3 Analyze and Address Causes and Impacts of Selected Incidents

- SP 3.1 Analyze Selected Incidents
- SP 3.2 Establish Solutions to Respond to Future Incidents
- SP 3.3 Establish and Apply Solutions to Reduce Incident Occurrence

Specific Practices by Goal

SG 1 Prepare for Incident Resolution and Prevention

Preparation for incident resolution and prevention is conducted.

Establish and maintain an approach for ensuring timely and effective resolution and prevention of incidents to ensure the terms of the service agreement are met.

SP 1.1 Establish an Approach to Incident Resolution and Prevention

Establish and maintain an approach to incident resolution and prevention.

The approach to incident resolution and prevention describes the organizational functions involved in incident resolution and prevention, the procedures employed, the support tools used, and the assignment of responsibility during the lifecycle of incidents. Such an approach is typically documented.

Often, the amount of time needed to fully address an incident is defined before the start of service delivery and documented in a service agreement.

In many service domains, the approach to incident resolution and prevention involves a function called a “help desk,” “service desk,” or one of many other names. This function is typically the one that communicates with the customer, accepts incidents, applies workarounds, and addresses incidents. However, this function is not present in all service domains. In addition, other functional groups are routinely included to address incidents as appropriate.

Refer to the Service Delivery process area for more information about establishing service agreements.

Example Work Products

1. Incident management approach
2. Incident criteria

Subpractices

1. Define criteria for determining what an incident is.

To be able to identify valid incidents, criteria are defined that enable service providers to determine what is and what is not an incident. Typically, criteria also are defined for differentiating the severity and priority of each incident.

2. Define categories for incidents and criteria for determining which categories an incident belongs to.

The resolution of incidents is facilitated by having an established set of categories, severity levels, and other criteria for assigning types to incidents. These predetermined criteria can enable prioritization, assignment, and escalation actions quickly and efficiently.

Appropriate incident categories vary according to the service. As an example, IT related security incident categories could include the following:

- Probes or scans of internal or external systems (e.g., networks, web applications, mail servers)
- Administrative or privileged (i.e., root) access to accounts, applications, servers networks, etc.
- Distributed denial of service attacks, web defacements, malicious code (e.g., viruses)
- Insider attacks or other misuse of resources (e.g., password sharing)
- Loss of personally identifiable information

Criteria are established that enable service staff to quickly and easily identify major incidents.

Examples of incident severity level approaches include the following:

- Critical, high, medium, low
- Numerical scales (e.g., 1-5 with 1 being the highest)

3. Describe how responsibility for processing incidents is assigned and transferred.

The description can include the following:

- Who is responsible for addressing underlying causes of incidents
- Who is responsible for monitoring and tracking the status of incidents
- Who is responsible for tracking the progress of actions related to incidents
- Escalation procedures
- How responsibility for all of these elements is assigned and transferred

4. Identify one or more mechanisms that customers and end users can use to report incidents.

These mechanisms account for how groups and individuals can report incidents.

5. Define methods and acquire tools to use for incident management.

6. Describe how to notify all relevant customers and end users who may be affected by a reported incident.

How to communicate with customers and end users is typically documented in the service agreement.

7. Define criteria for determining severity and priority levels and categories of actions and responses to be taken based on severity and priority levels.

Examples of responses based on severity and priority levels include immediate short-term action, retraining or documentation updates, and deferring responses until later.

8. Identify requirements on the amount of time defined for the resolution of incidents in the service agreement.

Often, the minimum and maximum amounts of time needed to resolve an incident is defined and documented in the service agreement before the start of service delivery.

Refer to the Service Delivery process area for more information about establishing service agreements.

9. Document criteria that define when an incident should be closed.

Not all underlying causes of incidents are addressed and not all incidents have workarounds either. Incidents should not be closed until the documented criteria are met.

Often closure codes are used to classify each incident. These codes are useful when data are analyzed further.

SP 1.2 Establish an Incident Management System

Establish and maintain an incident management system for processing and tracking incident information.

An incident management system includes the storage media, procedures, and tools for accessing the incident management system. These storage media, procedures, and tools can be automated but are not required to be automated. For example, storage media might be a filing system where documents are stored. Procedures can be documented on paper and tools can be hand tools or instruments for performing work without automated help.

A collection of historical data covering addressed incidents, underlying causes of incidents, known approaches to addressing incidents, and workarounds should be available to support incident management.

Example Work Products

1. An incident management system with controlled work products
2. Access control procedures for the incident management system

Subpractices

1. Ensure that the incident management system allows the escalation and transfer of incidents among groups.

Incidents may need to be transferred or escalated between different groups because the group that entered the incident may not be best suited for taking action to address it.

2. Ensure that the incident management system allows the storage, update, retrieval, and reporting of incident information that is useful to the resolution and prevention of incidents.

Examples of incident management systems include the following:

- Indexed physical files of customer complaints and resolutions
- Bug or issue tracking software
- Help desk software

3. Maintain the integrity of the incident management system and its contents.

Examples of maintaining the integrity of the incident management system include the following:

- Backing up and restoring incident files
- Archiving incident files
- Recovering from incident errors
- Maintaining security that prevents unauthorized access

4. Maintain the incident management system as necessary.

Maintenance should include removing obsolete information and consolidating redundant information that accumulates over time.

SG 2 Identify, Control, and Address Individual Incidents

Individual incidents are identified, controlled, and addressed.

The focus of this goal is on managing individual incidents as they occur to restore service or otherwise resolve the incidents as quickly as possible. Managing individual incidents can also include handling multiple related incidents through actions that focus on completing or restoring already affected service delivery. The practices that comprise this goal include interaction with those who report incidents and those who are affected by them. The processing and tracking of incident data happens among these practices until the incident is addressed and closed.

Treatment of incidents can include collecting and analyzing data looking for potential incidents or simply waiting for incidents to be reported by end users or customers.

The specific practices of this goal can also depend on the practices in the goal to Analyze and Address Causes and Impacts of Selected Incidents. The practices in *that* goal are used to identify and define the range of approaches available to address individual incidents as called for in *this* goal.

Often, incidents involve work products that are under configuration management.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

SP 2.1 Identify and Record Incidents

Identify incidents and record information about them.

Capacity, performance, or availability issues often signal potential incidents.

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

Example Work Products

1. Incident management record

Subpractices**1. Identify incidents that are in scope.**

Examples of how incidents can be identified include the following:

- Incidents reported by the customer to a help desk by phone
- Incidents reported by the end user in a web form
- Incidents detected by automated detection systems
- Incidents derived from the analysis of anomalies in data collected
- Monitoring and analyzing external sources of information (e.g., RSS feeds, news services, websites)

2. Record information about the incident.

When recording information about an incident, record sufficient information to properly support analysis and resolution activities.

Examples of information to record about the incident include the following:

- Name and contact information of the person who reported the incident
- Description of the incident
- Categories the incident belongs to
- Date and time of occurrence and date and time the incident was reported
- The configuration items involved in the incident
- Closure code and information
- Relevant characteristics of the situation in which the incident occurred

3. Categorize the incident.

Using the categories established in the approach to incident resolution and prevention, assign the relevant categories to the incident in the incident management system. Communicating with those who reported the incident about its status enables the service provider to confirm incident information early.

SP 2.2 Analyze Individual Incident Data***Analyze individual incident data to determine a course of action.***

The best course of action may be to do nothing, to address an incident as a unique case, to increase monitoring for other incidents, to educate an end user, or to employ a previously established workaround or other known reusable solution for handling similar incidents.

The analysis covered by this practice focuses on resolving incidents as they occur through a course of action that is both timely and effective enough to meet immediate service request needs. When more in-depth analyses and actions are required to mitigate future incidents, refer to the goal to Analyze and Address Causes and Impacts of Selected Incidents.

Example Work Products

1. Major incident report
2. Incident assignment report

Subpractices

1. Analyze incident data.

For known incidents, the analysis can be done by merely selecting the type of incident. For major incidents, a separate incident resolution team may be assembled to analyze the incident.

2. Determine which group is best suited to take action to address the incident.

Which group is best suited to take action to address the incident can depend on a number of different factors, including the type of incident, locations involved, and severity.

Examples of groups that deal with different types of incidents include the following:

- A healthcare team deals with adverse medical outcomes.
- A network support group handles network connectivity incidents.
- A help desk deals with password related incidents.

3. Determine actions that should be taken to address the incident.

Examples of actions include the following:

- Replacing a broken component
- Notifying or reminding customers, end users, or service delivery staff of correct procedures
- Releasing an announcement (e.g., public relations release, media response, bulletin, notice to customers or other relevant stakeholders)

4. Plan the actions to be taken.

SP 2.3 Resolve Incidents***Resolve incidents.***

Incidents are resolved by following the course of action determined by individual incident analysis. It is possible that the initial selected course of action may fail to resolve an incident or may be only partially successful, in which case additional follow-up analyses and actions may be necessary.

Applying workarounds and other previously established reusable solutions can significantly reduce the impact of incidents, which otherwise be handled on a case-by-case basis. The use of already known reusable solutions to resolve incidents helps to reduce the time required to resolve them, and can also improve the quality of resolutions. It is essential to have a single repository established that contains all previously established reusable solutions. This repository can be used to quickly determine the appropriate reusable solution to be used for related incidents.

Example Work Products

1. Updated incident management record

Subpractices

1. Address the incident using the best course of action.

The best course of action can employ an applicable workaround or other previously established reusable solution if one is available.

2. Manage the actions until the impact of the incident is at an acceptable level.
3. Record the actions and result.
4. Review actions taken that resulted in service system changes to determine if further actions are needed to ensure traceability to requirements.

SP 2.4 Monitor the Status of Incidents to Closure

Monitor the status of incidents to closure.

Throughout the life of the incident, the status of the incident should be recorded, tracked, escalated as necessary, and closed.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Example Work Products

1. Closed incident management records

Subpractices

1. Document actions and monitor and track the incidents until they meet the terms of the service agreement and satisfy the incident submitter as appropriate.

Monitor the responses to those who reported the incident and how the incident was addressed until it is resolved to the customer's or organization's satisfaction.

2. Escalate incidents as necessary.

The incident should be tracked throughout its life and escalated, as necessary, to ensure its resolution. Escalation may be required if relevant stakeholders are not satisfied with the resolution or if the resolution is urgent or requires non-standard processes or resources.

3. Review the resolution and confirm the results with relevant stakeholders.

Confirming that the underlying causes were successfully addressed can involve confirming with the person who reported the incident or others involved in analyzing the incident that the actions taken in fact resulted in the incident no longer occurring. Part of the result of addressing the incident can be the level of customer satisfaction.

Now that the incident has been addressed, it is confirmed that the service again meets the terms of the service agreement.

4. Close incidents that meet the criteria for closure.

SP 2.5 Communicate the Status of Incidents

Communicate the status of incidents.

Communication is a critical factor when providing services, especially when incidents occur. Communication with the person who reported the incident and possibly those who were affected by it should be considered throughout the life of the incident record in the incident management system. Well-informed end users and customers are more understanding and can even be helpful in addressing the incident successfully.

Communication and coordination between incident resolution staff and service delivery staff may be appropriate to prevent incident resolution actions from interfering with ongoing service delivery.

Typically, the results of actions are reviewed with the person that reported the incident to verify that the actions indeed resolved the incident to the satisfaction of the submitter.

Example Work Products

1. Records of communication with customers and end users
2. Status reports

SG 3 Analyze and Address Causes and Impacts of Selected Incidents

Causes and impacts of selected incidents are analyzed and addressed.

The focus of this goal is on reducing the impact or occurrence of future incidents. The practices in this goal cover the analysis of selected incidents to define how to address similar incidents in the future. The results of this analysis are fed back to those who control and address incidents, and can also lead to the prevention of certain types of incidents.

All incidents have one or more underlying causes that trigger their occurrence. Addressing an underlying cause of some selected types of incidents can reduce the likelihood of service interference, reduce the workload on the service provider, or improve the level of service.

Underlying causes can be identified for selected incidents that have already happened, and for types of incidents that have never occurred but are possible.

Examples include analyzing the cause of a delivery error or system outage and monitoring use of software memory to detect memory leaks as soon as possible.

The root cause of an incident is often different than the immediate underlying cause. For example, an incident can be caused by a faulty system component (the underlying cause), while the root cause of the incident is a suboptimal supplier selection process. This process area uses the term “underlying cause” flexibly, ranging from immediate causes or conditions to deeper root causes, to allow for a variety of possible solutions ranging from workarounds to complete prevention of a class of related incidents.

Refer to the Causal Analysis and Resolution process area for more information about determining causes of selected outcomes.

SP 3.1 Analyze Selected Incidents***Analyze the underlying causes of selected incidents.***

The purpose of conducting causal analysis on incidents is to determine the best course of action to address incidents in the future so that their impact will be minimized most effectively. While completely preventing incidents is usually desirable, other business objectives can limit the extent to which incident prevention is effective. In some cases, it can be more effective to respond to certain incidents after they occur via reusable solutions than it is to try to reduce or prevent their occurrence in the first place. Therefore, a possible course of action includes not addressing an underlying cause at all and continuing to deal with selected incidents after they occur by using newly established or revised workarounds and other reusable solutions.

Often, analyzing incidents involves work products that are under configuration management.

It is essential to have a single repository established that contains all known incidents, their underlying causes, and approaches to addressing these underlying causes. This repository can be used to quickly determine the causes of related incidents.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

Example Work Products

1. Report of underlying causes of incidents
2. Documented causal analysis activities

Subpractices

1. Identify underlying causes of incidents.

Examples of approaches to identifying underlying causes of incidents include the following:

- Analyze incidents reported by customers to a help desk
- Monitor the service system to identify potential incidents
- Analyze trends in the use of resources
- Analyze strengths and weaknesses of the service system
- Analyze mean times between service system failures and availability
- Analyze external sources of information such as alerts, news feeds, and websites

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

2. Record information about the underlying causes of an incident or group of incidents.

When recording information about the underlying causes of an incident, record sufficient information to properly support causal analysis and resolution.

Examples of information to record include the following:

- Incidents affected or potentially affected by the underlying cause
- Configuration items involved
- Relevant characteristics of the situation in which the incidents did or could occur

3. Conduct causal analysis with the people who are responsible for performing related tasks.

For underlying causes of major incidents, the analysis can involve assembling a separate team to analyze the underlying cause.

Refer to the Causal Analysis and Resolution process area for more information about determining causes of selected outcomes.

4. Determine the best overall approach for dealing with selected incidents in the future.

This approach can include service system changes that reduce or prevent the occurrence of similar incidents, that limit the impact of similar incidents through reusable solutions, or that combine some of these approaches.

SP 3.2 Establish Solutions to Respond to Future Incidents

Establish and maintain solutions to respond to future incidents.

Reusable solutions such as workarounds are important mechanisms that enable service delivery to continue in spite of the occurrence of an incident. (A workaround is a less-than-optimal solution for a certain type of incident that is nevertheless effective enough to use until a better solution can be developed and deployed.) Therefore, it is important that workarounds and other reusable solutions be documented and confirmed to be effective before they are used to address incidents with customers and end users.

Example Work Products

1. Reusable solution description and instructions
2. Contribution to collection of workarounds for incidents
3. Workaround verification results

Subpractices

1. Determine which group is best suited to establish and maintain a reusable solution.

The group should be best suited to define the reusable solution, describe the steps involved, and communicate this information appropriately.

2. Plan and document the reusable solution.
3. Verify and validate the reusable solution to ensure that it effectively addresses the incident.
4. Communicate the reusable solution to relevant stakeholders.

SP 3.3 Establish and Apply Solutions to Reduce Incident Occurrence***Establish and apply solutions to reduce the occurrence of selected incidents.***

After analysis has determined the underlying causes of incidents, the actions to be taken, if any, are planned and performed. Planning includes determining who will act, when, and how. All of this information is documented in an action proposal. The action proposal is used by those who take action to address the underlying causes of incidents, and the actions are managed to closure. The end result will be a reduction in the occurrence of the selected incidents.

Example Work Products

1. Action proposal
2. Contribution to collection of known approaches to addressing underlying causes of incidents
3. Updated incident management record

Subpractices

1. Determine which group is best suited to address the underlying cause.

Which group is best suited to address the underlying cause can depend on the type of underlying cause, configuration items involved, and the severity of the relevant incidents.

Examples of groups and departments that deal with different types of underlying causes include the following:

- A network support group handles network issues.
- A UNIX server support team deals with server configuration issues.
- Human Resources handles privacy issues.
- The Legal department controls issues relating to intellectual property, disclosure of information, and data loss
- Public Relations is responsible for issues relating to the reputation of the organization.

2. Determine the actions to be taken to address the underlying cause.

When analyzing standard incidents, the actions for addressing that standard incident can be documented as a standard action plan. If the incident is not standard, a historical collection of addressed incidents and known errors should be searched to see if the incident is related to others. This data should be maintained to allow this kind of analysis, thus saving time and leveraging effort.

Examples of actions taken to address the underlying cause include the following:

- Replacing a broken component
- Training end users or service delivery staff
- Fixing a software defect
- Not addressing the underlying cause because it is cheaper or less risky to deal with the incidents than address the underlying cause

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

3. Document the actions to be taken in an action proposal.
4. Verify and validate the action proposal to ensure that it effectively addresses the underlying cause.
5. Communicate the action proposal to relevant stakeholders.
6. Address the underlying cause by implementing the action proposal that resulted from the analysis of the incidents' underlying causes.

Often, the actions called for in an action proposal will include maintaining or changing the service system.

Refer to the Service Delivery process area for more information about maintaining the service system.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

7. Manage the actions until the underlying cause is addressed.

Managing the actions can include escalating the selected incidents as appropriate.

Examples of escalation criteria include the following:

- When the impact of the selected incidents on the organization or customer is large
- When addressing the underlying cause of the selected incidents will take considerable time or effort

8. Record the actions and result.

The actions used to address the underlying cause of the selected incidents and the results of those approaches are recorded in the incident management system to support analyzing similar incidents in the future.

INTEGRATED WORK MANAGEMENT

A Project and Work Management Process Area at Maturity Level 3

Purpose

The purpose of Integrated Work Management (IWM) is to establish and manage the work and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.

Introductory Notes

Integrated Work Management involves the following activities:

- Establishing the defined process at work startup by tailoring the organization's set of standard processes
- Managing the work using the defined process
- Establishing the work environment for the work based on the organization's work environment standards
- Establishing teams that are tasked to accomplish work objectives
- Using and contributing to organizational process assets
- Enabling relevant stakeholders' concerns to be identified, considered, and, when appropriate, addressed during the work
- Ensuring that relevant stakeholders (1) perform their tasks in a coordinated and timely manner; (2) address their requirements, plans, objectives, problems, and risks; (3) fulfill their commitments; and (4) identify, track, and resolve coordination issues

The integrated and defined process that is tailored from the organization's set of standard processes is called the defined process for the work.

Managing the work effort, cost, schedule, staffing, risks, and other factors is tied to the tasks of the defined process for the work. The implementation and management of the defined process for the work are typically described in the work plan. Certain activities may be covered in other plans that affect the work, such as the quality assurance plan, risk management strategy, and the configuration management plan.

Since the defined process for each work group is tailored from the organization's set of standard processes, variability among work groups is typically reduced and work groups can easily share process assets, data, and lessons learned.

This process area also addresses the coordination of all activities associated with the work such as the following:

- Development activities (e.g., requirements development, design, verification)
- Service activities (e.g., delivery, help desk, operations, customer contact)
- Acquisition activities (e.g., solicitation, agreement monitoring, transition to operations)
- Support activities (e.g., configuration management, documentation, marketing, training)

The working interfaces and interactions among relevant internal and external stakeholders are planned and managed to ensure the quality and integrity of the overall endeavor. Relevant stakeholders participate as appropriate in defining the defined process and the plan for the work. Reviews and exchanges are regularly conducted with relevant stakeholders to ensure that coordination issues receive appropriate attention and everyone involved with the work is appropriately aware of status, plans, and activities. (See the definition of “relevant stakeholder” in the glossary.) In defining the process for the work, formal interfaces are created as necessary to ensure that appropriate coordination and collaboration occurs.

This process area applies in any organizational structure, including work groups that are structured as line organizations, matrix organizations, or teams. The terminology should be appropriately interpreted for the organizational structure in place.

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Refer to the Organizational Process Definition process area for more information about establishing and maintaining a usable set of organizational process assets, work environment standards, and rules and guidelines for teams.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

Refer to the Work Planning process area for more information about developing a work plan.

Specific Goal and Practice Summary

SG 1 Use the Defined Process for the Work

- SP 1.1 Establish the Defined Process
- SP 1.2 Use Organizational Process Assets for Planning Work Activities
- SP 1.3 Establish the Work Environment
- SP 1.4 Integrate Plans
- SP 1.5 Manage the Work Using Integrated Plans
- SP 1.6 Establish Teams
- SP 1.7 Contribute to Organizational Process Assets

SG 2 Coordinate and Collaborate with Relevant Stakeholders

- SP 2.1 Manage Stakeholder Involvement
- SP 2.2 Manage Dependencies
- SP 2.3 Resolve Coordination Issues

Specific Practices by Goal

SG 1 Use the Defined Process for the Work

The work is conducted using a defined process tailored from the organization's set of standard processes.

The defined process for the work includes those processes from the organization's set of standard processes that address all processes necessary to acquire, develop, maintain, or deliver the product.

SP 1.1 Establish the Defined Process

Establish and maintain the defined process from startup and throughout the work.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets and establishing the organization's measurement repository.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets and deploying standard processes.

The defined process for the work consists of defined processes that form an integrated, coherent lifecycle.

The defined process for the work should satisfy contractual requirements, operational needs, opportunities, and constraints. It is designed to provide a best fit for work needs.

A defined process for the work is based on the following factors:

- Stakeholder requirements
- Commitments
- Organizational process needs and objectives
- The organization's set of standard processes and tailoring guidelines
- The operational environment
- The business environment
- The service delivery environment

In addition, the description of the defined process should be based on the services that the work group will deliver, including both standard services that have been tailored and services that are unique.

Establishing the defined process at work startup helps to ensure that staff and relevant stakeholders implement a set of activities needed to efficiently establish an initial set of requirements and plans for the work. As the work progresses, the description of the defined process is elaborated and revised to better meet service requirements and the organization's process needs and objectives. Also, as the organization's set of standard processes changes, the defined process may need to be revised.

Example Work Products

1. The defined process for the work

Subpractices

1. Select a lifecycle model from the ones available in organizational process assets.

Examples of work characteristics that could affect the selection of lifecycle models include the following:

- Size or complexity of the work
- Work strategy
- Experience and familiarity of staff with implementing the process
- Constraints such as service level and cycle time
- Clarity of requirements
- Customer expectations

2. Select standard processes from the organization's set of standard processes that best fit the needs of the work.

Organizations that define standard services will normally have standard service systems that enable the delivery of those services. Any processes that are components of an organization's relevant standard service system(s) are good candidates to consider when selecting standard processes for delivering services.

3. Tailor the organization's set of standard processes and other organizational process assets according to tailoring guidelines to produce the defined process for the work.

Sometimes the available lifecycle models and standard processes are inadequate for a particular work activity. In such circumstances, the work group should seek approval to deviate from what is required by the organization. Waivers are provided for this purpose.

Tailoring can include adapting the organization's common measures and specifying additional measures to meet the information needs of the workgroup.

4. Use other artifacts from the organization's process asset library as appropriate.

Other artifacts can include the following:

- Lessons learned documents
- Templates
- Example documents
- Estimating models

5. Document the defined process for the work.

The defined process covers all of the service establishment and delivery activities for the work and its interfaces to relevant stakeholders.

Examples of work activities include the following:

- Planning
- Monitoring
- Supplier management
- Quality assurance
- Risk management
- Decision analysis and resolution
- Requirements management
- Incident management
- Service system development and support

6. Conduct peer reviews of the defined process for the work.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

7. Revise the defined process for the work as necessary.

SP 1.2 Use Organizational Process Assets for Planning Work Activities

Use organizational process assets and the measurement repository for estimating and planning work activities.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

When available, use results of previous planning and execution activities as predictors of the relative scope and risk of the effort being estimated.

Example Work Products

1. Work estimates
2. Work plans

Subpractices

1. Use the tasks and work products of the defined process for the work as a basis for estimating and planning work activities.

An understanding of the relationships among tasks and work products of the defined process for the work, and of the roles to be performed by relevant stakeholders, is a basis for developing a realistic plan.

2. Use the organization's measurement repository in estimating the work planning parameters.

This estimate typically includes the following:

- Appropriate historical data from this work or similar work
- Similarities and differences between the current work and work from which historical data will be used
- Validated historical data
- Reasoning, assumptions, and rationale used to select the historical data

Examples of parameters that are considered for similarities and differences include the following:

- Work product and task attributes
- Application domain
- Service system and service system components
- Operational or delivery environment
- Experience of the people

Examples of data contained in the organization's measurement repository include the following:

- Size of work products or other work product attributes
- Effort
- Cost
- Schedule
- Staffing
- Response time
- Service capacity
- Supplier performance
- Quality

SP 1.3 Establish the Work Environment***Establish and maintain the work environment based on the organization's work environment standards.***

An appropriate work environment for the work comprises an infrastructure of facilities, tools, and equipment that people need to perform their jobs effectively in support of business and service objectives. The work environment and its components are maintained at a level of work environment performance and reliability indicated by organizational work environment standards. As required, the work environment or some of its components can be developed internally or acquired from external sources.

The work environment should encompass all work spaces where the work group operates. This work environment includes work spaces not under the direct control or ownership of the organization (e.g., delivering a product or service at a customer site).

SSD Addition

Verification and validation of the service system can include both initial and ongoing evaluation of the work environment in which the service is delivered.

Refer to the Service System Development process area for more information about preparing for verification and validation.

Refer to the Establish Work Environment Standards specific practice in the Organizational Process Definition process area for more information about work environment standards.

Example Work Products

1. Equipment and tools for the work
2. Installation, operation, and maintenance manuals for the work environment
3. User surveys and results
4. Use, performance, and maintenance records
5. Support services for the work environment

Subpractices

1. Plan, design, and install a work environment.

The critical aspects of the work environment are, like any other product, requirements driven. Functionality and quality attributes of the work environment are explored with the same rigor as is done for any other product development project.

It may be necessary to make tradeoffs among quality attributes, costs, and risks. The following are examples of each:

- Quality attribute considerations can include timely communication, safety, security, and maintainability.
- Costs can include capital outlays, training, a support structure; disassembly and disposal of existing environments; and the operation and maintenance of the environment.
- Risks can include workflow disruptions.

Examples of equipment and tools include the following:

- Office software
- Decision support software
- Project management tools
- Service management tools
- Requirements management tools
- Incident and request management tools
- Test and evaluation equipment

2. Provide ongoing maintenance and operational support for the work environment.

Maintenance and support of the work environment can be accomplished either with capabilities found inside the organization or hired from outside the organization.

Examples of maintenance and support approaches include the following:

- Hiring people to perform maintenance and support
- Training people to perform maintenance and support
- Contracting maintenance and support
- Developing expert users for selected tools

3. Maintain the qualification of components of the work environment.

Components include the ones necessary to support service delivery, software, databases, hardware, tools, test equipment, and appropriate documentation. Qualification of a service delivery environment includes audits of the environment and its components for compliance with safety requirements and regulations. Qualification of software includes appropriate certifications. Hardware and test equipment qualification includes calibration and adjustment records and traceability to calibration standards.

4. Periodically review how well the work environment is meeting work activity needs and supporting collaboration, and take action as appropriate.

Examples of actions that might be taken include the following:

- Adding new tools
- Acquiring additional networks, equipment, training, and support

SP 1.4 Integrate Plans

Integrate the work plan and other plans that affect the work to describe the defined process for the work.

Refer to the Capacity and Availability Management process area for more information about preparing for capacity and availability management.

Refer to the Incident Resolution and Prevention process area for more information about preparing for incident resolution and prevention.

Refer to the Service Continuity process area for more information about establishing service continuity plans.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets and, in particular, establishing the organization's measurement repository.

Refer to the Organizational Process Focus process area for more information about establishing organizational process needs and determining process improvement opportunities.

Refer to the Work Planning process area for more information about developing a work plan.

This specific practice extends the specific practices for establishing and maintaining a work plan to address additional planning activities such as incorporating the defined process for the work, coordinating with relevant stakeholders, using organizational process assets, incorporating plans for peer reviews, and establishing objective entry and exit criteria for tasks.

The work plan should include plans for service system development and service delivery as appropriate.

The development of the work plan should account for current and projected needs, objectives, and requirements of the organization, customer, suppliers, and end users as appropriate.

Example Work Products

1. Integrated plans

Subpractices

1. Integrate other plans that affect the work with the work plan.

Other plans that affect the work plan can include the following:

- Quality assurance plans
- Risk management strategy
- Verification and validation plans
- Transition to operations and support plans
- Communication plans
- Capacity and availability management strategy
- Service continuity plan
- Incident management approach

2. Incorporate into the work plan the definitions of measures and measurement activities for managing the work.

Examples of measures that would be incorporated include the following:

- Organization's common set of measures
- Additional work-specific measures

Refer to the Measurement and Analysis process area for more information about developing and sustaining a measurement capability used to support management information needs.

3. Identify and analyze product and work group interface risks.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

Examples of product and work group interface risks include the following:

- Incomplete interface descriptions
- Unavailability of tools, suppliers, or test equipment
- Unavailability of COTS components
- Inadequate or ineffective team interfaces
- Inadequate product and service interfaces

4. Schedule tasks in a sequence that accounts for critical development and delivery factors and work risks.

Examples of factors considered in scheduling include the following:

- Size and complexity of tasks
- Needs of the customer and end users
- Availability of critical resources
- Availability of key staff

5. Incorporate plans for performing peer reviews on work products of the defined process for the work.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

6. Incorporate the training needed to perform the defined process for the work in the work group's training plans.

This task typically includes negotiating with the organizational training group on the support they will provide.

7. Establish objective entry and exit criteria to authorize the initiation and completion of tasks described in the work breakdown structure (WBS).

Refer to the Work Planning process area for more information about estimating the scope of the work.

8. Ensure that the work plan is appropriately compatible with the plans of relevant stakeholders.

Typically the plan and changes to the plan will be reviewed for compatibility.

9. Identify how conflicts will be resolved that arise among relevant stakeholders.

SP 1.5 Manage the Work Using Integrated Plans

Manage the work using the work plan, other plans that affect the work, and the defined process for the work.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Refer to the Organizational Process Focus process area for more information about establishing organizational process needs, deploying organizational process assets, and deploying standard processes.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Example Work Products

1. Work products created by performing the defined process for the work
2. Collected measures (i.e., actuals) and status records or reports
3. Revised requirements, plans, and commitments
4. Integrated plans

Subpractices

1. Implement the defined process using the organization's process asset library.

This task typically includes the following activities:

- Incorporating artifacts from the organization's process asset library into the work group as appropriate
- Using lessons learned from the organization's process asset library to manage the work

2. Monitor and control the work activities and work products using the defined process for the work, work plan, and other plans that affect the work.

This task typically includes the following activities:

- Using the defined entry and exit criteria to authorize the initiation and determine the completion of tasks
- Monitoring activities that could significantly affect actual values of the work planning parameters
- Tracking work planning parameters using measurable thresholds that will trigger investigation and appropriate actions
- Monitoring work group interface risks
- Managing external and internal commitments based on plans for tasks and work products of the defined process for the work

An understanding of the relationships among tasks and work products of the defined process for the work and of the roles to be performed by relevant stakeholders, along with well-defined control mechanisms (e.g., peer reviews), achieves better visibility into performance and better control of the work.

3. Obtain and analyze selected measurements to manage the work and support organization needs.

Refer to the Measurement and Analysis process area for more information about obtaining measurement data and analyzing measurement data.

4. Periodically review and align the service performance with current and anticipated needs, objectives, and requirements of the organization, customer, and end users as appropriate.

This review includes alignment with organizational process needs and objectives.

Examples of actions that achieve alignment include the following:

- Changing the schedule with appropriate adjustments to other planning parameters and work risks
- Changing requirements or commitments in response to a change in market opportunities or customer and end-user needs
- Terminating the work

5. Address causes of selected issues that can affect work objectives.

Issues that require corrective action are determined and analyzed as in the Analyze Issues and Take Corrective Actions specific practices of the Work Monitoring and Control process area. As appropriate, the workgroup may periodically review issues previously encountered on other work or in earlier phases of the work, and conduct causal analysis of selected issues to determine how to prevent recurrence for issues which can significantly affect work objectives. Process changes implemented as a result of causal analysis activities should be evaluated for effectiveness to ensure that the process change has prevented recurrence and improved performance.

SP 1.6 Establish Teams***Establish and maintain teams.***

The work is managed using teams that reflect the organizational rules and guidelines for team structuring, formation, and operation. (See the definition of “team” in the glossary.)

The work group's shared vision is established prior to establishing the team structure, which can be based on the WBS. For small organizations, the whole organization and relevant external stakeholders can be treated as a team.

Refer to the Establish Rules and Guidelines for Teams specific practice in the Organizational Process Definition process area for more information about establishing and maintaining organizational rules and guidelines for the structure, formation, and operation of teams.

One of the best ways to ensure coordination and collaboration with relevant stakeholders is to include them on the team.

When a work group is a service provider, one team may be responsible for overall service development and maintenance and another team responsible for service delivery. In the case of multiple critical services each requiring a different skill set, the staff associated with each service can form its own team with an objective to ensure the successful and continuing delivery of that service (or timely response to an ad-hoc request or incident resolution as appropriate).

In a customer environment that requires coordination among multiple service development or service delivery organizations, it is important to establish a team with representation from all parties that affect overall success. Such representation helps to ensure effective collaboration across these organizations, including the timely resolution of coordination issues.

Example Work Products

1. Documented shared vision
2. List of members assigned to each team
3. Team charters
4. Periodic team status reports

Subpractices

1. Establish and maintain the work group's shared vision.

When creating a shared vision, it is critical to understand the interfaces between the work group and stakeholders external to the work group. The vision should be shared among relevant stakeholders to obtain their agreement and commitment.

2. Establish and maintain the team structure.

The WBS, cost, schedule, work risks, resources, interfaces, the defined process for the work, and organizational guidelines are evaluated to establish an appropriate team structure, including team responsibilities, authorities, and interrelationships.

3. Establish and maintain each team.

Establishing and maintaining teams encompasses choosing team leaders and team members and establishing team charters for each team. It also involves providing resources required to accomplish tasks assigned to the team.

4. Periodically evaluate the team structure and composition.

Teams should be monitored to detect misalignment of work across different teams, mismanaged interfaces, and mismatches of tasks to team members. Take corrective action when team performance does not meet expectations.

SP 1.7 Contribute to Organizational Process Assets

Contribute process related experiences to organizational process assets.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets, establishing the organization's measurement repository, and establishing the organization's process asset library.

Refer to the Organizational Process Focus process area for more information about incorporating experiences into organizational process assets.

This specific practice addresses contributing information from processes in the defined process for the work to organizational process assets.

Example Work Products

1. Proposed improvements to organizational process assets
2. Actual process and product measures collected from the work
3. Documentation (e.g., exemplary process descriptions, plans, training modules, checklists, lessons learned)
4. Process artifacts associated with tailoring and implementing the organization's set of standard processes for the work

Subpractices

1. Propose improvements to the organizational process assets.
2. Store process and product measures in the organization's measurement repository.

Refer to the Measurement and Analysis process area for more information about obtaining measurement data.

Refer to the Work Monitoring and Control process area for more information about monitoring work planning parameters.

Refer to the Work Planning process area for more information about planning data management.

These process and product measures typically include the following:

- Planning data
- Replanning data

Examples of data recorded by the work group include the following:

- Task descriptions
- Assumptions
- Estimates
- Revised estimates
- Definitions of recorded data and measures
- Measures
- Context information that relates the measures to the activities performed and work products produced
- Associated information needed to reconstruct the estimates, assess their reasonableness, and derive estimates for new work

3. Submit documentation for possible inclusion in the organization's process asset library.

Examples of documentation include the following:

- Exemplary process descriptions
- Training modules
- Exemplary plans
- Checklists and templates
- Tool configurations

4. Document lessons learned from the work for inclusion in the organization's process asset library.
5. Provide process artifacts associated with tailoring and implementing the organization's set of standard processes in support of the organization's process monitoring activities.

Refer to the Monitor the Implementation specific practice in the Organizational Process Focus process area for more information about the organization's activities to understand the extent of deployment of standard processes on new and existing work groups.

SG 2 Coordinate and Collaborate with Relevant Stakeholders

Coordination and collaboration of relevant stakeholders are conducted.

SP 2.1 Manage Stakeholder Involvement

Manage the involvement of relevant stakeholders in the work.

Stakeholder involvement is managed according to the integrated plan and defined process for the work.

The supplier agreement provides the basis for managing supplier involvement in the work. Supplier agreements (e.g., interagency and intercompany agreements, memoranda of understanding, memoranda of agreement) that the work group makes with stakeholder organizations, which can be product or service providers or recipients, provide the basis for their involvement.

These agreements are particularly important when the work group's delivered services are integrated into a larger service delivery context.

Refer to the Work Planning process area for more information about planning stakeholder involvement and obtaining plan commitment.

Example Work Products

1. Agendas and schedules for collaborative activities
2. Recommendations for resolving relevant stakeholder issues
3. Documented issues (e.g., issues with stakeholder and service system requirements, architecture, design)

Subpractices

1. Coordinate with relevant stakeholders who should participate in work activities.

The relevant stakeholders should already be identified in the work plan.
2. Ensure work products that are produced to satisfy commitments meet the requirements of the recipients.

SSD Addition

Refer to the Service System Development process area for more information about verifying and validating service systems.

The work products produced to satisfy commitments can be services.

This task typically includes the following:

- Reviewing, demonstrating, or testing, as appropriate, each work product produced by relevant stakeholders
 - Reviewing, demonstrating, or testing, as appropriate, each work product produced by the work group for other work groups with representatives of the work groups receiving the work product
 - Resolving issues related to the acceptance of the work products
3. Develop recommendations and coordinate actions to resolve misunderstandings and problems with requirements.

SP 2.2 Manage Dependencies

Participate with relevant stakeholders to identify, negotiate, and track critical dependencies.

Example Work Products

1. Defects, issues, and action items resulting from reviews with relevant stakeholders
2. Critical dependencies
3. Commitments to address critical dependencies
4. Status of critical dependencies

Subpractices

1. Conduct reviews with relevant stakeholders.
2. Identify each critical dependency.
3. Establish need dates and plan dates for each critical dependency based on the work schedule.
4. Review and get agreement on commitments to address each critical dependency with those who are responsible for providing or receiving the work product or performing or receiving the service.
5. Document critical dependencies and commitments.

Documentation of commitments typically includes the following:

- Describing the commitment
- Identifying who made the commitment
- Identifying who is responsible for satisfying the commitment
- Specifying when the commitment will be satisfied
- Specifying the criteria for determining if the commitment has been satisfied

6. Track the critical dependencies and commitments and take corrective action as appropriate.

Refer to the Work Monitoring and Control process area for more information about monitoring commitments.

Tracking critical dependencies typically includes the following:

- Evaluating the effects of late and early completion for impacts on future activities and milestones
- Resolving actual and potential problems with responsible parties whenever possible
- Escalating to the appropriate party the actual and potential problems not resolvable by the responsible individual or group

SP 2.3 Resolve Coordination Issues

Resolve issues with relevant stakeholders.

Examples of coordination issues include the following:

- Service system requirements and design defects
- Late critical dependencies and commitments
- Product level problems
- Unavailable critical resources or staff

Example Work Products

1. Relevant stakeholder coordination issues
2. Status of relevant stakeholder coordination issues

Subpractices

1. Identify and document issues.
2. Communicate issues to relevant stakeholders.
3. Resolve issues with relevant stakeholders.
4. Escalate to appropriate managers the issues not resolvable with relevant stakeholders.
5. Track issues to closure.
6. Communicate with relevant stakeholders on the status and resolution of issues.

MEASUREMENT AND ANALYSIS

A Support Process Area at Maturity Level 2

Purpose

The purpose of Measurement and Analysis (MA) is to develop and sustain a measurement capability used to support management information needs.

Introductory Notes

The Measurement and Analysis process area involves the following activities:

- Specifying objectives of measurement and analysis so that they are aligned with identified information needs and work, organizational, or business objectives
- Specifying measures, analysis techniques, and mechanisms for data collection, data storage, reporting, and feedback
- Implementing the analysis techniques and mechanisms for data collection, data reporting, and feedback
- Providing objective results that can be used in making informed decisions and taking appropriate corrective action

The integration of measurement and analysis activities into the processes of the work supports the following:

- Objective planning and estimating
- Tracking actual progress and performance against established plans and objectives
- Identifying and resolving process related issues
- Providing a basis for incorporating measurement into additional processes in the future

The staff required to implement a measurement capability may or may not be employed in a separate organization-wide program. Measurement capability may be integrated into individual work groups or other organizational functions (e.g., quality assurance).

The initial focus for measurement activities is at the work group level. However, a measurement capability can prove useful for addressing organization- and enterprise-wide information needs. To support this capability, measurement activities should support information needs at multiple levels, including the business, organizational unit, and work group to minimize re-work as the organization matures.

Work groups can store work-specific data and results in a work-specific repository, but when data are to be used widely or are to be analyzed in

support of determining data trends or benchmarks, data may reside in the organization's measurement repository.

Measurement and analysis of product components provided by suppliers is essential for effective management of the quality and costs of the work. It is possible, with careful management of supplier agreements, to provide insight into data that support supplier performance analysis.

Measurement objectives are derived from information needs that come from work, organizational, or business objectives. In this process area, when the term "objectives" is used without the "measurement" qualifier, it indicates either work, organizational, or business objectives.

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Configuration Management process area for more information about establishing and maintaining the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

Refer to the Organizational Process Definition process area for more information about establishing the organization's measurement repository.

Refer to the Quantitative Work Management process area for more information about quantitatively manage the work to achieve the established quality and process performance objectives for the work.

Refer to the Work Monitoring and Control process area for more information about monitoring work planning parameters.

Refer to the Work Planning process area for more information about establishing estimates.

Specific Goal and Practice Summary

SG 1 Align Measurement and Analysis Activities

- SP 1.1 Establish Measurement Objectives
- SP 1.2 Specify Measures
- SP 1.3 Specify Data Collection and Storage Procedures
- SP 1.4 Specify Analysis Procedures

SG 2 Provide Measurement Results

- SP 2.1 Obtain Measurement Data
- SP 2.2 Analyze Measurement Data
- SP 2.3 Store Data and Results
- SP 2.4 Communicate Results

Specific Practices by Goal

SG 1 Align Measurement and Analysis Activities

Measurement objectives and activities are aligned with identified information needs and objectives.

The specific practices under this specific goal can be addressed concurrently or in any order.

When establishing measurement objectives, experts often think ahead about necessary criteria for specifying measures and analysis procedures. They also think concurrently about the constraints imposed by data collection and storage procedures.

Often it is important to specify the essential analyses to be conducted before attending to details of measurement specification, data collection, or storage.

SP 1.1 Establish Measurement Objectives

Establish and maintain measurement objectives derived from identified information needs and objectives.

Measurement objectives document the purposes for which measurement and analysis are done and specify the kinds of actions that can be taken based on results of data analyses. Measurement objectives can also identify the change in behavior desired as a result of implementing a measurement and analysis activity.

Measurement objectives may be constrained by existing processes, available resources, or other measurement considerations. Judgments may need to be made about whether the value of the result is commensurate with resources devoted to doing the work.

Modifications to identified information needs and objectives can, in turn, be indicated as a consequence of the process and results of measurement and analysis.

Sources of information needs and objectives can include the following:

- Recurring or other troublesome incidents.
- Work plans
- Work performance monitoring
- Interviews with managers and others who have information needs
- Established management objectives
- Strategic plans
- Business plans
- Formal requirements or contractual obligations
- Recurring or other troublesome management or technical problems
- Experiences of other work groups or organizational entities
- External industry benchmarks
- Process improvement plans

Example measurement objectives include the following:

- Provide insight into schedule fluctuations and progress
- Provide insight into actual size compared to plan
- Identify unplanned growth
- Evaluate the effectiveness of defect detection throughout the product development lifecycle
- Determine the cost of correcting defects
- Provide insight into actual costs compared to plan
- Evaluate supplier progress against the plan
- Evaluate the effectiveness of mitigating information system vulnerabilities

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Requirements Management process area for more information about maintaining bidirectional traceability of requirements.

Refer to the Work Monitoring and Control process area for more information about monitoring work planning parameters.

Refer to the Work Planning process area for more information about establishing estimates.

Example Work Products

1. Measurement objectives

Subpractices

1. Document information needs and objectives.
2. Prioritize information needs and objectives.

It can be neither possible nor desirable to subject all initially identified information needs to measurement and analysis. Priorities may also need to be set within the limits of available resources.

3. Document, review, and update measurement objectives.

Carefully consider the purposes and intended uses of measurement and analysis.

The measurement objectives are documented, reviewed by management and other relevant stakeholders, and updated as necessary. Doing so enables traceability to subsequent measurement and analysis activities, and helps to ensure that analyses will properly address identified information needs and objectives.

It is important that users of measurement and analysis results be involved in setting measurement objectives and deciding on plans of action. It may also be appropriate to involve those who provide the measurement data.

4. Provide feedback for refining and clarifying information needs and objectives as necessary.

Identified information needs and objectives can be refined and clarified as a result of setting measurement objectives. Initial descriptions of information needs may be ambiguous. Conflicts can arise between existing needs and objectives. Precise targets on an already existing measure may be unrealistic.

5. Maintain traceability of measurement objectives to identified information needs and objectives.

There should always be a good answer to the question, "Why are we measuring this?"

Of course, measurement objectives can also change to reflect evolving information needs and objectives.

SP 1.2 Specify Measures

Specify measures to address measurement objectives.

Measurement objectives are refined into precise, quantifiable measures.

Measurement of work can typically be traced to one or more measurement information categories. These categories include the following: service continuity, capacity, availability, service performance, and service quality.

Measures can be either *base* or *derived*. Data for base measures are obtained by direct measurement. Data for derived measures come from other data, typically by combining two or more base measures.

Examples of commonly used base measures include the following:

- Estimates and actual measures of work product size (e.g., number of pages)
- Estimates and actual measures of effort and cost (e.g., number of person hours)
- Quality measures (e.g., number of defects by severity)
- Information security measures (e.g., number of system vulnerabilities identified)
- Customer satisfaction survey scores

Examples of commonly used derived measures include the following:

- Earned value
- Schedule performance index
- Defect density
- Peer review coverage
- Test or verification coverage
- Reliability measures (e.g., mean time to failure)
- Quality measures (e.g., number of defects by severity/total number of defects)
- Information security measures (e.g., percentage of system vulnerabilities mitigated)
- Customer satisfaction trends

Derived measures typically are expressed as ratios, composite indices, or other aggregate summary measures. They are often more quantitatively reliable and meaningfully interpretable than the base measures used to generate them.

There are direct relationships among information needs, measurement objectives, measurement categories, base measures, and derived measures. This direct relationship is depicted for service work using some common examples in Table MA.1.

Table MA.1: Example Measurement Relationships

Example Work, Organizational, or Business Objectives	Information Need	Measurement Objective	Measurement Information Categories	Example Base Measures	Example Derived Measures
Provide agreed service continuity	Can services be recovered from disasters or major disruptions within agreed timeframes?	Provide insight into whether the service continuity plans will be executed successfully to provide agreed service continuity	Service continuity	Number of services with recovery test failures Total number of services in the service catalogue	Service continuity confidence rate
Provide appropriate capacity to meet business need Prevent capacity related incidents	Are there enough resources (or too many) to meet demand for services?	Provide insight into resource utilization, idle resources, and inadequate capacity to meet demand	Capacity	Total number of service requests Available service provider staff hours Service time	Average service time Service provider staff utilization
Provide cost effective service	Is a cost-effective service being demonstrated through accurate capacity planning?	Provide insight into unplanned capacity expenses	Capacity	Total expenses for unplanned capacity Total costs for resources	Percentage of service resource costs that are unplanned capacity expenses
Improve the level of service quality	Is the level of service quality improving?	Provide insight into whether the quality of service being delivered is improving by understanding how many errors are repeat errors	Service quality	Total number of repeat errors Total number of errors	Error repeat rate

Provide effective services	How effective is the service?	Provide insight into what percentage of service requests are being reworked	Service performance	Number of service requests reworked Total number of service requests	Service rework rate
Provide appropriate, agreed service availability	Is appropriate, agreed service availability being provided?	Provide insight into the availability of the service	Availability	Agreed service time Downtime	Availability
	Is the service as reliable as agreed?	Provide insight into the reliability of the service	Availability	Available time (in hours) Total downtime (in hours) Number of breaks in service (normal service is interrupted)	Reliability as mean time between failure (MTBF)

Example Work Products

1. Specifications of base and derived measures

Subpractices

1. Identify candidate measures based on documented measurement objectives.

Measurement objectives are refined into measures. Identified candidate measures are categorized and specified by name and unit of measure.

2. Maintain traceability of measures to measurement objectives.

Interdependencies among candidate measures are identified to enable later data validation and candidate analyses in support of measurement objectives.

3. Identify existing measures that already address measurement objectives.

Specifications for measures may already exist, perhaps established for other purposes earlier or elsewhere in the organization.

4. Specify operational definitions for measures.

Operational definitions are stated in precise and unambiguous terms. They address two important criteria:

- Communication: What has been measured, how was it measured, what are the units of measure, and what has been included or excluded?
- Repeatability: Can the measurement be repeated, given the same definition, to get the same results?

5. Prioritize, review, and update measures.

Proposed specifications of measures are reviewed for their appropriateness with potential end users and other relevant stakeholders. Priorities are set or changed, and specifications of measures are updated as necessary.

SP 1.3 Specify Data Collection and Storage Procedures

Specify how measurement data are obtained and stored.

Explicit specification of collection methods helps to ensure that the right data are collected properly. This specification can also help further clarify information needs and measurement objectives.

Proper attention to storage and retrieval procedures helps to ensure that data are available and accessible for future use.

Example Work Products

1. Data collection and storage procedures
2. Data collection tools

Subpractices

1. Identify existing sources of data that are generated from current work products, processes, or transactions.

Existing sources of data may have been identified when specifying the measures. Appropriate collection mechanisms may exist whether or not pertinent data have already been collected.

2. Identify measures for which data are needed but are not currently available.

3. Specify how to collect and store the data for each required measure.

Explicit specifications are made of what, how, where, and when data will be collected and stored to ensure its validity and to support later use for analysis and documentation purposes.

Questions to be considered typically include the following:

- Have the frequency of collection and the points in the process where measurements will be made been determined?
- Has the timeline that is required to move measurement results from points of collection to repositories, other databases, or end users been established?
- Who is responsible for obtaining data?
- Who is responsible for data storage, retrieval, and security?
- Have necessary supporting tools been developed or acquired?

4. Create data collection mechanisms and process guidance.

Data collection and storage mechanisms are well integrated with other normal work processes. Data collection mechanisms can include manual or automated forms and templates. Clear, concise guidance on correct procedures is available to those who are responsible for doing the work. Training is provided as needed to clarify processes required for the collection of complete and accurate data and to minimize the burden on those who provide and record data.

5. Support automatic collection of data as appropriate and feasible.

Examples of such automated support include the following:

- Time stamped activity logs
- Static or dynamic analyses of artifacts

6. Prioritize, review, and update data collection and storage procedures.

Proposed procedures are reviewed for their appropriateness and feasibility with those who are responsible for providing, collecting, and storing data. They also may have useful insights about how to improve existing processes or may be able to suggest other useful measures or analyses.

7. Update measures and measurement objectives as necessary.

SP 1.4 Specify Analysis Procedures

Specify how measurement data are analyzed and communicated.

Specifying analysis procedures in advance ensures that appropriate analyses will be conducted and reported to address documented measurement objectives (and thereby the information needs and objectives on which they are based). This approach also provides a check that necessary data will, in fact, be collected. Analysis procedures should account for the quality (e.g., age, reliability) of all data that enter into an analysis (whether from the work group, organization's measurement repository, or other source). The quality of data should be considered to help select the appropriate analysis procedure and evaluate the results of the analysis.

Example Work Products

1. Analysis specifications and procedures
2. Data analysis tools

Subpractices

1. Specify and prioritize the analyses to be conducted and the reports to be prepared.

Early on, pay attention to the analyses to be conducted and to the manner in which results will be reported. These analyses and reports should meet the following criteria:

- The analyses explicitly address the documented measurement objectives.
- Presentation of results is clearly understandable by the audiences to whom the results are addressed.

Priorities may have to be set for available resources.

2. Select appropriate data analysis methods and tools.

Issues to be considered typically include the following:

- Choice of visual display and other presentation techniques (e.g., pie charts, bar charts, histograms, radar charts, line graphs, scatter plots, tables)
- Choice of appropriate descriptive statistics (e.g., arithmetic mean, median, mode)
- Decisions about statistical sampling criteria when it is impossible or unnecessary to examine every data element
- Decisions about how to handle analysis in the presence of missing data elements
- Selection of appropriate analysis tools

Descriptive statistics are typically used in data analysis to do the following:

- Examine distributions of specified measures (e.g., central tendency, extent of variation, data points exhibiting unusual variation)
- Examine interrelationships among specified measures (e.g., comparisons of defects by phase of the product's lifecycle, comparisons of defects by product component)
- Display changes over time

Refer to the Select Measures and Analytic Techniques specific practice and Monitor the Performance of Selected Subprocesses specific practice in the Quantitative Work Management process area for more information about the appropriate use of statistical techniques and understanding variation.

3. Specify administrative procedures for analyzing data and communicating results.

Issues to be considered typically include the following:

- Identifying the persons and groups responsible for analyzing the data and presenting the results
- Determining the timeline to analyze the data and present the results
- Determining the venues for communicating the results (e.g., progress reports, transmittal memos, written reports, staff meetings)

4. Review and update the proposed content and format of specified analyses and reports.

All of the proposed content and format are subject to review and revision, including analytic methods and tools, administrative procedures, and priorities. Relevant stakeholders consulted should include end users, sponsors, data analysts, and data providers.

5. Update measures and measurement objectives as necessary.

Just as measurement needs drive data analysis, clarification of analysis criteria can affect measurement. Specifications for some measures may be refined further based on specifications established for data analysis procedures. Other measures may prove unnecessary or a need for additional measures may be recognized.

Specifying how measures will be analyzed and reported can also suggest the need for refining measurement objectives themselves.

6. Specify criteria for evaluating the utility of analysis results and for evaluating the conduct of measurement and analysis activities.

Criteria for evaluating the utility of the analysis might address the extent to which the following apply:

- The results are provided in a timely manner, understandable, and used for decision making.
- The work does not cost more to perform than is justified by the benefits it provides.

Criteria for evaluating the conduct of the measurement and analysis might include the extent to which the following apply:

- The amount of missing data or the number of flagged inconsistencies is beyond specified thresholds.
- There is selection bias in sampling (e.g., only satisfied end users are surveyed to evaluate end-user satisfaction, only unsuccessful work groups are evaluated to determine overall productivity).
- Measurement data are repeatable (e.g., statistically reliable).
- Statistical assumptions have been satisfied (e.g., about the distribution of data, about appropriate measurement scales).

SG 2 Provide Measurement Results

Measurement results, which address identified information needs and objectives, are provided.

The primary reason for conducting measurement and analysis is to address identified information needs derived from work, organizational, and business objectives. Measurement results based on objective evidence can help to monitor progress and performance, fulfill obligations documented in a supplier agreement, make informed management and technical decisions, and enable corrective actions to be taken.

SP 2.1 Obtain Measurement Data

Obtain specified measurement data.

The data necessary for analysis are obtained and checked for completeness and integrity.

Example Work Products

1. Base and derived measurement data sets
2. Results of data integrity tests

Subpractices

1. Obtain data for base measures.

Data are collected as necessary for previously used and newly specified base measures. Existing data are gathered from work records or elsewhere in the organization.

2. Generate data for derived measures.

Values are newly calculated for all derived measures.

3. Perform data integrity checks as close to the source of data as possible.

All measurements are subject to error in specifying or recording data. It is always better to identify these errors and sources of missing data early in the measurement and analysis cycle.

Checks can include scans for missing data, out-of-bounds data values, and unusual patterns and correlation across measures. It is particularly important to do the following:

- Test and correct for inconsistency of classifications made by human judgment (i.e., to determine how frequently people make differing classification decisions based on the same information, otherwise known as “inter-coder reliability”).
- Empirically examine the relationships among measures that are used to calculate additional derived measures. Doing so can ensure that important distinctions are not overlooked and that derived measures convey their intended meanings (otherwise known as “criterion validity”).

SP 2.2 Analyze Measurement Data

Analyze and interpret measurement data.

Measurement data are analyzed as planned, additional analyses are conducted as necessary, results are reviewed with relevant stakeholders, and necessary revisions for future analyses are noted.

Example Work Products

1. Analysis results and draft reports

Subpractices

1. Conduct initial analyses, interpret results, and draw preliminary conclusions.

The results of data analyses are rarely self evident. Criteria for interpreting results and drawing conclusions should be stated explicitly.

2. Conduct additional measurement and analysis as necessary and prepare results for presentation.

Results of planned analyses can suggest (or require) additional, unanticipated analyses. In addition, these analyses can identify needs to refine existing measures, to calculate additional derived measures, or even to collect data for additional base measures to properly complete the planned analysis. Similarly, preparing initial results for presentation can identify the need for additional, unanticipated analyses.

3. Review initial results with relevant stakeholders.

It may be appropriate to review initial interpretations of results and the way in which these results are presented before disseminating and communicating them widely.

Reviewing the initial results before their release can prevent needless misunderstandings and lead to improvements in the data analysis and presentation.

Relevant stakeholders with whom reviews may be conducted include intended end users, sponsors, data analysts, and data providers.

4. Refine criteria for future analyses.

Lessons that can improve future efforts are often learned from conducting data analyses and preparing results. Similarly, ways to improve measurement specifications and data collection procedures can become apparent as can ideas for refining identified information needs and objectives.

SP 2.3 Store Data and Results

Manage and store measurement data, measurement specifications, and analysis results.

Storing measurement related information enables its timely and cost effective use as historical data and results. The information also is needed to provide sufficient context for interpretation of data, measurement criteria, and analysis results.

Information stored typically includes the following:

- Measurement plans
- Specifications of measures
- Sets of data that were collected
- Analysis reports and presentations
- Retention period for data stored

Stored information contains or refers to other information needed to understand and interpret the measures and to assess them for reasonableness and applicability (e.g., measurement specifications used on different work activities when comparing across work groups).

Typically, data sets for derived measures can be recalculated and need not be stored. However, it may be appropriate to store summaries based on derived measures (e.g., charts, tables of results, report text).

Interim analysis results need not be stored separately if they can be efficiently reconstructed.

Refer to the Configuration Management process area for more information about establishing a configuration management system.

Refer to the Establish the Organization's Measurement Repository specific practice in the Organizational Process Definition process area for more information about establishing the organization's measurement repository.

Example Work Products

1. Stored data inventory

Subpractices

1. Review data to ensure their completeness, integrity, accuracy, and currency.
2. Store data according to data storage procedures.

3. Make stored contents available for use only to appropriate groups and staff members.
4. Prevent stored information from being used inappropriately.

Examples of ways to prevent the inappropriate use of data and related information include controlling access to data and educating people on the appropriate use of data.

Examples of the inappropriate use of data include the following:

- Disclosure of information provided in confidence
- Faulty interpretations based on incomplete, out-of-context, or otherwise misleading information
- Measures used to improperly evaluate the performance of people or to rank work groups
- Impugning the integrity of individuals

SP 2.4 Communicate Results

Communicate results of measurement and analysis activities to all relevant stakeholders.

The results of the measurement and analysis process are communicated to relevant stakeholders in a timely and usable fashion to support decision making and assist in taking corrective action.

Relevant stakeholders include intended end users, sponsors, data analysts, and data providers.

Example Work Products

1. Delivered reports and related analysis results
2. Contextual information or guidance to help interpret analysis results

Subpractices

1. Keep relevant stakeholders informed of measurement results in a timely manner.

To the extent possible and as part of the normal way they do business, users of measurement results are kept personally involved in setting objectives and deciding on plans of action for measurement and analysis. Users are regularly kept informed of progress and interim results.

Refer to the Work Monitoring and Control process area for more information about conducting progress reviews.

2. Assist relevant stakeholders in understanding results.

Results are communicated in a clear and concise manner appropriate to relevant stakeholders. Results are understandable, easily interpretable, and clearly tied to identified information needs and objectives.

The data analyzed are often not self evident to practitioners who are not measurement experts. The communication of results should be clear about the following:

- How and why base and derived measures were specified
- How data were obtained
- How to interpret results based on the data analysis methods used
- How results address information needs

Examples of actions taken to help others to understand results include the following:

- Discussing the results with relevant stakeholders
- Providing background and explanation in a document
- Briefing users on results
- Providing training on the appropriate use and understanding of measurement results

ORGANIZATIONAL PROCESS DEFINITION

A Process Management Process Area at Maturity Level 3

Purpose

The purpose of Organizational Process Definition (OPD) is to establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams.

Introductory Notes

Organizational process assets enable consistent process execution across the organization and provide a basis for cumulative, long-term benefits to the organization. (See the definition of “organizational process assets” in the glossary.)

The organization’s process asset library supports organizational learning and process improvement by allowing the sharing of best practices and lessons learned across the organization. (See the definition of “organizational process assets” in the glossary.)

The organization’s set of standard processes also describes standard interactions with suppliers. Supplier interactions are characterized by the following typical items: deliverables expected from suppliers, acceptance criteria applicable to those deliverables, standards (e.g., architecture and technology standards), and standard milestone and progress reviews.

The organization’s “set of standard processes” is tailored by work groups to create their defined processes. Other organizational process assets are used to support tailoring and implementing defined processes. Work environment standards are used to guide the creation of work environments. Rules and guidelines for teams are used to aid in their structuring, formation, and operation.

A “standard process” is composed of other processes (i.e., subprocesses) or process elements. A “process element” is the fundamental (i.e., atomic) unit of process definition that describes activities and tasks to consistently perform work. The process architecture provides rules for connecting the process elements of a standard process. The organization’s set of standard processes can include multiple process architectures.

(See the definitions of “standard process,” “process architecture,” “subprocess,” and “process element” in the glossary.)

Organizational process assets can be organized in many ways, depending on the implementation of the Organizational Process Definition process area. Examples include the following:

- Descriptions of lifecycle models can be part of the organization's set of standard processes or they can be documented separately.
- The organization's set of standard processes can be stored in the organization's process asset library or it can be stored separately.
- A single repository can contain both measurements and process related documentation, or they can be stored separately.

Related Process Areas

Refer to the Strategic Service Management process area for more information about establishing and maintaining standard services in concert with strategic needs and plans.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets.

Specific Goal and Practice Summary

SG 1 Establish Organizational Process Assets

- SP 1.1 Establish Standard Processes
- SP 1.2 Establish Lifecycle Model Descriptions
- SP 1.3 Establish Tailoring Criteria and Guidelines
- SP 1.4 Establish the Organization's Measurement Repository
- SP 1.5 Establish the Organization's Process Asset Library
- SP 1.6 Establish Work Environment Standards
- SP 1.7 Establish Rules and Guidelines for Teams

Specific Practices by Goal

SG 1 Establish Organizational Process Assets

A set of organizational process assets is established and maintained.

SP 1.1 Establish Standard Processes

Establish and maintain the organization's set of standard processes.

Standard processes can be defined at multiple levels in an enterprise and they can be related hierarchically. For example, an enterprise can have a set of standard processes that is tailored by individual organizations (e.g., a division, a site) in the enterprise to establish their set of standard processes. The set of standard processes can also be tailored for each of the organization's business areas, product lines, or standard services. Thus the *organization's set of standard processes* can refer to the standard processes established at the organization level and standard processes that may be established at lower levels, although some organizations may

have only one level of standard processes. (See the definitions of “standard process” and “organization’s set of standard processes” in the glossary.)

Multiple standard processes may be needed to address the needs of different application domains, lifecycle models, methodologies, and tools. The organization’s set of standard processes contains process elements (e.g., a work product size estimating element) that may be interconnected according to one or more process architectures that describe relationships among process elements.

The organization’s set of standard processes typically includes technical, management, administrative, support, and organizational processes.

The organization’s set of standard processes should collectively cover all processes needed by the organization and work groups, including those processes addressed by the process areas at maturity level 2.

Example Work Products

1. Organization’s set of standard processes

Subpractices

1. Decompose each standard process into constituent process elements to the detail needed to understand and describe the process.

Each process element covers a closely related set of activities. The descriptions of process elements may be templates to be filled in, fragments to be completed, abstractions to be refined, or complete descriptions to be tailored or used unmodified. These elements are described in such detail that the process, when fully defined, can be consistently performed by appropriately trained and skilled people.

Examples of process elements include the following:

- Template for generating work product size estimates
- Description of work product design methodology
- Tailorable peer review methodology
- Tailorable incident resolution process
- Template for creating service agreements
- Template for conducting management reviews
- Templates or task flows embedded in workflow tools
- Description of methods for prequalifying suppliers as preferred suppliers

2. Specify the critical attributes of each process element.

Examples of critical attributes include the following:

- Process roles
- Applicable standards
- Applicable procedures, methods, tools, and resources
- Process performance objectives
- Entry criteria
- Inputs
- Verification points (e.g., peer reviews)
- Outputs
- Interfaces
- Exit criteria
- Product and process measures

3. Specify relationships among process elements.

Examples of relationships include the following:

- Order of the process elements
- Interfaces among process elements
- Interfaces with external processes
- Interdependencies among process elements

The rules for describing relationships among process elements are referred to as the “process architecture.” The process architecture covers essential requirements and guidelines. Detailed specifications of these relationships are covered in descriptions of defined processes that are tailored from the organization’s set of standard processes.

4. Ensure that the organization’s set of standard processes adheres to applicable policies, standards, and models.

Adherence to applicable process standards and models is typically demonstrated by developing a mapping from the organization’s set of standard processes to relevant process standards and models. This mapping is a useful input to future appraisals.

5. Ensure that the organization’s set of standard processes satisfies process needs and objectives of the organization.

Refer to the Organizational Process Focus process area for more information about establishing organizational process needs.

6. Ensure that there is appropriate integration among processes that are included in the organization’s set of standard processes.

7. Document the organization’s set of standard processes.

8. Conduct peer reviews on the organization’s set of standard processes.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

9. Revise the organization's set of standard processes as necessary.

Examples of when the organization's set of standard processes may need to be revised include the following:

- When improvements to the process are identified
- When causal analysis and resolution data indicate that a process change is needed
- When process improvement proposals are selected for deployment across the organization
- When the organization's process needs and objectives are updated

SP 1.2 Establish Lifecycle Model Descriptions

Establish and maintain descriptions of lifecycle models approved for use in the organization.

Lifecycle models can be developed for a variety of customers or in a variety of situations, since one lifecycle model may not be appropriate for all situations. Lifecycle models are often used to define phases of the work. Also, the organization can define different lifecycle models for each type of product and service it delivers.

Example Work Products

1. Descriptions of lifecycle models

Subpractices

1. Select lifecycle models based on the needs of work groups and the organization.

The selection of a service lifecycle model depends on the characteristics of the services and the environment. Some service providers define lifecycle phases based on their standard service definitions.

Examples of sets of phases that can comprise a service lifecycle include the following:

- Plan, define, enable, and measure
- Scope definition, planning, execution, and termination
- Strategy, design, transition, operation, and improvement

Often, individual service domains have implicit lifecycles associated with them that involve points of communication, evaluation, and decision. Descriptions of these points can be included in the set of descriptions of lifecycle models approved for use in the organization.

Examples of lifecycle models used for developing a service system include the following:

- Waterfall
- Spiral
- Evolutionary
- Incremental
- Iterative

2. Document descriptions of lifecycle models.

Lifecycle models can be documented as part of the organization's standard process descriptions or they can be documented separately.

3. Conduct peer reviews on lifecycle models.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

4. Revise the descriptions of lifecycle models as necessary.

SP 1.3 Establish Tailoring Criteria and Guidelines

Establish and maintain tailoring criteria and guidelines for the organization's set of standard processes.

Tailoring criteria and guidelines describe the following:

- How the organization's set of standard processes and organizational process assets are used to create defined processes
- Requirements that must be satisfied by defined processes (e.g., the subset of organizational process assets that are essential for any defined process)
- Options that can be exercised and criteria for selecting among options
- Procedures that must be followed in performing and documenting process tailoring

Examples of reasons for tailoring include the following:

- Adapting the process to a new service or type of customer
- Elaborating the process description so that the resulting defined process can be performed
- Customizing the process for an application or class of similar applications

Flexibility in tailoring and defining processes is balanced with ensuring appropriate consistency of processes across the organization. Flexibility is needed to address contextual variables such as the domain; the nature of the customer; cost, schedule, and quality tradeoffs; the technical difficulty of the work; and the experience of the people implementing the process. Consistency across the organization is needed so that organizational

standards, objectives, and strategies are appropriately addressed, and process data and lessons learned can be shared.

Tailoring is a critical activity that allows controlled changes to processes due to the specific needs of a work group or a part of the organization. Processes and process elements that are directly related to critical business objectives should usually be defined as mandatory, but processes and process elements that are less critical or only indirectly affect business objectives may allow for more tailoring.

The amount of tailoring could also depend on the work group's lifecycle model, the use of suppliers, and other factors.

Tailoring criteria and guidelines can allow for using a standard process “as is,” with no tailoring.

Example Work Products

1. Tailoring guidelines for the organization's set of standard processes

Subpractices

1. Specify selection criteria and procedures for tailoring the organization's set of standard processes.

Examples of criteria and procedures include the following:

- Criteria for selecting lifecycle models from the ones approved by the organization
- Criteria for selecting process elements from the organization's set of standard processes
- Procedures for tailoring selected lifecycle models and process elements to accommodate process characteristics and needs
- Procedures for adapting the organization's common measures to address information needs

Examples of tailoring include the following:

- Modifying a lifecycle model
- Combining elements of different lifecycle models
- Modifying process elements
- Replacing process elements
- Reordering process elements

2. Specify the standards used for documenting defined processes.
3. Specify the procedures used for submitting and obtaining approval of waivers from the organization's set of standard processes.
4. Document tailoring guidelines for the organization's set of standard processes.
5. Conduct peer reviews on the tailoring guidelines.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

6. Revise tailoring guidelines as necessary.

SP 1.4 Establish the Organization's Measurement Repository
Establish and maintain the organization's measurement repository.

Refer to the Use Organizational Process Assets for Planning Work Activities specific practice in the Integrated Work Management process area for more information about the use of the organization's measurement repository in planning work activities.

The repository contains both product and process measures that are related to the organization's set of standard processes. It also contains or refers to information needed to understand and interpret measures and to assess them for reasonableness and applicability. For example, the definitions of measures are used to compare similar measures from different processes.

Example Work Products

1. Definition of the common set of product and process measures for the organization's set of standard processes
2. Design of the organization's measurement repository
3. Organization's measurement repository (i.e., the repository structure, support environment)
4. Organization's measurement data

Subpractices

1. Determine the organization's needs for storing, retrieving, and analyzing measurements.
2. Define a common set of process and product measures for the organization's set of standard processes.

Measures in the common set are selected for their ability to provide visibility into processes critical to achieving business objectives and to focus on process elements significantly impacting cost, schedule, and performance within a work group and across the organization. The common set of measures can vary for different standard processes.

Measures defined include the ones related to agreement management, some of which may need to be collected from suppliers.

Operational definitions for measures specify procedures for collecting valid data and the point in the process where data will be collected.

Examples of classes of commonly used measures include the following:

- Estimates of work product size (e.g., pages)
- Estimates of effort and cost (e.g., person hours)
- Actual measures of size, effort, and cost
- Quality measures (e.g., number of incidents reported)
- Peer review coverage
- Test coverage
- Reliability measures (e.g., mean time to failure)

3. Design and implement the measurement repository.

Functions of the measurement repository include the following:

- Supporting effective comparison and interpretation of measurement data among work activities
- Providing sufficient context to allow a new work group to quickly identify and access data in the repository for similar work
- Enabling work groups to improve the accuracy of their estimates by using their own and other historical data
- Aiding in the understanding of process performance
- Supporting potential statistical management of processes or subprocesses, as needed

4. Specify procedures for storing, updating, and retrieving measures.

Refer to the Measurement and Analysis process area for more information about specifying data collection and storage procedures.

5. Conduct peer reviews on definitions of the common set of measures and procedures for storing, updating, and retrieving measures.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

6. Enter specified measures into the repository.

Refer to the Measurement and Analysis process area for more information about specifying measures.

7. Make the contents of the measurement repository available for use by the organization and work groups as appropriate.

8. Revise the measurement repository, the common set of measures, and procedures as the organization's needs change.

Examples of when the common set of measures may need to be revised include the following:

- New processes are added
- Processes are revised and new measures are needed
- Finer granularity of data is required
- Greater visibility into the process is required
- Measures are retired

SP 1.5 Establish the Organization's Process Asset Library

Establish and maintain the organization's process asset library.

Examples of items to be stored in the organization's process asset library include the following:

- Organizational policies
- Process descriptions
- Procedures (e.g., estimating procedure)
- Development plans
- Acquisition plans
- Quality assurance plans
- Training materials
- Process aids (e.g., checklists)
- Lessons learned reports

Example Work Products

1. Design of the organization's process asset library
2. The organization's process asset library
3. Selected items to be included in the organization's process asset library
4. The catalog of items in the organization's process asset library

Subpractices

1. Design and implement the organization's process asset library, including the library structure and support environment.
2. Specify criteria for including items in the library.
Items are selected based primarily on their relationship to the organization's set of standard processes.
3. Specify procedures for storing, updating, and retrieving items.
4. Enter selected items into the library and catalog them for easy reference and retrieval.
5. Make items available for use by work groups.
6. Periodically review the use of each item.

7. Revise the organization's process asset library as necessary.

Examples of when the library may need to be revised include the following:

- New items are added
- Items are retired
- Current versions of items are changed

SP 1.6 Establish Work Environment Standards

Establish and maintain work environment standards.

Work environment standards allow the organization and work groups to benefit from common tools, training, and maintenance, as well as cost savings from volume purchases. Work environment standards address the needs of all stakeholders and consider productivity, cost, availability, security, and workplace health, safety, and ergonomic factors. Work environment standards can include guidelines for tailoring and the use of waivers that allow adaptation of the work environment to meet work group needs.

Examples of work environment standards include the following:

- Procedures for the operation, safety, and security of the customer work environment in which the service provider works
- Procedures for the operation, safety, and security of the work environment
- Standard workstation hardware and software
- Standard application software and tailoring guidelines for it
- Standard production and calibration equipment
- Process for requesting and approving tailoring or waivers

Example Work Products

1. Work environment standards

Subpractices

1. Evaluate commercially available work environment standards appropriate for the organization.
2. Adopt existing work environment standards and develop new ones to fill gaps based on the organization's process needs and objectives.

SP 1.7 Establish Rules and Guidelines for Teams

Establish and maintain organizational rules and guidelines for the structure, formation, and operation of teams.

Operating rules and guidelines for teams define and control how teams are created and how they interact to accomplish objectives. Team members should understand the standards for work and participate according to those standards.

When establishing rules and guidelines for teams, ensure they comply with all local and national regulations or laws that can affect the use of teams.

Structuring teams involves defining the number of teams, the type of each team, and how each team relates to the others in the structure. Forming teams involves chartering each team, assigning team members and team leaders, and providing resources to each team to accomplish work.

Example Work Products

1. Rules and guidelines for structuring and forming teams
2. Operating rules for teams

Subpractices

1. Establish and maintain empowerment mechanisms to enable timely decision making.

In a successful teaming environment, clear channels of responsibility and authority are established by documenting and deploying organizational guidelines that clearly define the empowerment of teams.

2. Establish and maintain rules and guidelines for structuring and forming teams.

Organizational process assets can help the work group to structure and implement teams. Such assets can include the following:

- Guidelines for establishing lines of communication, authority, and escalation
- Team structure guidelines
- Team formation guidelines
- Team authority and responsibility guidelines
- Team leader selection criteria

3. Define the expectations, rules, and guidelines that guide how teams work collectively.

These rules and guidelines establish organizational practices for consistency across teams and can include the following:

- How interfaces among teams are established and maintained
- How assignments are accepted and transferred
- How resources and inputs are accessed
- How work gets done
- Who checks, reviews, and approves work
- How work is approved
- How work is delivered and communicated
- Who reports to whom
- What the reporting requirements (e.g., cost, schedule, performance status), measures, and methods are
- Which progress reporting measures and methods are used

ORGANIZATIONAL PROCESS FOCUS

A Process Management Process Area at Maturity Level 3

Purpose

The purpose of Organizational Process Focus (OPF) is to plan, implement, and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets.

Introductory Notes

The organization's processes include all processes used by the organization and its work groups. Candidate improvements to the organization's processes and process assets are obtained from various sources, including the measurement of processes, lessons learned in implementing processes, results of process appraisals, results of product and service evaluation activities, results of customer satisfaction evaluations, results of benchmarking against other organizations' processes, and recommendations from other improvement initiatives in the organization.

Process improvement occurs in the context of the organization's needs and is used to address the organization's objectives. The organization encourages participation in process improvement activities by those who perform the process. The responsibility for facilitating and managing the organization's process improvement activities, including coordinating the participation of others, is typically assigned to a process group. The organization provides the long-term commitment and resources required to sponsor this group and to ensure the effective and timely deployment of improvements.

Careful planning is required to ensure that process improvement efforts across the organization are adequately managed and implemented. Results of the organization's process improvement planning are documented in a process improvement plan.

The "organization's process improvement plan" addresses appraisal planning, process action planning, pilot planning, and deployment planning. Appraisal plans describe the appraisal timeline and schedule, the scope of the appraisal, resources required to perform the appraisal, the reference model against which the appraisal will be performed, and logistics for the appraisal.

Process action plans usually result from appraisals and document how improvements targeting weaknesses uncovered by an appraisal will be implemented. Sometimes the improvement described in the process action plan should be tested on a small group before deploying it across the organization. In these cases, a pilot plan is generated.

When the improvement is to be deployed, a deployment plan is created. This plan describes when and how the improvement will be deployed across the organization.

Organizational process assets are used to describe, implement, and improve the organization's processes. (See the definition of "organizational process assets" in the glossary.)

Related Process Areas

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Specific Goal and Practice Summary

- SG 1 Determine Process Improvement Opportunities
 - SP 1.1 Establish Organizational Process Needs
 - SP 1.2 Appraise the Organization's Processes
 - SP 1.3 Identify the Organization's Process Improvements
- SG 2 Plan and Implement Process Actions
 - SP 2.1 Establish Process Action Plans
 - SP 2.2 Implement Process Action Plans
- SG 3 Deploy Organizational Process Assets and Incorporate Experiences
 - SP 3.1 Deploy Organizational Process Assets
 - SP 3.2 Deploy Standard Processes
 - SP 3.3 Monitor the Implementation
 - SP 3.4 Incorporate Experiences into Organizational Process Assets

Specific Practices by Goal

SG 1 Determine Process Improvement Opportunities

Strengths, weaknesses, and improvement opportunities for the organization's processes are identified periodically and as needed.

Strengths, weaknesses, and improvement opportunities can be determined relative to a process standard or model such as a CMMI model or ISO standard. Process improvements should be selected to address the organization's needs.

Process improvement opportunities can arise as a result of changing business objectives, legal and regulatory requirements, and results of benchmarking studies.

SP 1.1 Establish Organizational Process Needs

Establish and maintain the description of process needs and objectives for the organization.

The organization's processes operate in a business context that should be understood. The organization's business objectives, needs, and constraints determine the needs and objectives for the organization's processes. Typically, issues related to customer satisfaction, finance, technology, quality, human resources, and marketing are important process considerations.

The organization's process needs and objectives cover aspects that include the following:

- Characteristics of processes
- Process performance objectives, such as time-to-market and delivered quality
- Process effectiveness

Example Work Products

1. The organization's process needs and objectives

Subpractices

1. Identify policies, standards, and business objectives that are applicable to the organization's processes.

Examples of standards include the following:

- ISO/IEC 12207:2008 Systems and Software Engineering – Software Life Cycle Processes [ISO 2008a]
- ISO/IEC 15288:2008 Systems and Software Engineering – System Life Cycle Processes [ISO 2008b]
- ISO/IEC 27001:2005 Information technology – Security techniques – Information Security Management Systems – Requirements [ISO/IEC 2005]
- ISO/IEC 14764:2006 Software Engineering – Software Life Cycle Processes – Maintenance [ISO 2006b]
- ISO/IEC 20000 Information Technology – Service Management [ISO 2005b]
- Assurance Focus for CMMI [DHS 2009]
- NDIA Engineering for System Assurance Guidebook [NDIA 2008]
- Resiliency Management Model [SEI 2010c]

2. Examine relevant process standards and models for best practices.
3. Determine the organization's process performance objectives.

Process performance objectives can be expressed in quantitative or qualitative terms.

Refer to the Measurement and Analysis process area for more information about establishing measurement objectives.

Refer to the Organizational Process Performance process area for more information about establishing quality and process performance objectives.

Examples of process performance objectives include the following:

- Achieve a customer satisfaction rating of a certain value
- Decrease incident rates by a given percentage.
- Close a certain number of incident reports per month
- Achieve a certain cycle time for a given activity
- Improve productivity by a given percentage
- Simplify the requirements approval workflow
- Improve quality of products delivered to customer

4. Define essential characteristics of the organization's processes.

Essential characteristics of the organization's processes are determined based on the following:

- Processes currently being used in the organization
- Standards imposed by the organization
- Standards commonly imposed by customers of the organization

Examples of process characteristics include the following:

- Level of detail
- Process notation
- Granularity

5. Document the organization's process needs and objectives.

6. Revise the organization's process needs and objectives as needed.

SP 1.2 Appraise the Organization's Processes

Appraise the organization's processes periodically and as needed to maintain an understanding of their strengths and weaknesses.

Process appraisals can be performed for the following reasons:

- To identify processes to be improved
- To confirm progress and make the benefits of process improvement visible
- To satisfy the needs of a customer-supplier relationship
- To motivate and facilitate buy-in

The buy-in gained during a process appraisal can be eroded significantly if it is not followed by an appraisal based action plan.

Example Work Products

1. Plans for the organization's process appraisals
2. Appraisal findings that address strengths and weaknesses of the organization's processes
3. Improvement recommendations for the organization's processes

Subpractices

1. Obtain sponsorship of the process appraisal from senior management.

Senior management sponsorship includes the commitment to have the organization's managers and staff participate in the process appraisal and to provide resources and funding to analyze and communicate findings of the appraisal.

2. Define the scope of the process appraisal.

Process appraisals can be performed on the entire organization or can be performed on a smaller part of an organization such as a single work group or business area.

The scope of the process appraisal addresses the following:

- Definition of the organization (e.g., sites, business areas) to be covered by the appraisal
 - Identification of the work group and support functions that will represent the organization in the appraisal
 - Processes to be appraised
3. Determine the method and criteria to be used for the process appraisal.

Process appraisals can occur in many forms. They should address the needs and objectives of the organization, which can change over time. For example, the appraisal can be based on a process model, such as a CMMI model, or on a national or international standard, such as ISO 9001 [ISO 2008c]. Appraisals can also be based on a benchmark comparison with other organizations in which practices that can contribute to improved organizational performance are identified. The characteristics of the appraisal method may vary, including time and effort, makeup of the appraisal team, and the method and depth of investigation.

4. Plan, schedule, and prepare for the process appraisal.
5. Conduct the process appraisal.
6. Document and deliver the appraisal's activities and findings.

SP 1.3 Identify the Organization's Process Improvements

Identify improvements to the organization's processes and process assets.

Example Work Products

1. Analysis of candidate process improvements
2. Identification of improvements for the organization's processes

Subpractices

1. Determine candidate process improvements.

Candidate process improvements are typically determined by doing the following:

- Measuring processes and analyzing measurement results
- Reviewing processes for effectiveness and suitability
- Assessing customer satisfaction
- Reviewing lessons learned from tailoring the organization's set of standard processes
- Reviewing lessons learned from implementing processes
- Reviewing process improvement proposals submitted by the organization's managers, staff, and other relevant stakeholders
- Soliciting inputs on process improvements from senior management and other leaders in the organization
- Examining results of process appraisals and other process related reviews
- Reviewing results of other organizational improvement initiatives

2. Prioritize candidate process improvements.

Criteria for prioritization are as follows:

- Consider the estimated cost and effort to implement the process improvements.
- Evaluate the expected improvement against the organization's improvement objectives and priorities.
- Determine the potential barriers to the process improvements and develop strategies for overcoming these barriers.

Examples of techniques to help determine and prioritize possible improvements to be implemented include the following:

- A cost benefit analysis that compares the estimated cost and effort to implement the process improvements and their associated benefits
- A gap analysis that compares current conditions in the organization with optimal conditions
- Force field analysis of potential improvements to identify potential barriers and strategies for overcoming those barriers
- Cause-and-effect analyses to provide information on the potential effects of different improvements that can then be compared

3. Identify and document the process improvements to be implemented.

4. Revise the list of planned process improvements to keep it current.

SG 2 Plan and Implement Process Actions

Process actions that address improvements to the organization's processes and process assets are planned and implemented.

The successful implementation of improvements requires participation in process action planning and implementation by process owners, those who perform the process, and support organizations.

SP 2.1 Establish Process Action Plans

Establish and maintain process action plans to address improvements to the organization's processes and process assets.

Establishing and maintaining process action plans typically involves the following roles:

- Management steering committees that set strategies and oversee process improvement activities
- Process groups that facilitate and manage process improvement activities
- Process action teams that define and implement process actions
- Process owners that manage deployment
- Practitioners that perform the process

Stakeholder involvement helps to obtain buy-in on process improvements and increases the likelihood of effective deployment.

Process action plans are detailed implementation plans. These plans differ from the organization's process improvement plan by targeting

improvements that were defined to address weaknesses and that were usually uncovered by appraisals.

Example Work Products

1. The organization's approved process action plans

Subpractices

1. Identify strategies, approaches, and actions to address identified process improvements.

New, unproven, and major changes are piloted before they are incorporated into normal use.

2. Establish process action teams to implement actions.

The teams and people performing the process improvement actions are called "process action teams." Process action teams typically include process owners and those who perform the process.

3. Document process action plans.

Process action plans typically cover the following:

- Process improvement infrastructure
- Process improvement objectives
- Process improvements to be addressed
- Procedures for planning and tracking process actions
- Strategies for piloting and implementing process actions
- Responsibility and authority for implementing process actions
- Resources, schedules, and assignments for implementing process actions
- Methods for determining the effectiveness of process actions
- Risks associated with process action plans

4. Review and negotiate process action plans with relevant stakeholders.
5. Revise process action plans as necessary.

SP 2.2 Implement Process Action Plans

Implement process action plans.

Example Work Products

1. Commitments among process action teams
2. Status and results of implementing process action plans
3. Plans for pilots

Subpractices

1. Make process action plans readily available to relevant stakeholders.
2. Negotiate and document commitments among process action teams and revise their process action plans as necessary.
3. Track progress and commitments against process action plans.

4. Conduct joint reviews with process action teams and relevant stakeholders to monitor the progress and results of process actions.
5. Plan pilots needed to test selected process improvements.
6. Review the activities and work products of process action teams.
7. Identify, document, and track to closure issues encountered when implementing process action plans.
8. Ensure that results of implementing process action plans satisfy the organization's process improvement objectives.

SG 3 Deploy Organizational Process Assets and Incorporate Experiences

Organizational process assets are deployed across the organization and process related experiences are incorporated into organizational process assets.

The specific practices under this specific goal describe ongoing activities. New opportunities to benefit from organizational process assets and changes to them can arise throughout the work lifecycle. Deployment of standard processes and other organizational process assets should be continually supported in the organization, particularly for new work at startup.

SP 3.1 Deploy Organizational Process Assets

Deploy organizational process assets across the organization.

Deploying organizational process assets or changes to them should be performed in an orderly manner. Some organizational process assets or changes to them may not be appropriate for use in some parts of the organization (e.g., because of stakeholder requirements or the current lifecycle phase being implemented). It is therefore important that those who are or will be executing the process, as well as other organization functions (e.g., training, quality assurance), be involved in deployment as necessary.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Example Work Products

1. Plans for deploying organizational process assets and changes to them across the organization
2. Training materials for deploying organizational process assets and changes to them
3. Documentation of changes to organizational process assets
4. Support materials for deploying organizational process assets and changes to them

Subpractices

1. Deploy organizational process assets across the organization.

Typical activities performed as a part of the deployment of process assets include the following:

- Identifying organizational process assets that should be adopted by those who perform the process
- Determining how organizational process assets are made available (e.g., via a website)
- Identifying how changes to organizational process assets are communicated
- Identifying resources (e.g., methods, tools) needed to support the use of organizational process assets
- Planning the deployment
- Assisting those who use organizational process assets
- Ensuring that training is available for those who use organizational process assets

Refer to the Organizational Training process area for more information about establishing an organizational training capability.

2. Document changes to organizational process assets.

Documenting changes to organizational process assets serves two main purposes:

- To enable the communication of changes
- To understand the relationship of changes in the organizational process assets to changes in process performance and results

3. Deploy changes that were made to organizational process assets across the organization.

Typical activities performed as a part of deploying changes include the following:

- Determining which changes are appropriate for those who perform the process
- Planning the deployment
- Arranging for the support needed for the successful transition of changes

4. Provide guidance and consultation on the use of organizational process assets.

SP 3.2 Deploy Standard Processes

Deploy the organization's set of standard processes to work groups at their startup and deploy changes to them as appropriate throughout the work.

It is important that new work groups use proven and effective processes to perform critical early activities (e.g., work planning, receiving requirements, obtaining resources).

Work groups should also periodically update their defined processes to incorporate the latest changes made to the organization's set of standard processes when it will benefit them. This periodic update helps to ensure that all work activities derive the full benefit of what other work groups have learned.

Refer to the Organizational Process Definition process area for more information about establishing standard processes and establishing tailoring criteria and guidelines.

Example Work Products

1. The organization's list of work and the status of process deployment on each (i.e., existing and planned work activities)
2. Guidelines for deploying the organization's set of standard processes on new work
3. Records of tailoring and implementing the organization's set of standard processes

Subpractices

1. Identify work groups in the organization that are starting up.
2. Identify active work groups that would benefit from implementing the organization's current set of standard processes.
3. Establish plans to implement the organization's current set of standard processes on the identified work.
4. Assist work groups in tailoring the organization's set of standard processes to meet their needs.

Refer to the Integrated Work Management process area for more information about establishing the defined process for the work.

5. Maintain records of tailoring and implementing processes on the identified work.
6. Ensure that the defined processes resulting from process tailoring are incorporated into plans for process compliance audits.

Process compliance audits are objective evaluations of work activities against the defined process for the work.

7. As the organization's set of standard processes is updated, identify which work groups should implement the changes.

SP 3.3 Monitor the Implementation

Monitor the implementation of the organization's set of standard processes and use of process assets on all work.

By monitoring implementation, the organization ensures that the organization's set of standard processes and other process assets are appropriately deployed to all work groups. Monitoring implementation also helps the organization to develop an understanding of the organizational process assets being used and where they are used in the organization. Monitoring also helps to establish a broader context for interpreting and using process and product measures, lessons learned, and improvement information obtained from work groups.

Example Work Products

1. Results of monitoring process implementation on work

2. Status and results of process compliance audits
3. Results of reviewing selected process artifacts created as part of process tailoring and implementation

Subpractices

1. Monitor the work groups' use of organizational process assets and changes to them.
2. Review selected process artifacts created during the life of the work.
Reviewing selected process artifacts created during the work lifecycle ensures that all work groups are making appropriate use of the organization's set of standard processes.
3. Review results of process compliance audits to determine how well the organization's set of standard processes has been deployed.
Refer to the Process and Product Quality Assurance process area for more information about objectively evaluating processes.
4. Identify, document, and track to closure issues related to implementing the organization's set of standard processes.

SP 3.4 Incorporate Experiences into Organizational Process Assets

Incorporate process related experiences derived from planning and performing the process into organizational process assets.

Example Work Products

1. Process improvement proposals
2. Process lessons learned
3. Measurements of organizational process assets
4. Improvement recommendations for organizational process assets
5. Records of the organization's process improvement activities
6. Information on organizational process assets and improvements to them

Subpractices

1. Conduct periodic reviews of the effectiveness and suitability of the organization's set of standard processes and related organizational process assets relative to the process needs and objectives derived from the organization's business objectives.
2. Obtain feedback about the use of organizational process assets.
3. Derive lessons learned from defining, piloting, implementing, and deploying organizational process assets.
4. Make lessons learned available to people in the organization as appropriate.

Actions may be necessary to ensure that lessons learned are used appropriately.

Examples of the inappropriate use of lessons learned include the following:

- Evaluating the performance of people
- Judging process performance or results

Examples of ways to prevent the inappropriate use of lessons learned include the following:

- Controlling access to lessons learned
- Educating people about the appropriate use of lessons learned

5. Analyze measurement data obtained from the use of the organization's common set of measures.

Refer to the Measurement and Analysis process area for more information about analyzing measurement data.

Refer to the Organizational Process Definition process area for more information about establishing the organization's measurement repository.

6. Appraise processes, methods, and tools in use in the organization and develop recommendations for improving organizational process assets.

This appraisal typically includes the following:

- Determining which processes, methods, and tools are of potential use to other parts of the organization
- Appraising the quality and effectiveness of organizational process assets
- Identifying candidate improvements to organizational process assets
- Determining compliance with the organization's set of standard processes and tailoring guidelines

7. Make the best of the organization's processes, methods, and tools available to people in the organization as appropriate.
8. Manage process improvement proposals.

Process improvement proposals can address both process and technology improvements.

The activities for managing process improvement proposals typically include the following:

- Soliciting process improvement proposals
- Collecting process improvement proposals
- Reviewing process improvement proposals
- Selecting the process improvement proposals to be implemented
- Tracking the implementation of process improvement proposals

Process improvement proposals are documented as process change requests or problem reports as appropriate.

Some process improvement proposals can be incorporated into the organization's process action plans.

9. Establish and maintain records of the organization's process improvement activities.

ORGANIZATIONAL PERFORMANCE MANAGEMENT

A Process Management Process Area at Maturity Level 5

Purpose

The purpose of Organizational Performance Management (OPM) is to proactively manage the organization's performance to meet its business objectives.

Introductory Notes

The Organizational Performance Management process area enables the organization to manage organizational performance by iteratively analyzing aggregated project or work data, identifying gaps in performance against the business objectives, and selecting and deploying improvements to close the gaps.

In this process area, the term "improvement" includes all incremental and innovative process and technology improvements, including those improvements made to work environments. "Improvement" refers to all ideas that would change the organization's processes, technologies, and performance to better meet the organization's business objectives and associated quality and process performance objectives.

Business objectives that this process area might address include the following:

- Improved product quality (e.g., functionality, quality attributes)
- Increased productivity
- Increased process efficiency and effectiveness
- Increased consistency in meeting budget and schedule
- Decreased cycle time
- Greater customer and end-user satisfaction
- Shorter development or production time to change functionality, add new features, or adapt to new technologies
- Improved performance of a supply chain involving multiple suppliers
- Improved use of resources across the organization

The organization analyzes product and process performance data from the work to determine if it is capable of meeting the quality and process performance objectives. Process performance baselines and process performance models, developed using Organizational Process Performance processes, are used as part of the analysis. Causal Analysis and Resolution processes can also be used to identify potential areas of improvement or specific improvement proposals.

The organization identifies and proactively solicits incremental and innovative improvements from within the organization and from external sources such as academia, competitive intelligence, and successful improvements implemented elsewhere.

Realization of the improvements and their effects on the quality and process performance objectives depends on being able to effectively identify, evaluate, implement, and deploy improvements to the organization's processes and technologies.

Realization of the improvements and beneficial effects also depends on engaging the workforce in identifying and evaluating possible improvements and maintaining a focus on long-term planning that includes the identification of innovations.

Improvement proposals are evaluated and validated for their effectiveness in the target environment. Based on this evaluation, improvements are prioritized and selected for deployment to new and ongoing work. Deployment is managed in accordance with the deployment plan and performance data are analyzed using statistical and other quantitative techniques to determine the effects of the improvement on quality and process performance objectives.

This improvement cycle continually optimizes organizational processes based on quality and process performance objectives. Business objectives are periodically reviewed to ensure they are current and quality and process performance objectives are updated as appropriate.

The Organizational Process Focus process area includes no assumptions about the quantitative basis for identifying improvements, nor their expected results. This process area extends the Organizational Process Focus practices by focusing on process improvement based on a quantitative understanding of the organization's set of standard processes and technologies and their expected quality and process performance.

The specific practices of this process area apply to organizations whose work is quantitatively managed. Use of the specific practices of this process area can add value in other situations, but the results may not provide the same degree of impact to the organization's quality and process performance objectives.

Related Process Areas

Refer to the Causal Analysis and Resolution process area for more information about identifying causes of selected outcomes and taking action to improve process performance.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Refer to the Organizational Process Focus process area for more information about planning, implementing, and deploying organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets.

Refer to the Organizational Process Performance process area for more information about establishing quality and process performance objectives and establishing process performance baselines and models.

Refer to the Organizational Training process area for more information about providing training.

Specific Goal and Practice Summary

SG 1 Manage Business Performance

- SP 1.1 Maintain Business Objectives
- SP 1.2 Analyze Process Performance Data
- SP 1.3 Identify Potential Areas for Improvement

SG 2 Select Improvements

- SP 2.1 Elicit Suggested Improvements
- SP 2.2 Analyze Suggested Improvements
- SP 2.3 Validate Improvements
- SP 2.4 Select and Implement Improvements for Deployment

SG 3 Deploy Improvements

- SP 3.1 Plan the Deployment
- SP 3.2 Manage the Deployment
- SP 3.3 Evaluate Improvement Effects

Specific Practices by Goal

SG 1 Manage Business Performance

The organization's business performance is managed using statistical and other quantitative techniques to understand process performance shortfalls, and to identify areas for process improvement.

Managing business performance requires the following:

- Maintaining the organization's business objectives
- Understanding the organization's ability to meet the business objectives
- Continually improving processes related to achieving the business objectives

The organization uses defined process performance baselines to determine if the current and projected organizational business objectives are being met. Shortfalls in process performance are identified and analyzed to determine potential areas for process improvement.

Refer to the Organizational Process Performance process area for more information about establishing performance baselines and models.

As the organization improves its process performance or as business strategies change, new business objectives are identified and associated quality and process performance objectives are derived.

Specific goal 2 addresses eliciting and analyzing improvement suggestions that address shortfalls in achieving quality and process performance objectives.

SP 1.1 Maintain Business Objectives

Maintain business objectives based on an understanding of business strategies and actual performance results.

Organizational performance data, characterized by process performance baselines, are used to evaluate whether business objectives are realistic and aligned with business strategies. After business objectives have been revised and prioritized by senior management, quality and process performance objectives may need to be created or maintained and re-communicated.

Example Work Products

1. Revised business objectives
2. Revised quality and process performance objectives
3. Senior management approval of revised business objectives and quality and process performance objectives
4. Communication of all revised objectives
5. Updated process performance measures

Subpractices

1. Evaluate business objectives periodically to ensure they are aligned with business strategies.

Senior management is responsible for understanding the marketplace, establishing business strategies, and establishing business objectives.

Because business strategies and organizational performance evolve, business objectives should be reviewed periodically to determine whether they should be updated. For example, a business objective might be retired when process performance data show that the business objective is being met consistently over time or when the associated business strategy has changed.

2. Compare business objectives with actual process performance results to ensure they are realistic.

Business objectives can set the bar too high to motivate real improvement. Using process performance baselines helps balance desires and reality.

If process performance baselines are unavailable, sampling techniques can be used to develop a quantitative basis for comparison in a short period of time.

3. Prioritize business objectives based on documented criteria, such as the ability to win new business, retain existing clients, or accomplish other key business strategies.

4. Maintain quality and process performance objectives to address changes in business objectives.

Business objectives and quality and process performance objectives will typically evolve over time. As existing objectives are achieved, they will be monitored to ensure they continue to be met, while new business objectives and associated quality and process performance objectives are identified and managed.

Refer to the Organizational Process Performance process area for more information about establishing quality and process performance objectives.

5. Revise process performance measures to align with quality and process performance objectives.

Refer to the Organizational Process Performance process area for more information about establishing process performance measures.

SP 1.2 Analyze Process Performance Data

Analyze process performance data to determine the organization's ability to meet identified business objectives.

The data that result from applying the process performance measures, which are defined using Organizational Process Performance processes, are analyzed to create process performance baselines that help in understanding the current capability of the organization. Comparing process performance baselines to quality and process performance objectives helps the organization to determine its ability to meet business objectives. This data typically are collected from work group or project level process performance data to enable organizational analysis.

Example Work Products

1. Analysis of current capability vs. business objectives
2. Process performance shortfalls
3. Risks associated with meeting business objectives

Subpractices

1. Periodically compare quality and process performance objectives to current process performance baselines to evaluate the ability of the organization to meet its business objectives.

For example, if cycle time is a critical business need, many different cycle time measures may be collected by the organization. Overall cycle time performance data should be compared to the business objectives to understand if expected performance will satisfy business objectives.

2. Identify shortfalls where the actual process performance is not satisfying the business objectives.
3. Identify and analyze risks associated with not meeting business objectives.

4. Report results of the process performance and risk analyses to organizational leadership.

SP 1.3 Identify Potential Areas for Improvement

Identify potential areas for improvement that could contribute to meeting business objectives.

Potential areas for improvement are identified through a proactive analysis to determine areas that could address process performance shortfalls. Causal Analysis and Resolution processes can be used to diagnose and resolve root causes.

The output from this activity is used to evaluate and prioritize potential improvements, and can result in either incremental or innovative improvement suggestions as described in specific goal 2.

Example Work Products

1. Potential areas for improvement

Subpractices

1. Identify potential improvement areas based on the analysis of process performance shortfalls.

Performance shortfalls include not meeting productivity, cycle time, or customer satisfaction objectives. Examples of areas to consider for improvement include product technology, process technology, staffing and staff development, team structures, supplier selection and management, and other organizational infrastructures.

2. Document the rationale for the potential improvement areas, including references to applicable business objectives and process performance data.
3. Document anticipated costs and benefits associated with addressing potential improvement areas.
4. Communicate the set of potential improvement areas for further evaluation, prioritization, and use.

SG 2 Select Improvements

Improvements are proactively identified, evaluated using statistical and other quantitative techniques, and selected for deployment based on their contribution to meeting quality and process performance objectives.

Improvements to be deployed across the organization are selected from improvement suggestions which have been evaluated for effectiveness in the target deployment environment. These improvement suggestions are elicited and submitted from across the organization to address the improvement areas identified in specific goal 1.

Evaluations of improvement suggestions are based on the following:

- A quantitative understanding of the organization's current quality and process performance

- Satisfaction of the organization's quality and process performance objectives
- Estimated costs and impacts of developing and deploying the improvements, resources, and funding available for deployment
- Estimated benefits in quality and process performance resulting from deploying the improvements

SP 2.1 Elicit Suggested Improvements

Elicit and categorize suggested improvements.

This practice focuses on eliciting suggested improvements and includes categorizing suggested improvements as incremental or innovative.

Incremental improvements generally originate with those who do the work (i.e., users of the process or technology). Incremental improvements can be simple and inexpensive to implement and deploy. Incremental improvement suggestions are analyzed, but, if selected, may not need rigorous validation or piloting. Innovative improvements such as new or redesigned processes are more transformational than incremental improvements.

Innovative improvements often arise out of a systematic search for solutions to particular performance issues or opportunities to improve performance. They are identified by those who are trained and experienced with the maturation of particular technologies or whose job it is to track or directly contribute to increased performance.

Innovations can be found externally by actively monitoring innovations used in other organizations or documented in the research literature. Innovations can also be found by looking internally (e.g., by examining project lessons learned). Innovations are inspired by the need to achieve quality and process performance objectives, the need to improve performance baselines, or the external business environment.

Examples of incremental improvements include the following:

- Adding an item to a peer review checklist.
- Combining the technical review and management review for suppliers into a single review.
- Introducing an incident workaround.
- Substituting a new component
- Making minor updates to a tool

Some suggested improvements may be received in the form of a proposal (e.g., an organizational improvement proposal arising from a causal analysis and resolution activity). These suggested improvements will have been analyzed and documented prior to input to Organizational Performance Management processes. When suggested improvements are received as proposals, the proposals are reviewed for completeness and are evaluated as part of the selection process for implementation.

Improvement searches can involve looking outside the organization, deriving innovations from work groups using Causal Analysis and Resolution processes, using competitive business intelligence, or analyzing existing organizational performance.

Example Work Products

1. Suggested incremental improvements
2. Suggested innovative improvements

Subpractices

1. Elicit suggested improvements.

These suggestions document potential improvements to processes and technologies. Managers and staff in the organization as well as customers, end users, and suppliers can submit suggestions. The organization can also search the academic and technology communities for suggested improvements. Some suggested improvements may have been implemented at the work group or project level before being proposed for the organization.

Examples of sources for improvements include the following:

- Findings and recommendations from process appraisals
- The organization's quality and process performance objectives
- Analysis of data about customer and end-user problems as well as customer and end-user satisfaction
- Results of process and product benchmarking efforts
- Measured effectiveness of process activities
- Measured effectiveness of work environments
- Examples of improvements that were successfully adopted elsewhere
- Feedback on previous improvements
- Spontaneous ideas from managers and staff
- Improvement proposals from Causal Analysis and Resolution processes resulting from implemented actions with proven effectiveness
- Analysis of data on acceptable quality
- Analysis of service system and service delivery performance measures
- Analysis of work group and organizational performance compared to quality and productivity objectives

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets and incorporating experiences.

2. Identify suggested improvements as incremental or innovative.
3. Investigate innovative improvements that may improve the organization's processes and technologies.

Investigating innovative improvements typically involves the following:

- Maintaining awareness of leading relevant technical work and technology trends
- Searching for commercially available innovative improvements
- Collecting proposals for innovative improvements from the work groups and the organization
- Reviewing processes and technologies used externally and comparing them to the processes and technologies used in the organization
- Identifying areas where innovative improvements have been used successfully, and reviewing data and documentation of experience using these improvements
- Identifying improvements that integrate new technology into products and work environments

SP 2.2 Analyze Suggested Improvements

Analyze suggested improvements for their possible impact on achieving the organization's quality and process performance objectives.

Suggested improvements are incremental and innovative improvements that are analyzed and possibly selected for validation, implementation, and deployment throughout the organization.

Example Work Products

1. Suggested improvement proposals
2. Selected improvements to be validated

Subpractices

1. Analyze the costs and benefits of suggested improvements.

Process performance models provide insight into the effect of process changes on process capability and performance.

Refer to the Organizational Process Performance process area for more information about establishing process performance models.

Improvement suggestions that have a large cost-to-benefit ratio or that would not improve the organization's processes may be rejected.

Criteria for evaluating costs and benefits include the following:

- Contribution toward meeting the organization's quality and process performance objectives
- Effect on mitigating identified work group and organizational risks
- Ability to respond quickly to changes in work requirements, market situations, and the business environment
- Effect on related processes and associated assets
- Cost of defining and collecting data that support the measurement and analysis of the process and technology improvement
- Expected life span of the improvement

2. Identify potential barriers and risks to deploying each suggested improvement.

Examples of barriers to deploying improvements include the following:

- Turf guarding and parochial perspectives
- Unclear or weak business rationale
- Lack of short-term benefits and visible successes
- Unclear picture of what is expected from everyone
- Too many changes at the same time
- Lack of involvement and support from relevant stakeholders

Examples of risk factors that affect the deployment of improvements include the following:

- Compatibility of the improvement with existing processes, values, and skills of potential end users
- Complexity of the improvement
- Difficulty implementing the improvement
- Ability to demonstrate the value of the improvement before widespread deployment
- Justification for large, up-front investments in areas such as tools and training
- Inability to overcome “technology drag” where the current implementation is used successfully by a large and mature installed base of end users

3. Estimate the cost, effort, and schedule required for implementing, verifying, and deploying each suggested improvement.
4. Select suggested improvements for validation and possible implementation and deployment based on the evaluations.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

5. Document the evaluation results of each selected improvement suggestion in an improvement proposal.

The proposal should include a problem statement, a plan (including cost and schedule, risk handling, method for evaluating effectiveness in the target environment) for implementing the improvement, and quantitative success criteria for evaluating actual results of the deployment.

6. Determine the detailed changes needed to implement the improvement and document them in the improvement proposal.
7. Determine the validation method that will be used before broad-scale deployment of the change and document it in the improvement proposal.

Determining the validation method includes defining the quantitative success criteria that will be used to evaluate results of the validation.

Since innovations, by definition, represent a major change with high impact, most innovative improvements will be piloted. Other validation methods, including modeling and simulation can be used as appropriate.

8. Document results of the selection process.

Results of the selection process usually include the following:

- The disposition of each suggested improvement
- The rationale for the disposition of each suggested improvement

SP 2.3 Validate Improvements

Validate selected improvements.

Selected improvements are validated in accordance with their improvement proposals.

Examples of validation methods include the following:

- Discussions with stakeholders, perhaps in the context of a formal review
- Prototype demonstrations
- Pilots of suggested improvements
- Modeling and simulation

Pilots can be conducted to evaluate significant changes involving untried, high-risk, or innovative improvements before they are broadly deployed. Not all improvements need the rigor of a pilot. Criteria for selecting improvements for piloting are defined and used. Factors such as risk, transformational nature of change, or number of functional areas affected will determine the need for a pilot of the improvement.

Red-lined or rough-draft process documentation can be made available for use in piloting.

Example Work Products

1. Validation plans
2. Validation evaluation reports
3. Documented lessons learned from validation

Subpractices

1. Plan the validation.

Quantitative success criteria documented in the improvement proposal can be useful when planning validation.

Validation plans for selected improvements to be piloted should include target work groups, work characteristics, a schedule for reporting results, and measurement activities

2. Review and get relevant stakeholder agreement on validation plans.
3. Consult with and assist those who perform the validation.

4. Create a trial implementation, in accordance with the validation plan, for selected improvements to be piloted.
5. Perform each validation in an environment that is similar to the environment present in a broad scale deployment.
6. Track validation against validation plans.
7. Review and document the results of validation.

Validation results are evaluated using the quantitative criteria defined in the improvement proposal.

Reviewing and documenting results of pilots typically involves the following activities:

- Reviewing pilot results with stakeholders
- Deciding whether to terminate the pilot, rework implementation of the improvement, replan and continue the pilot, or proceed with deployment
- Updating the disposition of improvement proposals associated with the pilot
- Identifying and documenting new improvement proposals as appropriate
- Identifying and documenting lessons learned and problems encountered during the pilot including feedback to the improvement team and changes to the improvement

SP 2.4 Select and Implement Improvements for Deployment

Select and implement improvements for deployment throughout the organization based on an evaluation of costs, benefits, and other factors.

Selection of suggested improvements for deployment is based on cost-to-benefit ratios with regard to quality and process performance objectives, available resources, and the results of improvement proposal evaluation and validation activities.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Example Work Products

1. Improvements selected for deployment
2. Updated process documentation and training

Subpractices

1. Prioritize improvements for deployment.

The priority of an improvement is based on an evaluation of its estimated cost-to-benefit ratio with regard to the quality and process performance objectives as compared to the performance baselines. Return on investment can be used as a basis of comparison.

2. Select improvements to be deployed.

Selection of improvements to be deployed is based on their priorities, available resources, and results of improvement proposal evaluation and validation activities.

3. Determine how to deploy each improvement.

Examples of where the improvements may be deployed include the following:

- Unique or common work environments
- Service lines
- Organization's services
- Organizational groups

4. Document results of the selection process.

Results of the selection process usually include the following:

- The selection criteria for suggested improvements
- The characteristics of the target work activities
- The disposition of each improvement proposal
- The rationale for the disposition of each improvement proposal

5. Review any changes needed to implement the improvements.

Examples of changes needed to deploy an improvement include the following:

- Process descriptions, standards, and procedures
- Work environments
- Education and training
- Skills
- Existing commitments
- Existing activities
- Continuing support to end users
- Organizational culture and characteristics

6. Update the organizational process assets.

Updating the organizational process assets typically includes reviewing them, gaining approval for them, and communicating them.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

SG 3 Deploy Improvements

Measurable improvements to the organization's processes and technologies are deployed and evaluated using statistical and other quantitative techniques.

Once improvements are selected for deployment, a plan for deployment is created and executed. The deployment of improvements is managed and the effects of the improvements are measured and evaluated as to how well they contribute to meeting quality and process performance objectives.

If the deployed improvement involves significant changes to a service system, then the deployment will probably include practices required for Service System Transition.

Refer to the Service System Transition process area for more information about deploying service system components.

SP 3.1 Plan the Deployment

Establish and maintain plans for deploying selected improvements.

The plans for deploying selected improvements can be included in the plan for organizational performance management, in improvement proposals, or in separate deployment documents.

This specific practice complements the Deploy Organizational Process Assets specific practice in the Organizational Process Focus process area and adds the use of quantitative data to guide the deployment and to determine the value of improvements.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets and incorporating experiences.

Example Work Products

1. Deployment plans for selected improvements

Subpractices

1. Determine how each improvement should be adjusted for deployment.

Improvements identified in a limited context (e.g., for a single improvement proposal) might need to be modified for a selected portion of the organization.

2. Identify strategies that address the potential barriers to deploying each improvement that were defined in the improvement proposals.

3. Identify the target work activities for deployment of the improvement.

Not all work activities are good candidates for all improvements. For example, improvements may be targeted to software only projects, COTS integration projects, or service delivery work.

4. Establish measures and objectives for determining the value of each improvement with respect to the organization's quality and process performance objectives.

Measures can be based on the quantitative success criteria documented in the improvement proposal or derived from organizational objectives.

Examples of measures for determining the value of an improvement include the following:

- Measured improvement in the work activity or organization's process performance
- Time to recover the cost of the improvement
- Number and types of work and organizational risks mitigated by the process or technology improvement
- Average time required to respond to changes in work requirements, market situations, and the business environment

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

5. Document the plans for deploying selected improvements.
The deployment plans should include relevant stakeholders, risk strategies, target work activities, measures of success, and schedule.
6. Review and get agreement with relevant stakeholders on the plans for deploying selected improvements.
Relevant stakeholders include the improvement sponsor, target work groups, support organizations, etc.
7. Revise the plans for deploying selected improvements as necessary.

SP 3.2 Manage the Deployment

Manage the deployment of selected improvements.

This specific practice can overlap with the Implement Action Proposals specific practice in the Causal Analysis and Resolution process area (e.g., when causal analysis and resolution is used organizationally or across multiple work groups).

Example Work Products

1. Updated training materials (to reflect deployed improvements)
2. Documented results of improvement deployment activities
3. Revised improvement measures, objectives, priorities, and deployment plans

Subpractices

1. Monitor the deployment of improvements using deployment plans.
2. Coordinate the deployment of improvements across the organization.

Coordinating deployment includes the following activities:

- Coordinating activities of work groups, support groups, and organizational groups for each improvement
- Coordinating activities for deploying related improvements

3. Deploy improvements in a controlled and disciplined manner.

Examples of methods for deploying improvements include the following:

- Deploying improvements incrementally rather than as a single deployment
- Providing comprehensive consulting to early adopters of improvement in lieu of revised formal training

4. Coordinate the deployment of improvements into the defined processes for the work as appropriate.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets and incorporating experiences.

5. Provide consulting as appropriate to support deployment of improvements.
6. Provide updated training materials or develop communication packages to reflect improvements to organizational process assets.

Refer to the Organizational Training process area for more information about providing training.

7. Confirm that the deployment of all improvements is completed in accordance with the deployment plan.
8. Document and review results of improvement deployment.

Documenting and reviewing results includes the following:

- Identifying and documenting lessons learned
- Revising improvement measures, objectives, priorities, and deployment plans

SP 3.3 Evaluate Improvement Effects

Evaluate the effects of deployed improvements on quality and process performance using statistical and other quantitative techniques.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

This specific practice can overlap with the Evaluate the Effect of Implemented Actions specific practice in the Causal Analysis and Resolution process area (e.g., when causal analysis and resolution is applied organizationally or across multiple work groups).

Example Work Products

1. Documented measures of the effects resulting from deployed improvements

Subpractices

1. Measure the results of each improvement as implemented on the target work activities, using the measures defined in the deployment plans.
2. Measure and analyze progress toward achieving the organization's quality and process performance objectives using statistical and other quantitative techniques and take corrective action as needed.

Refer to the Organizational Process Performance process area for more information about establishing quality and process performance objectives and establishing process performance baselines and models.

ORGANIZATIONAL PROCESS PERFORMANCE

A Process Management Process Area at Maturity Level 4

Purpose

The purpose of Organizational Process Performance (OPP) is to establish and maintain a quantitative understanding of the performance of selected processes in the organization's set of standard processes in support of achieving quality and process performance objectives, and to provide process performance data, baselines, and models to quantitatively manage the organization's work.

Introductory Notes

The Organizational Process Performance process area involves the following activities:

- Establishing organizational quantitative quality and process performance objectives based on business objectives (See the definition of "quality and process performance objectives" in the glossary.)
- Selecting processes or subprocesses for process performance analyses
- Establishing definitions of the measures to be used in process performance analyses (See the definition of "process performance" in the glossary.)
- Establishing process performance baselines and process performance models (See the definitions of "process performance baselines" and "process performance models" in the glossary.)

The collection and analysis of the data and creation of the process performance baselines and models can be performed at different levels of the organization, including individual work activities or groups of related work activities as appropriate based on the needs of the work and organization.

The common measures for the organization consist of process and product measures that can be used to characterize the actual performance of processes in the organization's work. By analyzing the resulting measurements, a distribution or range of results can be established that characterize the expected performance of the process when used on an individual work activity.

Measuring quality and process performance can involve combining existing measures into additional derived measures to provide more insight into overall efficiency and effectiveness at an individual work activity or organization level. The analysis at the organization level can be used to

study productivity, improve efficiencies, and increase throughput across work activities in the organization.

The expected process performance can be used in establishing the quality and process performance objectives for the work and can be used as a baseline against which actual performance can be compared. This information is used to quantitatively manage the work. Each quantitatively managed work activity, in turn, provides actual performance results that become a part of organizational process assets that are made available to all work groups.

Process performance models are used to represent past and current process performance and to predict future results of the process. For example, the latent defects in the delivered product can be predicted using measurements of work product attributes such as complexity and process attributes such as preparation time for peer reviews.

When the organization has sufficient measures, data, and analytical techniques for critical process, product, and service characteristics, it is able to do the following:

- Determine whether processes are behaving consistently or have stable trends (i.e., are predictable)
- Identify processes in which performance is within natural bounds that are consistent across work activities and could potentially be aggregated
- Identify processes that show unusual (e.g., sporadic, unpredictable) behavior
- Identify aspects of processes that can be improved in the organization's set of standard processes
- Identify the implementation of a process that performs best

This process area interfaces with and supports the implementation of other high maturity process areas. The assets established and maintained as part of implementing this process area (e.g., the measures to be used to characterize subprocess behavior, process performance baselines, process performance models) are inputs to the quantitative work management, causal analysis and resolution, and organizational performance management processes in support of the analyses described there. Quantitative work management processes provide the quality and process performance data needed to maintain the assets described in this process area.

Related Process Areas

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

Refer to the Strategic Service Management process area for more information about establish and maintain standard services in concert with strategic needs and plans.

Refer to the Measurement and Analysis process area for more information about specifying measures, obtaining measurement data, and analyzing measurement data.

Refer to the Organizational Performance Management process area for more information about proactively managing the organization's performance to meet its business objectives.

Refer to the Quantitative Work Management process area for more information about quantitatively managing the work to achieve the established quality and process performance objectives for the work.

Specific Goal and Practice Summary

SG 1 Establish Performance Baselines and Models

- SP 1.1 Establish Quality and Process Performance Objectives
- SP 1.2 Select Processes
- SP 1.3 Establish Process Performance Measures
- SP 1.4 Analyze Process Performance and Establish Process Performance Baselines
- SP 1.5 Establish Process Performance Models

Specific Practices by Goal

SG 1 Establish Performance Baselines and Models

Baselines and models, which characterize the expected process performance of the organization's set of standard processes, are established and maintained.

Prior to establishing process performance baselines and models, it is necessary to determine the quality and process performance objectives for those processes (the Establish Quality and Process Performance Objectives specific practice), which processes are suitable to be measured (the Select Processes specific practice), and which measures are useful for determining process performance (the Establish Process Performance Measures specific practice).

The first three practices of this goal are interrelated and often need to be performed concurrently and iteratively to select quality and process performance objectives, processes, and measures. Often, the selection of one quality and process performance objective, process, or measure will constrain the selection of the others. For example, selecting a quality and process performance objective relating to defects delivered to the customer will almost certainly require selecting the verification processes and defect related measures.

The intent of this goal is to provide work groups with the process performance baselines and models they need to perform quantitative work management. Many times these baselines and models are collected or created by the organization, but there are circumstances in which a work group may need to create the baselines and models for themselves. These

circumstances include work activities that are not covered by the organization's baselines and models. For these cases the work group follows the practices in this goal to create its baselines and models.

SP 1.1 Establish Quality and Process Performance Objectives

Establish and maintain the organization's quantitative objectives for quality and process performance, which are traceable to business objectives.

The organization's quality and process performance objectives can be established for different levels in the organizational structure (e.g., business area, product line, function, project, work activity) as well as at different levels in the process hierarchy. When establishing quality and process performance objectives, consider the following:

- Traceability to the organization's business objectives
- Past performance of the selected processes or subprocesses in context (e.g., on projects, work activities)
- Multiple attributes of process performance (e.g., product quality, productivity, cycle time, response time)
- Inherent variability or natural bounds of the selected processes or subprocesses

The organization's quality and process performance objectives provide focus and direction to the process performance analysis and quantitative work management activities. However, it should be noted that achieving quality and process performance objectives that are significantly different from current process capability requires use of techniques found in Causal Analysis and Resolution and Organizational Performance Management.

Example Work Products

1. Organization's quality and process performance objectives

Subpractices

1. Review the organization's business objectives related to quality and process performance.

Examples of business objectives include the following:

- Deliver products within budget and on time
- Improve product quality by a specified percent in a specified timeframe
- Improve productivity by a specified percent in a specified timeframe
- Maintain customer satisfaction ratings
- Improve time-to-market for new product or service system component releases by a specified percent in a specified timeframe
- Reduce deferred product functionality by a specified percent in a specified timeframe
- Reduce the rate of product recalls by a specified percent in a specified timeframe
- Reduce customer total cost of ownership by a specified percent in a specified timeframe
- Decrease the cost of maintaining legacy products by a specified percent in a specified timeframe

2. Define the organization's quantitative objectives for quality and process performance.

Quality and process performance objectives can be established for process or subprocess measurements (e.g., effort, cycle time, defect removal effectiveness) as well as for product measurements (e.g., reliability, defect density) and service measurements (e.g., capacity, response times) as appropriate.

Examples of quality and process performance objectives include the following:

- Achieve a specified defect escape rate, productivity, duration, capacity, or cost target
- Improve the defect escape rate, productivity, duration, capacity, or cost performance by a specified percent of the process performance baseline in a specified timeframe
- Improve service level agreement performance by a specified percent of the process performance baseline in a specified timeframe

3. Define the priorities of the organization's objectives for quality and process performance.
4. Review, negotiate, and obtain commitment to the organization's quality and process performance objectives and their priorities from relevant stakeholders.
5. Revise the organization's quantitative objectives for quality and process performance as necessary.

Examples of when the organization's quantitative objectives for quality and process performance may need to be revised include the following:

- When the organization's business objectives change
- When the organization's set of standard processes change
- When actual quality and process performance differ significantly from objectives

SP 1.2 Select Processes

Select processes or subprocesses in the organization's set of standard processes to be included in the organization's process performance analyses and maintain traceability to business objectives.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

The organization's set of standard processes consists of a set of standard processes that, in turn, are composed of subprocesses.

Typically, it is not possible, useful, or economically justifiable to apply statistical management techniques to all processes or subprocesses of the organization's set of standard processes. Selection of processes or subprocesses is based on the quality and process performance objectives of the organization, which are derived from business objectives as described in the previous specific practice.

Example Work Products

1. List of processes or subprocesses identified for process performance analyses with rationale for their selection including traceability to business objectives

Subpractices

1. Establish the criteria to use when selecting subprocesses.

Examples of criteria that can be used for the selection of a process or subprocess for the organization's process performance analysis include the following:

- The process or subprocess is strongly related to key business objectives.
- The process or subprocess has demonstrated stability in the past.
- Valid historical data are currently available that is relevant to the process or subprocess.
- The process or subprocess will generate data with sufficient frequency to allow for statistical management.
- The process or subprocess is an important contributor to quality and process performance.
- The process or subprocess is an important predictor of quality and process performance.
- The process or subprocess is a factor important to understanding the risk associated with achieving the quality and process performance objectives.
- The quality of the measures and measurements associated with the process or subprocess (e.g., measurement system error) is adequate.
- Multiple measurable attributes that characterize process or subprocess behavior are available.

2. Select the subprocesses and document the rationale for their selection.

Example approaches to identifying and evaluating subprocess alternatives as part of a selection include the following:

- Causal analysis
- Sensitivity analysis

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

3. Establish and maintain traceability between the selected subprocesses, quality and process performance objectives, and business objectives.

Examples of ways in which traceability can be expressed include the following:

- Mapping of subprocesses to quality and process performance objectives
- Objective flow-down (e.g., Big Y to Vital X, Hoshin planning)
- Balanced scorecard
- Quality Function Deployment (QFD)
- Goal Question Metric
- Documentation for a process performance model

4. Revise the selection as necessary.

It may be necessary to revise the selection in the following situations:

- The predictions made by process performance models result in too much variation to make them useful.
- The objectives for quality and process performance change.
- The organization's set of standard processes change.
- The underlying quality and process performance changes.

SP 1.3 Establish Process Performance Measures

Establish and maintain definitions of measures to be included in the organization's process performance analyses.

Refer to the Measurement and Analysis process area for more information about specifying measures.

Example Work Products

1. Definitions of selected measures of process performance with rationale for their selection including traceability to selected processes or subprocesses

Subpractices

1. Select measures that reflect appropriate attributes of the selected processes or subprocesses to provide insight into the organization's quality and process performance.

It is often helpful to define multiple measures for a process or subprocess to understand the impact of changes to the process and avoid sub-optimization. Also, it is often helpful to establish measures for both product and process attributes for the

selected process and subprocess, as well as its inputs, outputs, and resources (including people and the skill they bring) consumed.

The Goal Question Metric paradigm is an approach that can be used to select measures that provide insight into the organization's quality and process performance objectives. It is often useful to analyze how these quality and process performance objectives can be achieved based on an understanding of process performance provided by the selected measures.

Examples of criteria used to select measures include the following:

- Relationship of measures to the organization's quality and process performance objectives
- Coverage that measures provide over the life of the product or service
- Visibility that measures provide into process performance
- Availability of measures
- Frequency at which observations of the measure can be collected
- Extent to which measures are controllable by changes to the process or subprocess
- Extent to which measures represent the end users' view of effective process performance

2. Establish operational definitions for the selected measures.

Refer to the Measurement and Analysis process area for more information about specifying measures.

3. Incorporate selected measures into the organization's set of common measures.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

4. Revise the set of measures as necessary.

Measures are periodically evaluated for their continued usefulness and ability to indicate process effectiveness.

SP 1.4 Analyze Process Performance and Establish Process Performance Baselines

Analyze the performance of the selected processes, and establish and maintain the process performance baselines.

The selected measures are analyzed to characterize the performance of the selected processes or subprocesses achieved in work activities. This characterization is used to establish and maintain process performance baselines (See the definition of "process performance baseline" in the glossary.) These baselines are used to determine the expected results of the process or subprocess when used on a set of work activities under a given set of circumstances.

Process performance baselines are compared to the organization's quality and process performance objectives to determine if the quality and process performance objectives are being achieved.

The process performance baselines are a measurement of performance for the organization's set of standard processes at various levels of detail. The processes that the process performance baselines can address include the following:

- Sequence of connected processes
- Processes that cover the entire life of the work
- Processes for developing individual work products

There can be several process performance baselines to characterize performance for subgroups of the organization.

Examples of criteria used to categorize subgroups include the following:

- Product line or standard service
- Line of business
- Application domain
- Complexity
- Team size
- Work product size
- Process elements from the organization's set of standard processes

Tailoring the organization's set of standard processes can significantly affect the comparability of data for inclusion in process performance baselines. Effects of tailoring should be considered in establishing baselines. Depending on the tailoring allowed, separate performance baselines may exist for each type of tailoring.

Refer to the Quantitative Work Management process area for more information about quantitatively managing the work to achieve the established quality and process performance objectives for the work.

Example Work Products

1. Analysis of process performance data
2. Baseline data on the organization's process performance

Subpractices

1. Collect the selected measurements for the selected processes and subprocesses.

The process or subprocess in use when the measurement was taken is recorded to enable its use later.

Refer to the Measurement and Analysis process area for more information about specifying measurement data collection and storage procedures.

2. Analyze the collected measures to establish a distribution or range of results that characterize the expected performance of selected processes or subprocesses when used on a set of work activities.

This analysis should include the stability of the related process or subprocess, and the impacts of associated factors and context. Related factors include inputs to the process and other attributes that can affect the results obtained. The context includes the business context (e.g., domain) and significant tailoring of the organization's set of standard processes.

The measurements from stable subprocesses in work activities should be used when possible; other data may not be reliable.

3. Establish and maintain the process performance baselines from collected measurements and analyses.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Process performance baselines are derived by analyzing collected measures to establish a distribution or range of results that characterize the expected performance for selected processes or subprocesses when used on work activities in the organization.

4. Review and get agreement with relevant stakeholders about the process performance baselines.
5. Make the process performance information available across the organization in the measurement repository.

The organization's process performance baselines are used by work groups to estimate the natural bounds for process performance.

6. Compare the process performance baselines to associated quality and process performance objectives to determine if those quality and process performance objectives are being achieved.

These comparisons should use statistical techniques beyond a simple comparison of the mean to gauge the extent of quality and process performance objective achievement. If the quality and process performance objectives are not being achieved, corrective actions should be considered.

Refer to the Causal Analysis and Resolution process area for more information about determining causes of selected outcomes.

Refer to the Organizational Process Focus process area for more information about planning and implementing process actions.

Refer to the Organizational Performance Management for more information about analyzing process performance data and identifying potential areas for improvement.

7. Revise the process performance baselines as necessary.

Examples of when the organization's process performance baselines may need to be revised include the following:

- When processes change
- When the organization's results change
- When the organization's needs change
- When suppliers' processes change
- When suppliers change

SP 1.5 Establish Process Performance Models

Establish and maintain process performance models for the organization's set of standard processes.

High maturity organizations generally establish and maintain a set of process performance models at various levels of detail that cover a range of activities that are common across the organization and address the organization's quality and process performance objectives. (See the definition of "process performance model" in the glossary.) Under some circumstances, work groups may need to create their own process performance models.

Process performance models are used to estimate or predict the value of a process performance measure from the values of other process, product, and service measurements. These process performance models typically use process and product measurements collected throughout the service lifecycle to estimate progress toward achieving quality and process performance objectives that cannot be measured until later in the service lifecycle.

Process performance models are used as follows:

- The organization uses them for estimating, analyzing, and predicting the process performance associated with processes in and changes to the organization's set of standard processes.
- The organization uses them to assess the (potential) return on investment for process improvement activities.
- Work groups use them for estimating, analyzing, and predicting the process performance of their defined processes.
- Work groups use them for selecting processes or subprocesses for use.
- Work groups use them for estimating progress toward achieving the quality and process performance objectives.

These measures and models are defined to provide insight into and to provide the ability to predict critical process and product characteristics that are relevant to the organization's quality and process performance objectives.

Examples of process performance models include the following:

- System dynamics models
- Regression models
- Complexity models
- Discrete event simulation models
- Monte Carlo simulation models

Refer to the Quantitative Work Management process area for more information about quantitatively managing the work to achieve the established quality and process performance objectives for the work.

Example Work Products

1. Process performance models

Subpractices

1. Establish process performance models based on the organization's set of standard processes and process performance baselines.
2. Calibrate process performance models based on the past results and current needs.
3. Review process performance models and get agreement with relevant stakeholders.
4. Support the work groups' use of process performance models.
5. Revise process performance models as necessary.

Examples of when process performance models may need to be revised include the following:

- When processes change
- When the organization's results change
- When the organization's quality and process performance objectives change

ORGANIZATIONAL TRAINING

A Process Management Process Area at Maturity Level 3

Purpose

The purpose of Organizational Training (OT) is to develop skills and knowledge of people so they can perform their roles effectively and efficiently.

Introductory Notes

Organizational Training addresses training provided to support the organization's strategic business objectives and to meet the tactical training needs that are common across work groups and support groups. Training needs identified by individual work groups and support groups to meet their specific needs are handled at the work group and support group level and are outside the scope of the Organizational Training process area.

Refer to the Work Planning process area for more information about planning needed knowledge and skills.

An organizational training program involves the following activities:

- Identifying the training needed by the organization
- Obtaining and providing training to address those needs
- Establishing and maintaining a training capability
- Establishing and maintaining training records
- Assessing training effectiveness

Effective training requires the assessment of needs, planning, instructional design, and appropriate training media (e.g., workbooks, computer software), as well as a repository of training process data. As an organizational process, the main components of training include a managed training development program, documented plans, staff with an appropriate mastery of disciplines and other areas of knowledge, and mechanisms for measuring the effectiveness of the training program.

Identifying process training needs is based primarily on the skills required to perform the organization's set of standard processes.

Refer to the Organizational Process Definition process area for more information about establishing standard processes.

Certain skills can be effectively and efficiently imparted through vehicles other than classroom training experiences (e.g., informal mentoring). Other skills require more formalized training vehicles, such as in a classroom, by web-based training, through guided self study, or via a formalized on-the-job training program. The formal or informal training vehicles employed for each situation should be based on an assessment of the need for training

and the performance gap to be addressed. The term “training” used throughout this process area is used broadly to include all of these learning options.

Success in training is indicated by the availability of opportunities to acquire the skills and knowledge needed to perform new and ongoing enterprise activities.

Skills and knowledge can be technical, organizational, or contextual. Technical skills pertain to the ability to use equipment, tools, materials, data, and processes required by a work activity or process. Organizational skills pertain to behavior within and according to the staff members' organization structure, role and responsibilities, and general operating principles and methods. Contextual skills are the self-management, communication, and interpersonal abilities needed to successfully perform work in the organizational and social context of the work groups and support groups.

Related Process Areas

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Refer to the Work Planning process area for more information about planning needed knowledge and skills.

Specific Goal and Practice Summary

SG 1 Establish an Organizational Training Capability

- SP 1.1 Establish Strategic Training Needs
- SP 1.2 Determine Which Training Needs Are the Responsibility of the Organization
- SP 1.3 Establish an Organizational Training Tactical Plan
- SP 1.4 Establish a Training Capability

SG 2 Provide Training

- SP 2.1 Deliver Training
- SP 2.2 Establish Training Records
- SP 2.3 Assess Training Effectiveness

Specific Practices by Goal

SG 1 Establish an Organizational Training Capability

A training capability, which supports the roles in the organization, is established and maintained.

The organization identifies training required to develop the skills and knowledge necessary to perform enterprise activities. Once the needs are identified, a training program addressing those needs is developed.

SP 1.1 Establish Strategic Training Needs***Establish and maintain strategic training needs of the organization.***

Strategic training needs address long-term objectives to build a capability by filling significant knowledge gaps, introducing new technologies, or implementing major changes in behavior. Strategic planning typically looks two to five years into the future.

Examples of sources of strategic training needs include the following:

- The organization's standard processes
- The organization's strategic business plan
- The organization's process improvement plan
- Enterprise level initiatives
- Skill assessments
- Risk analyses
- Acquisition and supplier management

Example Work Products

1. Training needs
2. Assessment analysis

Subpractices

1. Analyze the organization's strategic business objectives and process improvement plan to identify potential training needs.
2. Document the strategic training needs of the organization.

Examples of categories of training needs include the following:

- Process analysis and documentation
- Engineering (e.g., requirements analysis, design, testing, configuration management, quality assurance)
- Selection and management of suppliers
- Team building
- Management (e.g., estimating, tracking, risk management)
- Leadership
- Disaster recovery and continuity of operations
- Communication and negotiation skills
- Service delivery

3. Determine the roles and skills needed to perform the organization's set of standard processes.
4. Document the training needed to perform roles in the organization's set of standard processes.
5. Document the training needed to maintain the safe, secure, and continued operation of the business.

6. Revise the organization's strategic needs and required training as necessary.

SP 1.2 Determine Which Training Needs Are the Responsibility of the Organization

Determine which training needs are the responsibility of the organization and which are left to the individual work group or support group.

Refer to the Work Planning process area for more information about planning needed knowledge and skills.

In addition to strategic training needs, organizational training addresses training requirements that are common across work groups and support groups. Work groups and support groups have the primary responsibility for identifying and addressing their training needs. The organization's training staff is responsible for addressing only common cross-work group and support group training needs (e.g., training in work environments common to multiple work groups). In some cases, however, the organization's training staff may address additional training needs of work groups and support groups, as negotiated with them, in the context of the training resources available and the organization's training priorities.

Example Work Products

1. Common work group and support group training needs
2. Training commitments

Subpractices

1. Analyze the training needs identified by work groups and support groups.

Analysis of work group and support group needs is intended to identify common training needs that can be most efficiently addressed organization wide. These needs analysis activities are used to anticipate future training needs that are first visible at the work group and support group level.

2. Negotiate with work groups and support groups on how their training needs will be satisfied.

The support provided by the organization's training staff depends on the training resources available and the organization's training priorities.

Examples of training appropriately performed by the work group or support group include the following:

- Training in the application or service domain of the work activity
- Training in the unique tools and methods used by the work group or support group
- Training in safety, security, and human factors

3. Document commitments for providing training support to work groups and support groups.

SP 1.3 Establish an Organizational Training Tactical Plan***Establish and maintain an organizational training tactical plan.***

The organizational training tactical plan is the plan to deliver the training that is the responsibility of the organization and is necessary for individuals to perform their roles effectively. This plan addresses the near-term execution of training and is adjusted periodically in response to changes (e.g., in needs, in resources) and to evaluations of effectiveness.

Example Work Products

1. Organizational training tactical plan

Subpractices

1. Establish the content of the plan.

Organizational training tactical plans typically contain the following:

- Training needs
- Training topics
- Schedules based on training activities and their dependencies
- Methods used for training
- Requirements and quality standards for training materials
- Training tasks, roles, and responsibilities
- Required resources including tools, facilities, environments, staffing, skills, and knowledge

2. Establish commitments to the plan.

Documented commitments by those who are responsible for implementing and supporting the plan are essential for the plan to be effective.

3. Revise the plan and commitments as necessary.

SP 1.4 Establish a Training Capability***Establish and maintain a training capability to address organizational training needs.***

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Example Work Products

1. Training materials and supporting artifacts

Subpractices

1. Select appropriate approaches to satisfy organizational training needs.

Many factors may affect the selection of training approaches, including audience specific knowledge, costs, schedule, and the work environment. Selecting an approach requires consideration of the means to provide skills and knowledge in the most effective way possible given the constraints.

Examples of training approaches include the following:

- Classroom training
- Computer aided instruction
- Guided self study
- Formal apprenticeship and mentoring programs
- Facilitated videos
- Chalk talks
- Brown bag lunch seminars
- Structured on-the-job training

2. Determine whether to develop training materials internally or to acquire them externally.

Determine the costs and benefits of internal training development and of acquiring training externally.

Example criteria that can be used to determine the most effective mode of knowledge or skill acquisition include the following:

- Applicability to work or process performance objectives
- Availability of time to prepare for project execution
- Applicability to business objectives
- Availability of in-house expertise
- Availability of training from external sources

Examples of external sources of training include the following:

- Customer provided training
- Commercially available training courses
- Academic programs
- Professional conferences
- Seminars

3. Develop or obtain training materials.

Training can be provided by the work group, support groups, the organization, or an external organization. The organization's training staff coordinates the acquisition and delivery of training regardless of its source.

Examples of training materials include the following:

- Courses
- Computer-aided instruction
- Videos

4. Develop or obtain qualified instructors, instructional designers, or mentors.

To ensure that those who develop and deliver internal training have the necessary knowledge and training skills, criteria can be defined to identify, develop, and qualify

them. The development of training, including self study and online training, should involve those who have experience in instructional design. In the case of external training, the organization's training staff can investigate how the training provider determines which instructors will deliver the training. This selection of qualified instructors can also be a factor in selecting or continuing to use a training provider.

5. Describe the training in the organization's training curriculum.

Examples of the information provided in training descriptions for each course include the following:

- Topics covered in the training
- Intended audience
- Prerequisites and preparation for participating
- Training objectives
- Length of the training
- Lesson plans
- Completion criteria for the course
- Criteria for granting training waivers

6. Revise training materials and supporting artifacts as necessary.

Examples of situations in which training materials and supporting artifacts may need to be revised include the following:

- Training needs change (e.g., when new technology associated with the training topic is available)
- An evaluation of the training identifies the need for change (e.g., evaluations of training effectiveness surveys, training program performance assessments, instructor evaluation forms)

SG 2 Provide Training

Training for individuals to perform their roles effectively is provided.

When selecting people to be trained, the following should be considered:

- Background of the target population of training participants
- Prerequisite background to receive training
- Skills and abilities needed by people to perform their roles
- Need for cross-discipline training for all disciplines, including project or service management
- Need for managers to have training in appropriate organizational processes
- Need for training in basic principles of all appropriate disciplines or services to support staff in quality management, configuration management, and other related support functions
- Need to provide competency development for critical functional areas
- Need to maintain competencies and qualifications of staff to operate and maintain work environments common to multiple work activities

SP 2.1 Deliver Training***Deliver training following the organizational training tactical plan.*****Example Work Products**

1. Delivered training course

Subpractices

1. Select those who will receive the training necessary to perform their roles effectively.

Training is intended to impart knowledge and skills to people performing various roles in the organization. Some people already possess the knowledge and skills required to perform well in their designated roles. Training can be waived for these people, but care should be taken that training waivers are not abused.

2. Schedule the training, including any resources, as necessary (e.g., facilities, instructors).

Training should be planned and scheduled. Training is provided that has a direct bearing on work performance expectations. Therefore, optimal training occurs in a timely manner with regard to imminent job performance expectations.

These performance expectations often include the following:

- Training in the use of specialized tools
- Training in procedures that are new to the person who will perform them

3. Deliver the training.

If the training is delivered by a person, then appropriate training professionals (e.g., experienced instructors, mentors) should deliver the training. When possible, training is delivered in settings that closely resemble the actual work environment and includes activities to simulate actual work situations. This approach includes integration of tools, methods, and procedures for competency development. Training is tied to work responsibilities so that on-the-job activities or other outside experiences will reinforce the training within a reasonable time after the training was delivered.

4. Track the delivery of training against the plan.

SP 2.2 Establish Training Records***Establish and maintain records of organizational training.***

This practice applies to the training performed at the organizational level. Establishment and maintenance of training records for work group or support group sponsored training is the responsibility of each individual work group or support group.

Example Work Products

1. Training records
2. Training updates to the organizational repository

Subpractices

1. Keep records of all students who successfully complete each training course or other approved training activity as well as those who are unsuccessful.

2. Keep records of all staff who are waived from training.

The rationale for granting a waiver should be documented, and both the manager responsible and the manager of the excepted individual should approve the waiver.

3. Keep records of all students who successfully complete their required training.

4. Make training records available to the appropriate people for consideration in assignments.

Training records may be part of a skills matrix developed by the training organization to provide a summary of the experience and education of people, as well as training sponsored by the organization.

SP 2.3 Assess Training Effectiveness***Assess the effectiveness of the organization's training program.***

A process should exist to determine the effectiveness of training (i.e., how well training is meeting the organization's needs).

Examples of methods used to assess training effectiveness include the following:

- Testing in the training context
- Post-training surveys of training participants
- Surveys of manager satisfaction with post-training effects
- Assessment mechanisms embedded in courseware

Measures can be taken to assess the benefits of training against both the work groups' and organization's objectives. Particular attention should be paid to the need for various training methods, such as training teams as integral work units. When used, work or process performance objectives should be unambiguous, observable, verifiable, and shared with course participants. The results of the training effectiveness assessment should be used to revise training materials as described in the Establish a Training Capability specific practice.

Example Work Products

1. Training effectiveness surveys
2. Training program performance assessments
3. Instructor evaluation forms
4. Training examinations

Subpractices

1. Assess in-progress or completed work to determine whether staff knowledge is adequate for performing work tasks.

2. Provide a mechanism for assessing the effectiveness of each training course with respect to established organizational, work group, or individual learning (or performance) objectives.
3. Obtain student evaluations of how well training activities met their needs.

PROCESS AND PRODUCT QUALITY ASSURANCE

A Support Process Area at Maturity Level 2

Purpose

The purpose of Process and Product Quality Assurance (PPQA) is to provide staff and management with objective insight into processes and associated work products.

Introductory Notes

The Process and Product Quality Assurance process area involves the following activities:

- Objectively evaluating performed processes and work products against applicable process descriptions, standards, and procedures
- Identifying and documenting noncompliance issues
- Providing feedback to work group staff and managers on the results of quality assurance activities
- Ensuring that noncompliance issues are addressed

The Process and Product Quality Assurance process area supports the delivery of high-quality products by providing work group staff and managers at all levels with appropriate visibility into, and feedback on, processes and associated work products throughout the work.

The practices in the Process and Product Quality Assurance process area ensure that planned processes are implemented, while the practices in the Service System Development process area ensure that specified requirements are satisfied. These two process areas can on occasion address the same work product but from different perspectives. Work groups should take advantage of the overlap to minimize duplication of effort while taking care to maintain separate perspectives.

Objectivity in process and product quality assurance evaluations is critical to the success of the work. (See the definition of “objectively evaluate” in the glossary.) Objectivity is achieved by both independence and the use of criteria. A combination of methods providing evaluations against criteria by those who do not produce the work product is often used. Less formal methods can be used to provide broad day-to-day coverage. More formal methods can be used periodically to assure objectivity.

Examples of ways to perform objective evaluations include the following:

- Formal audits by organizationally separate quality assurance organizations
- Peer reviews, which can be performed at various levels of formality
- In-depth review of work at the place it is performed (i.e., desk audits)
- Distributed review and comment of work products
- Process checks built into the processes such as a fail-safe for processes when they are done incorrectly (e.g., Poka-Yoke)

Traditionally, a quality assurance group that is independent of the work group provides objectivity. However, another approach may be appropriate in some organizations to implement the process and product quality assurance role without that kind of independence.

For example, in an organization with an open, quality oriented culture, the process and product quality assurance role can be performed, partially or completely, by peers and the quality assurance function can be embedded in the process. For small organizations, this embedded approach might be the most feasible approach.

If quality assurance is embedded in the process, several issues should be addressed to ensure objectivity. Everyone performing quality assurance activities should be trained in quality assurance. Those who perform quality assurance activities for a work product should be separate from those who are directly involved in developing or maintaining the work product. An independent reporting channel to the appropriate level of organizational management should be available so that noncompliance issues can be escalated as necessary.

For example, when implementing peer reviews as an objective evaluation method, the following issues should be addressed:

- Members are trained and roles are assigned for people attending the peer reviews.
- A member of the peer review who did not produce this work product is assigned to perform the quality assurance role.
- Checklists based on process descriptions, standards, and procedures are available to support the quality assurance activity.
- Noncompliance issues are recorded as part of the peer review report and are tracked and escalated outside the work group when necessary.

Quality assurance should begin in the early phases of work to establish plans, processes, standards, and procedures that will add value to the work and satisfy the requirements of the work and organizational policies. Those who perform quality assurance activities participate in establishing plans, processes, standards, and procedures to ensure that they fit work group needs and that they will be usable for performing quality assurance evaluations. In addition, processes and associated work products to be evaluated during the work are designated. This designation can be based on sampling or on objective criteria that are consistent with organizational policies, work requirements, and work group needs.

When noncompliance issues are identified, they are first addressed in the work group and resolved there if possible. Noncompliance issues that cannot be resolved in the work group are escalated to an appropriate level of management for resolution.

This process area applies to evaluations of work group activities and work products, and to organizational (e.g., process group, organizational training) activities and work products. For organizational activities and work products, the term “work group” should be appropriately interpreted.

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about verifying selected service system components.

Specific Goal and Practice Summary

SG 1 Objectively Evaluate Processes and Work Products

SP 1.1 Objectively Evaluate Processes

SP 1.2 Objectively Evaluate Work Products

SG 2 Provide Objective Insight

SP 2.1 Communicate and Resolve Noncompliance Issues

SP 2.2 Establish Records

Specific Practices by Goal

SG 1 Objectively Evaluate Processes and Work Products

Adherence of the performed process and associated work products to applicable process descriptions, standards, and procedures is objectively evaluated.

SP 1.1 Objectively Evaluate Processes

Objectively evaluate selected performed processes against applicable process descriptions, standards, and procedures.

Objectivity in quality assurance evaluations is critical to the success of the work. A description of the quality assurance reporting chain and how it ensures objectivity should be defined.

Example Work Products

1. Evaluation reports
2. Noncompliance reports
3. Corrective actions

Subpractices

1. Promote an environment (created as part of work management) that encourages staff participation in identifying and reporting quality issues.

2. Establish and maintain clearly stated criteria for evaluations.

The intent of this subpractice is to provide criteria, based on business needs, such as the following:

- What will be evaluated
- When or how often a process will be evaluated
- How the evaluation will be conducted
- Who must be involved in the evaluation

3. Use the stated criteria to evaluate selected performed processes for adherence to process descriptions, standards, and procedures.

4. Identify each noncompliance found during the evaluation.

5. Identify lessons learned that could improve processes.

SP 1.2 Objectively Evaluate Work Products

Objectively evaluate selected work products against applicable process descriptions, standards, and procedures.

Example Work Products

1. Evaluation reports
2. Noncompliance reports
3. Corrective actions

Subpractices

1. Select work products to be evaluated based on documented sampling criteria if sampling is used.

Work products can include services produced by a process whether the recipient of the service is internal or external to the work group or organization.

2. Establish and maintain clearly stated criteria for the evaluation of selected work products.

The intent of this subpractice is to provide criteria, based on business needs, such as the following:

- What will be evaluated during the evaluation of a work product
- When or how often a work product will be evaluated
- How the evaluation will be conducted
- Who must be involved in the evaluation

3. Use the stated criteria during evaluations of selected work products.

4. Evaluate selected work products at selected times.

Examples of when work products can be evaluated against process descriptions, standards, or procedures include the following:

- Before delivery to the customer
- During delivery to the customer
- Incrementally, when it is appropriate

5. Identify each case of noncompliance found during evaluations.
6. Identify lessons learned that could improve processes.

SG 2 Provide Objective Insight

Noncompliance issues are objectively tracked and communicated, and resolution is ensured.

SP 2.1 Communicate and Resolve Noncompliance Issues

Communicate quality issues and ensure the resolution of noncompliance issues with the staff and managers.

Noncompliance issues are problems identified in evaluations that reflect a lack of adherence to applicable standards, process descriptions, or procedures. The status of noncompliance issues provides an indication of quality trends. Quality issues include noncompliance issues and trend analysis results.

When noncompliance issues cannot be resolved in the work group, use established escalation mechanisms to ensure that the appropriate level of management can resolve the issue. Track noncompliance issues to resolution.

Example Work Products

1. Corrective action reports
2. Evaluation reports
3. Quality trends

Subpractices

1. Resolve each noncompliance with the appropriate members of the staff if possible.
2. Document noncompliance issues when they cannot be resolved in the work group.

Examples of ways to resolve noncompliance in the work group include the following:

- Fixing the noncompliance
- Changing the process descriptions, standards, or procedures that were violated
- Obtaining a waiver to cover the noncompliance

3. Escalate noncompliance issues that cannot be resolved in the work group to the appropriate level of management designated to receive and act on noncompliance issues.
4. Analyze noncompliance issues to see if there are quality trends that can be identified and addressed.
5. Ensure that relevant stakeholders are aware of results of evaluations and quality trends in a timely manner.
6. Periodically review open noncompliance issues and trends with the manager designated to receive and act on noncompliance issues.

7. Track noncompliance issues to resolution.

SP 2.2 Establish Records

Establish and maintain records of quality assurance activities.

Example Work Products

1. Evaluation logs
2. Quality assurance reports
3. Status reports of corrective actions
4. Reports of quality trends

Subpractices

1. Record process and product quality assurance activities in sufficient detail so that status and results are known.
2. Revise the status and history of quality assurance activities as necessary.

QUANTITATIVE WORK MANAGEMENT

A Project and Work Management Process Area at Maturity Level 4

Purpose

The purpose of Quantitative Work Management (QWM) is to quantitatively manage the work to achieve the established quality and process performance objectives for the work.

Introductory Notes

The Quantitative Work Management process area involves the following activities:

- Establishing and maintaining the quality and process performance objectives for the work
- Composing a defined process for the work to help to achieve the quality and process performance objectives for the work
- Selecting subprocesses and attributes critical to understanding performance and that help to achieve the quality and process performance objectives for the work
- Selecting measures and analytic techniques to be used in quantitative management
- Monitoring the performance of selected subprocesses using statistical and other quantitative techniques
- Managing the work using statistical and other quantitative techniques to determine whether or not the objectives for quality and process performance for the work are being satisfied
- Performing root cause analysis of selected issues to address deficiencies in achieving the quality and process performance objectives

Organizational process assets used to achieve high maturity, including quality and process performance objectives, selected processes, measures, baselines, and models, are established using organizational process performance processes and used in quantitative work management processes. The work group can use organizational process performance processes to define additional objectives, measures, baselines, and models as needed to effectively analyze and manage performance. The measures, measurements, and other data resulting from quantitative work management processes are incorporated into the organizational process assets. In this way, the organization and its work groups derive benefit from assets improved through use.

The defined process for the work is a set of interrelated subprocesses that form an integrated and coherent process for work activities. The Integrated Work Management practices describe establishing the defined process for

the work by selecting and tailoring processes from the organization's set of standard processes. (See the definition of “defined process” in the glossary.)

Quantitative Work Management practices, unlike Integrated Work Management practices, help you to develop a quantitative understanding of the expected performance of processes or subprocesses. This understanding is used as a basis for establishing the defined process for the work by evaluating processes or subprocesses for the work and selecting the ones that will best achieve the quality and process performance objectives.

Establishing effective relationships with suppliers is also important to the successful implementation of this process area. Establishing effective relationships can involve establishing quality and process performance objectives for suppliers, determining the measures and analytic techniques to be used to gain insight into supplier progress and performance, and monitoring progress toward achieving those objectives.

An essential element of quantitative management is having confidence in predictions (i.e., the ability to accurately predict the extent to which the work group can fulfill its quality and process performance objectives for the work). Subprocesses to be managed through the use of statistical and other quantitative techniques are chosen based on the needs for predictable process performance.

Another essential element of quantitative management is understanding the nature and extent of the variation experienced in process performance and recognizing when actual work performance may not be adequate to achieve the quality and process performance objectives for the work.

Thus, quantitative management includes statistical thinking and the correct use of a variety of statistical techniques. (See the definition of “quantitative management” in the glossary.)

Statistical and other quantitative techniques are used to develop an understanding of the actual performance or to predict the performance of processes. Such techniques can be applied at multiple levels, from a focus on individual subprocesses to analyses that span lifecycle phases and support functions. Non-statistical techniques provide a less rigorous but still useful set of approaches that together with statistical techniques help the work group to understand whether or not quality and process performance objectives are being satisfied and to identify any needed corrective actions.

This process area applies to managing a project or set of work activities. Applying these concepts to managing other groups and functions can help to link different aspects of performance in the organization to provide a basis for balancing and reconciling competing priorities to address a broader set of business objectives.

Examples of other groups and functions that could benefit from using this process area include the following:

- Quality assurance or quality control functions
- Process definition and improvement
- Internal research and development functions
- Risk identification and management functions
- Technology scouting functions
- Market research
- Customer satisfaction assessment
- Problem tracking and reporting

Related Process Areas

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

Refer to the Strategic Service Management process area for more information about establishing and maintaining standard services in concert with strategic needs and plans.

Refer to the Causal Analysis and Resolution process area for more information about identifying causes of selected outcomes and taking action to improve process performance.

Refer to the Integrated Work Management process area for more information about establishing the defined process for the work.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Refer to the Organizational Performance Management process area for more information about proactively managing the organization's performance to meet its business objectives.

Refer to the Organizational Process Performance process area for more information about establishing and maintaining a quantitative understanding of the performance of selected processes in the organization's set of standard processes in support of achieving quality and process performance objectives, and providing process performance data, baselines, and models to quantitatively manage the organization's work.

Refer to the Supplier Agreement Management process area for more information about managing the acquisition of products and services from suppliers.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Specific Goal and Practice Summary

SG 1 Prepare for Quantitative Management

- SP 1.1 Establish the Work Objectives
- SP 1.2 Compose the Defined Process
- SP 1.3 Select Subprocesses and Attributes
- SP 1.4 Select Measures and Analytic Techniques

SG 2 Quantitatively Manage the Work

- SP 2.1 Monitor the Performance of Selected Subprocesses
- SP 2.2 Manage Work Performance
- SP 2.3 Perform Root Cause Analysis

Specific Practices by Goal

SG 1 Prepare for Quantitative Management

Preparation for quantitative management is conducted.

Preparation activities include establishing quantitative objectives for the work, composing a defined process for the work that can help to achieve those objectives, selecting subprocesses and attributes critical to understanding performance and achieving the objectives, and selecting measures and analytic techniques that support quantitative management.

These activities may need to be repeated when needs and priorities change, when there is an improved understanding of process performance, or as part of risk mitigation or corrective action.

SP 1.1 Establish the Work Objectives

Establish and maintain the quality and process performance objectives for the work.

When establishing the quality and process performance objectives for the work, think about the processes that will be included in the defined process for the work and what the historical data indicate regarding their process performance. These considerations, along with others such as technical capability, will help in establishing realistic objectives for the work.

The objectives for quality and process performance for the work are established and negotiated at an appropriate level of detail (e.g., for individual product components, subprocesses, work groups) to permit an overall evaluation of the objectives and risks at the work group level. As the work progresses, work objectives can be updated as the actual work performance becomes known and more predictable, and to reflect changing needs and priorities of relevant stakeholders.

Example Work Products

1. The quality and process performance objectives for the work

2. Assessment of the risk of not achieving the objectives for the work

Subpractices

1. Review the organization's objectives for quality and process performance.

This review ensures that work group members understand the broader business context in which the work operates. The objectives for quality and process performance for the work are developed in the context of these overarching organizational objectives.

Refer to the Organizational Process Performance process area for more information about establishing quality and process performance objectives.

2. Identify the quality and process performance needs and priorities of the customer, suppliers, end users, and other relevant stakeholders.

Typically, the identification of relevant stakeholders' needs will begin early (e.g., during development of the service strategy). Needs are further elicited, analyzed, refined, prioritized, and balanced during development of stakeholder and service system requirements.

Examples of quality and process performance attributes for which needs and priorities might be identified include the following:

- Duration
- Predictability
- Reliability
- Response time
- Availability
- Service continuity

3. Define and document measurable quality and process performance objectives for the work.

Defining and documenting objectives for the work involve the following:

- Incorporating appropriate organizational quality and process performance objectives
- Writing objectives that reflect the quality and process performance needs and priorities of the customer, end users, and other relevant stakeholders
- Determining how each objective will be achieved
- Reviewing the objectives to ensure they are sufficiently specific, measurable, attainable, relevant, and time-bound

Examples of measurable quality attributes include the following:

- Mean time between failures
- Number and severity of defects in the released product
- Critical resource utilization
- Number and severity of customer complaints concerning the provided service

Examples of measurable process performance attributes include the following:

- Cycle time
- Percentage of rework time
- Percentage of defects removed by product verification activities (perhaps by type of verification, such as peer reviews and testing)
- Defect escape rates
- Number and severity of defects found (or incidents reported) in first year following product delivery (or start of service)

Examples of quality and process performance objectives for the work include:

- Maintain change request backlog size below a target value.
- Improve velocity in an Agile environment to a target value by a target date.
- Reduce idle time by x% by a target date.
- Maintain schedule slippage below a specified percent.
- Reduce the total lifecycle cost by a specified percent by a target date.
- Reduce incidents for services delivered to the customer by 10% without affecting cost.

4. Derive interim objectives to monitor progress toward achieving the work objectives.

Interim objectives can be established for attributes of selected lifecycle phases, milestones, work products, and subprocesses.

Since process performance models characterize relationships among product and process attributes, these models can be used to help derive interim objectives that guide the work group toward achieving its objectives.

5. Determine the risk of not achieving the quality and process performance objectives for the work.

The risk is a function of the established objectives, the product architecture, the defined process for the work, availability of needed knowledge and skills, etc. Process performance baselines and models can be used to evaluate the likelihood of achieving a set of objectives and provide guidance in negotiating objectives and commitments. The assessment of risk can involve various stakeholders and can be conducted as part of the conflict resolution described in the next subpractice.

6. Resolve conflicts among the quality and process performance objectives (e.g., if one objective cannot be achieved without compromising another).

Process performance models can help to identify conflicts and help to ensure that the resolution of conflicts does not introduce new conflicts or risks.

Resolving conflicts involves the following activities:

- Setting relative priorities for objectives
 - Considering alternative objectives in light of long-term business strategies as well as short-term needs
 - Involving the customer, end users, senior management, work group management, and other relevant stakeholders in tradeoff decisions
 - Revising objectives as necessary to reflect results of conflict resolution
7. Establish traceability to the quality and process performance objectives from their sources.

Examples of sources of objectives include the following:

- Requirements
- The organization's quality and process performance objectives
- The customer's quality and process performance objectives
- Business objectives
- Discussions with customers and potential customers
- Market surveys
- Product Architecture

An example of a method to identify and trace these needs and priorities is Quality Function Deployment (QFD).

8. Define and negotiate quality and process performance objectives for suppliers.
9. Revise the quality and process performance objectives as necessary.

SP 1.2 Compose the Defined Process

Using statistical and other quantitative techniques, compose a defined process that enables the work to achieve its quality and process performance objectives.

Refer to the Integrated Work Management process area for more information about establishing the defined process.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Refer to the Organizational Process Performance process area for more information about establishing performance baselines and models.

Composing the defined process for the work goes beyond the process selection and tailoring described in the Integrated Work Management process area. It involves identifying alternatives to one or more processes or subprocesses, performing quantitative analysis of performance and selecting the alternatives that are best able to help the project to achieve its quality and process performance objectives.

Example Work Products

1. Criteria used to evaluate alternatives for the work

2. Alternative subprocesses
3. Subprocesses to be included in the defined process
4. Assessment of risk of not achieving the objectives for the work

Subpractices

1. Establish the criteria to use in evaluating process alternatives for the work.

Criteria can be based on the following:

- Quality and process performance objectives
- Availability of process performance data and the relevance of the data to evaluating an alternative
- Familiarity with an alternative or with alternatives similar in composition
- Existence of process performance models that can be used in evaluating an alternative
- Product line standards
- Standard services and service levels
- Lifecycle models
- Stakeholder requirements
- Laws and regulations

2. Identify alternative processes and subprocesses for the work.

Identifying alternatives can include one or more of the following:

- Analyzing organizational process performance baselines to identify candidate subprocesses that would help achieve the quality and process performance objectives of the work
- Identifying subprocesses from the organization's set of standard processes as well as tailored processes in the process asset library that can help to achieve the objectives
- Identifying processes from external sources (e.g., such as other organizations, professional conferences, academic research)
- Adjusting the level or depth of intensity with which a subprocess is applied (as described in further detail in a subpractice that follows)

Adjusting the level or depth of intensity with which the subprocesses are applied can involve the following choices:

- Number and type of peer reviews to be held and when
- Amount of effort or calendar time devoted to particular tasks
- Number and selection of people involved
- Skill level requirements for performing specific tasks
- Selective application of specialized construction or verification techniques

- Reuse decisions and associated risk mitigation strategies
- The product and process attributes to be measured
- Sampling rate for management data

Refer to the Integrated Work Management process area for more information about using organizational process assets for planning work activities.

3. Analyze the interaction of alternative subprocesses to understand relationships among the subprocesses, including their attributes.

An analysis of the interaction will provide insight into the relative strengths and weaknesses of particular alternatives. This analysis can be supported by a calibration of the organization's process performance models with process performance data (e.g., as characterized in process performance baselines).

Additional modeling may be needed if existing process performance models cannot address significant relationships among the alternative subprocesses under consideration and there is high risk of not achieving objectives.

4. Evaluate alternative subprocesses against the criteria.

Use historical data, process performance baselines, and process performance models as appropriate to assist in evaluating alternatives against the criteria. These evaluations can include use of a sensitivity analysis particularly in high risk situations.

Refer to the Decision Analysis and Resolution process area for more information about evaluating alternatives.

5. Select the alternative subprocesses that best meet the criteria.

It may be necessary to iterate through the activities described in the previous subpractices several times before confidence is achieved that the best available alternatives have been identified.

6. Evaluate the risk of not achieving the quality and process performance objectives for the work.

An analysis of risk associated with the selected alternative defined process can lead to identifying new alternatives to be evaluated, as well as areas requiring more management attention.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

SP 1.3 Select Subprocesses and Attributes

Select subprocesses and attributes critical to evaluating performance and that help to achieve the quality and process performance objectives for the work.

Some subprocesses are critical because their performance significantly influences or contributes to achieving the objectives for the work. These subprocesses may be good candidates for monitoring and control using statistical and other quantitative techniques as described in the first specific practice of the second specific goal.

Also, some attributes of these subprocesses can serve as leading indicators of the process performance to expect of subprocesses that are further downstream and can be used to assess the risk of not achieving the objectives for the work (e.g., by using process performance models).

Subprocesses and attributes that play such critical roles may have already been identified as part of the analyses described in the previous specific practice.

For small projects, and circumstances in which subprocess data may not be generated frequently enough in a work activity to support a sufficiently sensitive statistical inference, it may still be possible to understand performance by examining process performance across similar iterations, teams, or work activities.

Example Work Products

1. Criteria used to select subprocesses that are key contributors to achieving the objectives for the work
2. Selected subprocesses
3. Attributes of selected subprocesses that help in predicting future work performance

Subpractices

1. Analyze how subprocesses, their attributes, other factors, and performance results of the work relate to each other.

A root cause analysis, sensitivity analysis, or process performance model can help to identify the subprocesses and attributes that most contribute to achieving particular performance results (and variation in performance results) or that are useful indicators of future achievement of performance results.

Refer to the Causal Analysis and Resolution process area for more information about determining causes of selected outcomes.

2. Identify criteria to be used in selecting subprocesses that are key contributors to achieving the quality and process performance objectives for the work.

Examples of criteria used to select subprocesses include the following:

- There is a strong correlation with performance results that are addressed in the objectives for the work.
- Stable performance of the subprocess is important.
- Poor subprocess performance is associated with major risks to the work.
- One or more attributes of the subprocess serve as key inputs to process performance models used for the work.
- The subprocess will be executed frequently enough to provide sufficient data for analysis.

3. Select subprocesses using the identified criteria.

Historical data, process performance models, and process performance baselines can help in evaluating candidate subprocesses against selection criteria.

Refer to the Decision Analysis and Resolution process area for more information about evaluating alternatives.

4. Identify product and process attributes to be monitored.

These attributes may have been identified as part of performing the previous subpractices.

Attributes that provide insight into current or future subprocess performance are candidates for monitoring, whether or not the associated subprocesses are under the control of the work group. Also, some of these same attributes may serve other roles, (e.g., to help in monitoring progress and performance of the work as described in Work Monitoring and Control [WMC]).

Examples of product and process attributes include the following:

- Effort consumed to perform the subprocess
- The rate at which the subprocess is performed
- Percentage compliance to the service level agreement
- Response time
- Resource or materials consumed as input to the subprocess
- Skill level of the staff member performing the subprocess
- Quality of the work environment used to perform the subprocess
- Volume of outputs of the subprocess (e.g., intermediate work products)
- Quality attributes of outputs of the subprocess (e.g., reliability, testability)

SP 1.4 Select Measures and Analytic Techniques

Select measures and analytic techniques to be used in quantitative management.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Example Work Products

1. Definitions of measures and analytic techniques to be used in quantitative management
2. Traceability of measures back to the quality and process performance objectives
3. Quality and process performance objectives for selected subprocesses and their attributes
4. Process performance baselines and models for use by the work group

Subpractices

1. Identify common measures from the organizational process assets that support quantitative management.

Refer to the Organizational Process Definition process area for more information about establishing organizational process assets.

Refer to the Organizational Process Performance process area for more information about establishing performance baselines and models.

Product lines, standard services, and service levels or other stratification criteria can categorize common measures.

2. Identify additional measures that may be needed to cover critical product and process attributes of the selected subprocesses.

In some cases, measures can be research oriented. Such measures should be explicitly identified.

3. Identify the measures to be used in managing subprocesses.

When selecting measures, keep the following considerations in mind:

- Measures that aggregate data from multiple sources (e.g., different processes, input sources, environments) or over time (e.g., at a phase level) can mask underlying problems, making problem identification and resolution difficult.
- For short-term work, it may be necessary to aggregate data across similar instances of a process to enable analysis of its process performance while continuing to use the unaggregated data in support of individual work activities.
- Selection should not be limited to service level or performance measures only. "Analysis measures" (e.g., transaction arrival rates, staff member skill levels, trends in the use of particular service system resources) may provide better insight into process performance.

4. Specify the operational definitions of measures, their collection points in subprocesses, and how the integrity of measures will be determined.
5. Analyze the relationship of identified measures to the quality and process performance objectives for the work and derive subprocess quality and process performance objectives that state targets (e.g., thresholds, ranges) to be met for each measured attribute of each selected subprocess.

Examples of derived subprocess quality and process performance objectives include the following:

- Maintain a code review rate between 75 to 100 lines of code per hour
- Keep requirements gathering sessions to under three hours
- Keep test rate over a specified number of test cases per day
- Maintain rework levels below a specified percent
- Maintain productivity in generating use cases per day
- Keep design complexity (fan-out rate) below a specified threshold

6. Identify the statistical and other quantitative techniques to be used in quantitative management.

In quantitative management, the process performance of selected subprocesses is analyzed using statistical and other quantitative techniques that help to characterize

subprocess variation, identify when statistically unexpected behavior occurs, recognize when variation is excessive, and investigate why. Examples of statistical techniques that can be used in the analysis of process performance include statistical process control charts, regression analysis, analysis of variance, and time series analysis.

The work can benefit from analyzing the performance of subprocesses not selected for their impact on work performance. Statistical and other quantitative techniques can be identified to address these subprocesses as well.

Statistical and other quantitative techniques sometimes involve the use of graphical displays that help visualize associations among the data and results of analyses. Such graphical displays can help visualize process performance and variation over time (i.e., trends), identify problems or opportunities, and evaluate the effects of particular factors.

Examples of graphical displays include the following:

- Scatterplots
- Histograms
- Box and whiskers plots
- Run charts
- Ishikawa diagrams

Examples of other techniques used to analyze process performance include the following:

- Tally sheets
- Classification schemas (e.g., Orthogonal Defect Classification)

7. Determine what process performance baselines and models may be needed to support identified analyses.

In some situations, the set of baselines and models provided as described in Organizational Process Performance may be inadequate to support quantitative work management. This situation can happen when the objectives, processes, stakeholders, skill levels, or environment for the work are different from other projects for which baselines and models were established.

As the work progresses, data from the work can serve as a more representative data set for establishing missing or a work-specific set of process performance baselines and models.

Hypothesis testing comparing work data to prior historical data can confirm the need to establish additional baselines and models specific to the work.

8. Instrument the organizational or work support environment to support collection, derivation, and analysis of measures.

This instrumentation is based on the following:

- Description of the organization's set of standard processes
- Description of the defined process for the work
- Capabilities of the organizational or work support environment

9. Revise measures and statistical analysis techniques as necessary.

SG 2 Quantitatively Manage the Work***The work is quantitatively managed.***

Quantitatively managing the work involves the use of statistical and other quantitative techniques to do the following:

- Monitor the selected subprocesses using statistical and other quantitative techniques
- Determine whether or not the quality and process performance objectives for the work are being satisfied
- Perform root cause analysis of selected issues to address deficiencies

SP 2.1 Monitor the Performance of Selected Subprocesses***Monitor the performance of selected subprocesses using statistical and other quantitative techniques.***

The intent of this specific practice is to use statistical and other quantitative techniques to analyze variation in subprocess performance and to determine actions necessary to achieve each subprocess's quality and process performance objectives.

Example Work Products

1. Natural bounds of process performance for each selected subprocess attribute
2. The actions needed to address deficiencies in the process stability or capability of each selected subprocess

Subpractices

1. Collect data, as defined by the selected measures, on the subprocesses as they execute.
2. Monitor the variation and stability of the selected subprocesses and address deficiencies.

This analysis involves evaluating measurements in relation to the natural bounds calculated for each selected measure and identifying outliers or other signals of potential non-random behavior, determining their causes and preventing or mitigating the effects of their recurrence (i.e., addressing special causes of variation).

During such analysis, be sensitive to the sufficiency of the data and to shifts in process performance that can affect the ability to achieve or maintain process stability.

Analytic techniques for identifying outliers or signals include statistical process control charts, prediction intervals, and analysis of variance. Some of these techniques involve graphical displays.

Other deficiencies in process performance to consider include when variation is too large to have confidence that the subprocess is stable, or too great to assess its capability (next subpractice) of achieving the objectives established for each selected attribute.

3. Monitor the capability and performance of the selected subprocesses and address deficiencies.

The intent of this subpractice is to identify what actions to take to help the subprocess achieve its quality and process performance objectives. Be sure that the subprocess performance is stable relative to the selected measures (previous subpractice) before comparing its capability to its quality and process performance objectives.

Examples of actions that can be taken when the performance of a selected subprocess fails to satisfy its objectives include the following:

- Improving the implementation of the existing subprocess to reduce its variation or improve its performance (i.e., addressing common causes of variation)
- Identifying and implementing an alternative subprocess through identifying and adopting new process elements, subprocesses, and technologies that may help better align with objectives
- Identifying risks and risk mitigation strategies for each deficiency in subprocess capability
- Renegotiating or re-deriving objectives for each selected attribute of a subprocess so that they can be met by the subprocess

Some actions can involve the use of root cause analysis, which is further described in SP 2.3.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

SP 2.2 Manage Work Performance

Manage the work using statistical and other quantitative techniques to determine whether or not the quality and process performance objectives for the work will be satisfied.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Refer to the Organizational Performance Management process area for more information about managing business performance.

This specific practice uses multiple inputs to predict if the quality and process-performance objectives for the work will be satisfied. Based on this prediction, risks associated with not meeting the quality and process performance objectives are identified and managed, and actions to address deficiencies are defined as appropriate.

Key inputs to this analysis include the individual subprocess stability and capability data derived from the previous specific practice, as well as performance data from monitoring other subprocesses, risks, and suppliers' progress.

Example Work Products

1. Predictions of results to be achieved relative to the quality and process performance objectives of the work
2. Graphical displays and data tabulations for other subprocesses, which support quantitative management

3. Assessment of risks of not achieving the quality and process performance objectives of the work
4. Actions needed to address deficiencies in achieving work objectives

Subpractices

1. Periodically review the performance of subprocesses.

Stability and capability data from monitoring selected subprocesses, as described in SP2.1, are a key input into understanding the work group's overall ability to meet quality and process performance objectives.

In addition, subprocesses not selected for their impact on work objectives can still create problems or risks for the work and thus some level of monitoring for these subprocesses may be desired as well. Analytic techniques involving the use of graphical displays can also prove to be useful to understanding subprocess performance.

2. Monitor and analyze suppliers' progress toward achieving their quality and process performance objectives.
3. Periodically review and analyze actual results achieved against established interim objectives.
4. Use process performance models calibrated with project data to assess progress toward achieving the quality and process performance objectives of the work.

Process performance models are used to assess progress toward achieving objectives that cannot be measured until a future phase in the work lifecycle. Objectives can either be interim objectives or overall objectives.

An example is the use of process performance models to predict the latent defects in work products in future phases or in the delivered product.

Calibration of process performance models is based on the results obtained from performing the activities described in the previous subpractices and specific practices.

5. Identify and manage risks associated with achieving the quality and process performance objectives of the work.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Example sources of risks include the following:

- Subprocesses having inadequate performance or capability
- Suppliers not achieving their quality and process performance objectives
- Lack of visibility into supplier capability
- Inaccuracies in the process performance models used for predicting performance
- Deficiencies in predicted process performance (estimated progress)
- Other identified risks associated with identified deficiencies

6. Determine and implement actions needed to address deficiencies in achieving the quality and process performance objectives of the work.

The intent of this subpractice is to identify and implement the right set of actions, resources, and schedule to place the work group back on a path toward achieving its objectives.

Examples of actions that can be taken to address deficiencies in achieving the work objectives include the following:

- Changing quality and process performance objectives so that they are within the expected range of the defined process
- Improving the implementation of the defined process
- Adopting new subprocesses and technologies that have the potential for satisfying objectives and managing associated risks
- Identifying the risk and risk mitigation strategies for deficiencies
- Terminating the work

Some actions can involve the use of root cause analysis, which is addressed in the next specific practice.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

When corrective actions result in changes to attributes or measures related to adjustable factors in a process performance model, the model can be used to predict the effects of the actions. When undertaking critical corrective actions in high risk situations, a process performance model can be created to predict the effects of the change.

SP 2.3 Perform Root Cause Analysis

Perform root cause analysis of selected issues to address deficiencies in achieving the work group's quality and process performance objectives.

Issues to address include deficiencies in subprocess stability and capability, and deficiencies in performance relative to its objectives.

Root cause analysis of selected issues is best performed shortly after the problem is first identified, while the event is still recent enough to be carefully investigated.

The formality of and effort required for a root cause analysis can vary greatly and can be determined by such factors as the stakeholders who are involved; the risk or opportunity that is present; the complexity of the situation; the frequency with which the situation could recur; the availability of data, baselines, and models that can be used in the analysis; and how much time has passed since the events triggering the deficiency.

In the case of a subprocess that exhibits too much variation, is performed rarely, and involves different stakeholders, it could take weeks or months to identify root causes.

Likewise, the actions to take can range significantly in terms of effort and time needed to determine, plan, and implement them.

It is often difficult to know how much time is needed unless an initial analysis of the deficiencies is undertaken.

Refer to the Causal Analysis and Resolution process area for more information about identifying causes of selected outcomes and taking action to improve process performance.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

Example Work Products

1. Subprocess and performance measurements and analyses (including statistical analyses) recorded in the organization's measurement repository
2. Graphical displays of data used to understand subprocess and performance and performance trends
3. Identified root causes and potential actions to take

Subpractices

1. Perform root cause analysis, as appropriate, to diagnose process performance deficiencies.

Process performance baselines and models are used in diagnosing deficiencies; identifying possible solutions; predicting future work and process performance; and evaluating potential actions as appropriate.

The use of process performance models in predicting future work and process performance is described in a subpractice of the previous specific practice.

2. Identify and analyze potential actions.
3. Implement selected actions.
4. Assess the impact of the actions on subprocess performance.

This assessment of impact can include an evaluation of the statistical significance of the impacts resulting from the actions taken to improve process performance.

REQUIREMENTS MANAGEMENT

A Project and Work Management Process Area at Maturity Level 2

Purpose

The purpose of Requirements Management (REQM) is to manage requirements of products and product components and to ensure alignment between those requirements and the work plans and work products.

Introductory Notes

Requirements management processes manage all requirements received or generated by the work group, including both technical and nontechnical requirements as well as requirements levied on the work by the organization.

In particular, all requirements that the customer and service provider have approved are addressed in the Requirements Management process area. Customer requirements for services are often identified in written agreements created prior to or during the establishment of service delivery. The customer can be internal or external to the service provider's organization.

Throughout the process areas, where the terms "product" and "product component" are used, their intended meanings also encompass services, service systems, and their components.

Requirements management processes should encourage open communication without retribution.

Sources and considerations for service requirements include mission related performance goals and objectives (found in strategic plans), issues identified during monitoring performance levels and service levels, constraints identified during selection of design solutions, and requirements derived from designing the service system (e.g., reliability, maintainability, availability, supportability, safety and health, mission operations, lifecycle cost, obsolescence management).

Other considerations affecting service requirements can stem from the customer's agreements with other suppliers (e.g., the customer's underpinning contracts, operational level agreements, memoranda of agreement, subcontracts).

The work group takes appropriate steps to ensure that the set of approved requirements is managed to support the planning and execution needs of the work. When a work group receives requirements from an approved requirements provider, these requirements are reviewed with the requirements provider to resolve issues and prevent misunderstanding before requirements are incorporated into work plans. Once the requirements provider and the requirements receiver reach an agreement,

commitment to the requirements is obtained from work participants. The work group manages changes to requirements as they evolve and identifies inconsistencies that occur among plans, work products, and requirements.

Part of managing requirements is documenting requirements changes and their rationale and maintaining bidirectional traceability between source requirements, all product and product component requirements, and other specified work products. (See the definition of “bidirectional traceability” in the glossary.)

All products and services have requirements. In the case of maintenance activities, changes are based on changes to the existing requirements, design, or implementation. The requirements changes, if any, might be documented in change requests from the customer or end users, or they might take the form of new requirements received from the requirements development process. Regardless of their source or form, the maintenance activities that are driven by changes to requirements are managed accordingly.

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Strategic Service Management process area for more information about establishing and maintaining standard services in concert with strategic needs and plans.

Refer to the Configuration Management process area for more information about establishing baselines and tracking and controlling changes.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan and managing corrective action to closure.

Refer to the Work Planning process area for more information about establishing and maintaining plans that define work activities.

Specific Goal and Practice Summary

SG 1 Manage Requirements

- SP 1.1 Understand Requirements
- SP 1.2 Obtain Commitment to Requirements
- SP 1.3 Manage Requirements Changes
- SP 1.4 Maintain Bidirectional Traceability of Requirements
- SP 1.5 Ensure Alignment Between Work Products and Requirements

Specific Practices by Goal

SG 1 Manage Requirements

Requirements are managed and inconsistencies with plans and work products are identified.

The work group maintains a current and approved set of requirements over the life of the project by doing the following:

- Managing all changes to requirements
- Maintaining relationships among requirements, plans, and work products
- Ensuring alignment among requirements, plans, and work products
- Taking corrective action

If the Service Delivery, Strategic Service Management, or Incident Resolution and Prevention process areas are implemented, their processes will generate stakeholder requirements that will also be managed by requirements management processes.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

SP 1.1 Understand Requirements

Develop an understanding with the requirements providers on the meaning of the requirements.

As the work matures and requirements are derived, all activities or disciplines will receive requirements. To avoid requirements creep, criteria are established to designate appropriate channels or official sources from which to receive requirements. Those who receive requirements conduct analyses of them with the provider to ensure that a compatible, shared understanding is reached on the meaning of requirements. The result of these analyses and dialogs is a set of approved requirements.

Example Work Products

1. Lists of criteria for distinguishing appropriate requirements providers
2. Criteria for evaluation and acceptance of requirements
3. Results of analyses against criteria
4. A set of approved requirements

Subpractices

1. Establish criteria for distinguishing appropriate requirements providers.
2. Establish objective criteria for the evaluation and acceptance of requirements.

SSD Addition

Refer to the Service System Development process area for more information about analyzing and validating requirements.

Lack of evaluation and acceptance criteria often results in inadequate verification, costly rework, or customer rejection.

Examples of evaluation and acceptance criteria include the following:

- Clearly and properly stated
- Complete
- Consistent with one another
- Uniquely identified
- Consistent with service system architecture and quality attribute priorities
- Appropriate to implement
- Verifiable (i.e., testable)
- Traceable
- Achievable
- Tied to business value
- Identified as a priority for the customer

3. Analyze requirements to ensure that established criteria are met.
4. Reach an understanding of requirements with requirements providers so that participants can commit to them.

SP 1.2 Obtain Commitment to Requirements

Obtain commitment to requirements from participants.

Refer to the Work Monitoring and Control process area for more information about monitoring commitments.

The previous specific practice dealt with reaching an understanding with requirements providers. This specific practice deals with agreements and commitments among those who carry out activities necessary to implement requirements. Requirements evolve throughout the work. As requirements evolve, this specific practice ensures that participants commit to the current and approved requirements and the resulting changes in work plans, activities, and work products.

Example Work Products

1. Requirements impact assessments
2. Documented commitments to requirements and requirements changes

Subpractices

1. Assess the impact of requirements on existing commitments.

The impact on the participants should be evaluated when the requirements change or at the start of a new requirement.

2. Negotiate and record commitments.

Changes to existing commitments should be negotiated before participants commit to a new requirement or requirement change.

SP 1.3 Manage Requirements Changes***Manage changes to requirements as they evolve.***

Refer to the Configuration Management process area for more information about tracking and controlling changes.

Requirements change for a variety of reasons. As needs change and as work proceeds, changes may have to be made to existing requirements. It is essential to manage these additions and changes efficiently and effectively. To effectively analyze the impact of changes, it is necessary that the source of each requirement is known and the rationale for the change is documented. The work group may want to track appropriate measures of requirements volatility to judge whether new or revised approach to change control is necessary.

Example Work Products

1. Requirements change requests
2. Requirements change impact reports
3. Requirements status
4. Requirements database

Subpractices

1. Document all requirements and requirements changes that are given to or generated by the work group.
2. Maintain a requirements change history, including the rationale for changes.
Maintaining the change history helps to track requirements volatility.
3. Evaluate the impact of requirement changes from the standpoint of relevant stakeholders.
4. Make requirements and change data available to the work group.

SP 1.4 Maintain Bidirectional Traceability of Requirements***Maintain bidirectional traceability among requirements and work products.***

The intent of this specific practice is to maintain the bidirectional traceability of requirements. (See the definition of “bidirectional traceability” in the glossary.) When requirements are managed well, traceability can be established from a source requirement to its lower level requirements and from those lower level requirements back to their source requirements. Such bidirectional traceability helps to determine whether all source requirements have been completely addressed and whether all lower level requirements can be traced to a valid source.

Requirements traceability also covers relationships to other entities such as intermediate and final work products, changes in design documentation, and test plans. Traceability can cover horizontal relationships, such as across interfaces, as well as vertical relationships. Traceability is

particularly needed when assessing the impact of requirements changes on work activities and work products.

In a service environment, you should be able to trace stakeholder requirements to the elements of the delivered service and supporting service system that were developed from those requirements or other requirements derived from stakeholder requirements. Conversely, elements of the delivered service and supporting service system should be traceable back to the stakeholder requirements they meet.

Examples of what aspects of traceability to consider include the following:

- Scope of traceability: The boundaries within which traceability is needed
- Definition of traceability: The elements that need logical relationships
- Type of traceability: When horizontal and vertical traceability is needed
- Integrated service environment: The scope of traceability applied in an organization in which tangible products or product elements are integral elements of services and services are the primary focus of the organization

Such bidirectional traceability is not always automated. It can be done manually using spreadsheets, databases, and other common tools.

Example Work Products

1. Requirements traceability matrix
2. Requirements tracking system

Subpractices

1. Maintain requirements traceability to ensure that the source of lower level (i.e., derived) requirements is documented.
2. Maintain requirements traceability from a requirement to its derived requirements and allocation to work products.

Work products for which traceability may be maintained include the service system architecture, service system components, development iterations (or increments), functions, interfaces, objects, people, processes, and other work products.

3. Generate a requirements traceability matrix.

A traceability matrix might have the list of stakeholder requirements and derived requirements on one axis. The other axis might list all of the components of the service system, including people and consumables. The intersections of the rows and columns would indicate where a particular requirement applies to the parts of the service system.

SP 1.5 Ensure Alignment Between Work Products and Requirements

Ensure that plans and work products remain aligned with requirements.

This specific practice finds inconsistencies between requirements and work plans and work products and initiates corrective actions to resolve them.

Example Work Products

1. Documentation of inconsistencies between requirements and work plans and work products, including sources and conditions
2. Corrective actions

Subpractices

1. Review work plans, activities, and work products for consistency with requirements and changes made to them.
2. Identify the source of the inconsistency (if any).
3. Identify any changes that should be made to plans and work products resulting from changes to the requirements baseline.
4. Initiate any necessary corrective actions.

RISK MANAGEMENT

A Project and Work Management Process Area at Maturity Level 3

Purpose

The purpose of Risk Management (RSKM) is to identify potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or work to mitigate adverse impacts on achieving objectives.

Introductory Notes

Risk management is a continuous, forward-looking process that is an important part of work management. Risk management should address issues that could endanger achievement of critical objectives. A continuous risk management approach effectively anticipates and mitigates risks that can have a critical impact on work activities.

Effective risk management includes early and aggressive risk identification through collaboration and the involvement of relevant stakeholders as described in the stakeholder involvement plan addressed in the Work Planning process area. Strong leadership among all relevant stakeholders is needed to establish an environment for free and open disclosure and discussion of risk.

Risk management should consider both internal and external, as well as both technical and non-technical, sources of cost, schedule, performance, and other risks. Early and aggressive detection of risk is important because it is typically easier, less costly, and less disruptive to make changes and correct work efforts during the earlier, rather than the later, phases of the work lifecycle.

For example, decisions related to service system architecture are often made early before their impacts can be fully understood, and thus the risk implications of such choices should be carefully considered.

Industry standards can help when determining how to prevent or mitigate specific risks commonly found in a particular industry. Certain risks can be proactively managed or mitigated by reviewing industry best practices and lessons learned.

Risk management can be divided into the following parts:

- Defining a risk management strategy
- Identifying and analyzing risks
- Handling identified risks, including the implementation of risk mitigation plans as needed

As represented in the Work Planning and Work Monitoring and Control process areas, organizations initially may focus on risk identification for

awareness and react to the realization of these risks as they occur. The Risk Management process area describes an evolution of these specific practices to systematically plan, anticipate, and mitigate risks to proactively minimize their impact on the work.

Although the primary emphasis of the Risk Management process area is on the work or work group, these concepts can also be applied to manage organizational risks.

Related Process Areas

Refer to the Service Continuity process area for more information about establishing and maintaining plans to ensure continuity of services during and following any significant disruption of normal operations.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Refer to the Work Monitoring and Control process area for more information about monitoring risks.

Refer to the Work Planning process area for more information about identifying risks and planning stakeholder involvement.

Specific Goal and Practice Summary

- SG 1 Prepare for Risk Management
 - SP 1.1 Determine Risk Sources and Categories
 - SP 1.2 Define Risk Parameters
 - SP 1.3 Establish a Risk Management Strategy
- SG 2 Identify and Analyze Risks
 - SP 2.1 Identify Risks
 - SP 2.2 Evaluate, Categorize, and Prioritize Risks
- SG 3 Mitigate Risks
 - SP 3.1 Develop Risk Mitigation Plans
 - SP 3.2 Implement Risk Mitigation Plans

Specific Practices by Goal

SG 1 Prepare for Risk Management

Preparation for risk management is conducted.

Prepare for risk management by establishing and maintaining a strategy for identifying, analyzing, and mitigating risks. Typically, this strategy is documented in a risk management plan. The risk management strategy addresses specific actions and the management approach used to apply and control the risk management program. The strategy typically includes identifying sources of risk, the scheme used to categorize risks, and parameters used to evaluate, bound, and control risks for effective handling.

SP 1.1 Determine Risk Sources and Categories***Determine risk sources and categories.***

Identifying risk sources provides a basis for systematically examining changing situations over time to uncover circumstances that affect the ability of the work group to meet its objectives. Risk sources are both internal and external to the work. As the work progresses, additional sources of risk can be identified. Establishing categories for risks provides a mechanism for collecting and organizing risks as well as ensuring appropriate scrutiny and management attention to risks that can have serious consequences on meeting work objectives.

Example Work Products

1. Risk source lists (external and internal)
2. Risk categories list

Subpractices

1. Determine risk sources.

Risk sources are fundamental drivers that cause risks in work activities or organization. There are many sources of risks, both internal and external to a work group. Risk sources identify where risks can originate.

Typical internal and external risk sources include the following:

- Uncertain requirements
- Unprecedented efforts (i.e., estimates unavailable)
- Infeasible design
- Competing quality attribute requirements that affect service system solution selection and design
- Architectural decisions that affect quality attribute requirements (e.g., for capacity and availability) for the service system, or business objectives
- Unavailable technology
- Unrealistic schedule estimates or allocation
- Inadequate staffing and skills
- Cost or funding issues
- Uncertain or inadequate subcontractor capability
- Uncertain or inadequate supplier capability
- Inadequate communication with actual or potential customers or with their representatives
- Disruptions to the continuity of operations
- Regulatory constraints (e.g. security, safety, environment)

Many of these sources of risk are accepted without adequately planning for them. Early identification of both internal and external sources of risk can lead to early identification of risks. Risk mitigation plans can then be implemented early in the work to preclude occurrence of risks or reduce consequences of their occurrence.

2. Determine risk categories.

Risk categories are “bins” used for collecting and organizing risks. Identifying risk categories aids the future consolidation of activities in risk mitigation plans.

The following factors can be considered when determining risk categories:

- Phases of the work lifecycle
- Types of processes used
- Types of products used
- Work management risks (e.g., contract risks, budget risks, schedule risks, resource risks)
- Technical performance risks (e.g., quality attribute related risks, supportability risks)

A risk taxonomy can be used to provide a framework for determining risk sources and categories.

SP 1.2 Define Risk Parameters

Define parameters used to analyze and categorize risks and to control the risk management effort.

Parameters for evaluating, categorizing, and prioritizing risks include the following:

- Risk likelihood (i.e., probability of risk occurrence)
- Risk consequence (i.e., impact and severity of risk occurrence)
- Thresholds to trigger management activities

Risk parameters are used to provide common and consistent criteria for comparing risks to be managed. Without these parameters, it is difficult to gauge the severity of an unwanted change caused by a risk and to prioritize the actions required for risk mitigation planning.

Work groups should document the parameters used to analyze and categorize risks so that they are available for reference throughout the work because circumstances change over time. Using these parameters, risks can easily be re-categorized and analyzed when changes occur.

The work group can use techniques such as failure mode and effects analysis (FMEA) to examine risks of potential failures in the service system or in selected service delivery processes. Such techniques can help to provide discipline in working with risk parameters.

Example Work Products

1. Risk evaluation, categorization, and prioritization criteria
2. Risk management requirements (e.g., control and approval levels, reassessment intervals)

Subpractices

1. Define consistent criteria for evaluating and quantifying risk likelihood and severity levels.

Consistently used criteria (e.g., bounds on likelihood, severity levels) allow impacts of different risks to be commonly understood, to receive the appropriate level of scrutiny, and to obtain the management attention warranted. In managing dissimilar risks (e.g., staff safety versus environmental pollution), it is important to ensure consistency in the end result. (For example, a high-impact risk of environmental pollution is as important as a high-impact risk to staff safety.) One way of providing a common basis for comparing dissimilar risks is assigning dollar values to risks (e.g., through a process of risk monetization).

2. Define thresholds for each risk category.

For each risk category, thresholds can be established to determine acceptability or unacceptability of risks, prioritization of risks, or triggers for management action.

Examples of thresholds include the following:

- Thresholds could be established to involve senior management when product costs exceed 10 percent of the target cost or when cost performance indices (CPIs) fall below 0.95.
- Schedule thresholds could be established to involve senior management when schedule performance indices (SPIs) fall below 0.95.
- Performance thresholds could be established to involve senior management when specified key items (e.g., processor utilization, average response times) exceed 125 percent of the intended design.

3. Define bounds on the extent to which thresholds are applied against or within a category.

There are few limits to which risks can be assessed in either a quantitative or qualitative fashion. Definition of bounds (or boundary conditions) can be used to help define the extent of the risk management effort and avoid excessive resource expenditures. Bounds can include the exclusion of a risk source from a category. These bounds can also exclude conditions that occur below a given frequency.

SP 1.3 Establish a Risk Management Strategy

Establish and maintain the strategy to be used for risk management.

A comprehensive risk management strategy addresses items such as the following:

- The scope of the risk management effort
- Methods and tools to be used for risk identification, risk analysis, risk mitigation, risk monitoring, and communication
- Work-specific sources of risks
- How risks are to be organized, categorized, compared, and consolidated
- Parameters used for taking action on identified risks, including likelihood, consequence, and thresholds

- Risk mitigation techniques to be used, such as prototyping, piloting, simulation, alternative designs, or evolutionary development
- The definition of risk measures used to monitor the status of risks
- Time intervals for risk monitoring or reassessment

The risk management strategy should be guided by a common vision of success that describes desired future work outcomes in terms of the product delivered, its cost, and its fitness for the task. The risk management strategy is often documented in a risk management plan for the organization or work group. This strategy is reviewed with relevant stakeholders to promote commitment and understanding.

A risk management strategy should be developed early in the work lifecycle, so that relevant risks are identified and managed proactively. Early identification and assessment of critical risks allows the work group to formulate risk handling approaches and adjust work definition and allocation of resources based on critical risks.

Example Work Products

1. Risk management strategy

SG 2 Identify and Analyze Risks

Risks are identified and analyzed to determine their relative importance.

The degree of risk affects the resources assigned to handle the risk and the timing of when appropriate management attention is required.

Risk analysis entails identifying risks from identified internal and external sources and evaluating each identified risk to determine its likelihood and consequences. Risk categorization, based on an evaluation against established risk categories and criteria developed for the risk management strategy, provides information needed for risk handling. Related risks can be grouped to enable efficient handling and effective use of risk management resources.

SP 2.1 Identify Risks

Identify and document risks.

Identifying potential issues, hazards, threats, and vulnerabilities that could negatively affect work efforts or plans is the basis for sound and successful risk management. Risks should be identified and described understandably before they can be analyzed and managed properly. Risks are documented in a concise statement that includes the context, conditions, and consequences of risk occurrence.

Risk identification should be an organized, thorough approach to seek out probable or realistic risks in achieving objectives. To be effective, risk identification should not attempt to address every possible event. Using categories and parameters developed in the risk management strategy and identified sources of risk can provide the discipline and streamlining appropriate for risk identification. Identified risks form a baseline for initiating risk management activities. Risks should be reviewed periodically

to reexamine possible sources of risk and changing conditions to uncover sources and risks previously overlooked or nonexistent when the risk management strategy was last updated.

Risk identification focuses on the identification of risks, not the placement of blame. The results of risk identification activities should never be used by management to evaluate the performance of individuals.

Many methods are used for identifying risks. Typical identification methods include the following:

- Examine each element of the work breakdown structure.
- Conduct a risk assessment using a risk taxonomy.
- Interview subject matter experts.
- Review risk management efforts from similar products.
- Examine lessons learned documents or databases.
- Examine design specifications and agreement requirements.

Example Work Products

1. List of identified risks, including the context, conditions, and consequences of risk occurrence

Subpractices

1. Identify the risks associated with cost, schedule, and performance.

Risks associated with cost, schedule, performance, and other business objectives should be examined to understand their effect on work objectives. Risk candidates can be discovered that are outside the scope of work objectives but vital to customer interests. For example, risks in development costs, product acquisition costs, cost of spare (or replacement) products, and product disposition (or disposal) costs have design implications.

The customer may not have considered the full cost of supporting a fielded product or using a delivered service. The customer should be informed of such risks, but actively managing those risks may not be necessary. Mechanisms for making such decisions should be examined at work activity and organization levels and put in place if deemed appropriate, especially for risks that affect the work group's ability to verify and validate the product.

In addition to the cost risks identified above, other cost risks can include the ones associated with funding levels, funding estimates, and distributed budgets.

Risks associated with service agreements, such as supplier dependencies, customer processes, and unrealistic service levels also should be considered.

Schedule risks can include risks associated with planned activities, key events, and milestones.

Performance risks can include risks associated with the following:

- Service interruptions
- Meeting service levels
- Impacts of customer processes
- Requirements
- Analysis and design
- Application of new technology
- Physical size
- Shape
- Weight
- Manufacturing and fabrication
- Service system behavior and operation with respect to functionality or quality attributes
- Verification
- Validation
- Performance maintenance attributes

Performance maintenance attributes are those characteristics that enable an in-use product or service to provide required performance, such as maintaining safety and security performance.

There are risks that do not fall into cost, schedule, or performance categories, but can be associated with other aspects of the organization's operation.

Examples of these other risks include risks related to the following:

- Dependency on customer provided resources (e.g., equipment, facilities)
- Operational resiliency
- Dependencies on suppliers
- Over reliance on key staff
- Strikes
- Diminishing sources of supply
- Technology cycle time
- Competition

2. Review environmental elements that can affect the work.

Risks to the work that frequently are missed include risks supposedly outside the scope of the work group (i.e., the work group does not control whether they occur but can mitigate their impact). These risks can include weather or natural disasters, political changes, and telecommunications failures.

3. Review all elements of the work breakdown structure as part of identifying risks to help ensure that all aspects of the work effort have been considered.

4. Review all elements of the work plan as part of identifying risks to help ensure that all aspects of the work have been considered.

Refer to the Work Planning process area for more information about identifying risks.

5. Document the context, conditions, and potential consequences of each risk.

Risk statements are typically documented in a standard format that contains the risk context, conditions, and consequences of occurrence. The risk context provides additional information about the risk such as the relative time frame of the risk, the circumstances or conditions surrounding the risk that has brought about the concern, and any doubt or uncertainty.

6. Identify the relevant stakeholders associated with each risk.

SP 2.2 Evaluate, Categorize, and Prioritize Risks

Evaluate and categorize each identified risk using defined risk categories and parameters, and determine its relative priority.

The evaluation of risks is needed to assign a relative importance to each identified risk and is used in determining when appropriate management attention is required. Often it is useful to aggregate risks based on their interrelationships and develop options at an aggregate level. When an aggregate risk is formed by a roll up of lower level risks, care should be taken to ensure that important lower level risks are not ignored.

Collectively, the activities of risk evaluation, categorization, and prioritization are sometimes called a “risk assessment” or “risk analysis.”

Example Work Products

1. List of risks and their assigned priority

Subpractices

1. Evaluate identified risks using defined risk parameters.

Each risk is evaluated and assigned values according to defined risk parameters, which can include likelihood, consequence (i.e., severity, impact), and thresholds. The assigned risk parameter values can be integrated to produce additional measures, such as risk exposure (i.e., the combination of likelihood and consequence), which can be used to prioritize risks for handling.

Often, a scale with three to five values is used to evaluate both likelihood and consequence.

Likelihood, for example, can be categorized as remote, unlikely, likely, highly likely, or nearly certain.

Example categories for consequence include the following:

- Low
- Medium
- High
- Negligible
- Marginal
- Significant
- Critical
- Catastrophic

Probability values are frequently used to quantify likelihood. Consequences are generally related to cost, schedule, environmental impact, or human measures (e.g., labor hours lost, severity of injury).

Risk evaluation is often a difficult and time consuming task. Specific expertise or group techniques may be needed to assess risks and gain confidence in the prioritization. In addition, priorities can require reevaluation as time progresses. To provide a basis for comparing the impact of the realization of identified risks, consequences of the risks can be monetized.

2. Categorize and group risks according to defined risk categories.

Risks are categorized into defined risk categories, providing a means to review them according to their source, taxonomy, or component. Related or equivalent risks can be grouped for efficient handling. The cause-and-effect relationships between related risks are documented.

3. Prioritize risks for mitigation.

A relative priority is determined for each risk based on assigned risk parameters. Clear criteria should be used to determine risk priority. Risk prioritization helps to determine the most effective areas to which resources for risks mitigation can be applied with the greatest positive impact on the work.

SG 3 Mitigate Risks

Risks are handled and mitigated as appropriate to reduce adverse impacts on achieving objectives.

The steps in handling risks include developing risk handling options, monitoring risks, and performing risk handling activities when defined thresholds are exceeded. Risk mitigation plans are developed and implemented for selected risks to proactively reduce the potential impact of risk occurrence. Risk mitigation planning can also include contingency plans to deal with the impact of selected risks that can occur despite attempts to mitigate them. Risk parameters used to trigger risk handling activities are defined by the risk management strategy.

SP 3.1 Develop Risk Mitigation Plans***Develop a risk mitigation plan in accordance with the risk management strategy.***

A critical component of risk mitigation planning is developing alternative courses of action, workarounds, and fallback positions, and a recommended course of action for each critical risk. The risk mitigation plan for a given risk includes techniques and methods used to avoid, reduce, and control the probability of risk occurrence; the extent of damage incurred should the risk occur (sometimes called a “contingency plan”); or both. Risks are monitored and when they exceed established thresholds, risk mitigation plans are deployed to return the affected effort to an acceptable risk level. If the risk cannot be mitigated, a contingency plan can be invoked. Both risk mitigation and contingency plans often are generated only for selected risks for which consequences of the risks are high or unacceptable. Other risks may be accepted and simply monitored.

Options for handling risks typically include alternatives such as the following:

- Risk avoidance: changing or lowering requirements while still meeting end user needs
- Risk control: taking active steps to minimize risks
- Risk transfer: reallocating requirements to lower risks
- Risk monitoring: watching and periodically reevaluating the risk for changes in assigned risk parameters
- Risk acceptance: acknowledging risk but not taking action

Often, especially for high-impact risks, more than one approach to handling a risk should be generated.

For example, in the case of an event that disrupts the continuity of operations, approaches to risk management can include establishing the following:

- Resource reserves to respond to disruptive events
- Lists of available backup equipment
- Backups to key staff
- Plans for testing emergency response systems
- Posted procedures for emergencies
- Disseminated lists of key contacts and information resources for emergencies

In many cases, risks are accepted or watched. Risk acceptance is usually done when the risk is judged too low for formal mitigation or when there appears to be no viable way to reduce the risk. If a risk is accepted, the rationale for this decision should be documented. Risks are watched when there is an objectively defined, verifiable, and documented threshold (e.g., for cost, schedule, performance, risk exposure) that will trigger risk mitigation planning or invoke a contingency plan.

Refer to the Decision Analysis and Resolution process area for more information about evaluating alternatives and selecting solutions.

Adequate consideration should be given early to technology demonstrations, models, simulations, pilots, and prototypes as part of risk mitigation planning.

Example Work Products

1. Documented handling options for each identified risk
2. Risk mitigation plans
3. Contingency plans
4. List of those who are responsible for tracking and addressing each risk

Subpractices

1. Determine the levels and thresholds that define when a risk becomes unacceptable and triggers the execution of a risk mitigation plan or contingency plan.

Risk level (derived using a risk model) is a measure combining the uncertainty of reaching an objective with the consequences of failing to reach the objective.

Risk levels and thresholds that bound planned or acceptable cost, schedule, or performance should be clearly understood and defined to provide a means with which risk can be understood. Proper categorization of risk is essential for ensuring an appropriate priority based on severity and the associated management response. There can be multiple thresholds employed to initiate varying levels of management response. Typically, thresholds for the execution of risk mitigation plans are set to engage before the execution of contingency plans.

2. Identify the person or group responsible for addressing each risk.
3. Determine the costs and benefits of implementing the risk mitigation plan for each risk.

Risk mitigation activities should be examined for benefits they provide versus resources they will expend. Just like any other design activity, alternative plans may need to be developed and costs and benefits of each alternative assessed. The most appropriate plan is selected for implementation.

4. Develop an overall risk mitigation plan for the work to orchestrate the implementation of individual risk mitigation and contingency plans.

The complete set of risk mitigation plans may not be affordable. A tradeoff analysis should be performed to prioritize risk mitigation plans for implementation.

5. Develop contingency plans for selected critical risks in the event their impacts are realized.

Risk mitigation plans are developed and implemented as needed to proactively reduce risks before they become problems. Despite best efforts, some risks can be unavoidable and will become problems that affect the work. Contingency plans can be developed for critical risks to describe actions a work group can take to deal with the occurrence of this impact. The intent is to define a proactive plan for handling the risk. Either the risk is reduced (mitigation) or addressed (contingency). In either event, the risk is managed.

Some risk management literature may consider contingency plans a synonym or subset of risk mitigation plans. These plans also can be addressed together as risk handling or risk action plans.

SP 3.2 Implement Risk Mitigation Plans

Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate.

To effectively control and manage risks during the work effort, follow a proactive program to regularly monitor risks and the status and results of risk handling actions. The risk management strategy defines the intervals at which risk status should be revisited. This activity can result in the discovery of new risks or new risk handling options that can require replanning and reassessment. In either event, acceptability thresholds associated with the risk should be compared to the risk status to determine the need for implementing a risk mitigation plan.

Example Work Products

1. Updated lists of risk status
2. Updated assessments of risk likelihood, consequence, and thresholds
3. Updated list of risk handling options
4. Updated list of actions taken to handle risks
5. Risk mitigation plans of risk handling options

Subpractices

1. Monitor risk status.

After a risk mitigation plan is initiated, the risk is still monitored. Thresholds are assessed to check for the potential execution of a contingency plan.

A mechanism for monitoring should be employed.

2. Provide a method for tracking open risk handling action items to closure.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

3. Invoke selected risk handling options when monitored risks exceed defined thresholds.

Often, risk handling is only performed for risks judged to be *high* and *medium*. The risk handling strategy for a given risk can include techniques and methods to avoid, reduce, and control the likelihood of the risk or the extent of damage incurred should the risk occur, or both. In this context, risk handling includes both risk mitigation plans and contingency plans.

Risk handling techniques are developed to avoid, reduce, and control adverse impact to work objectives and to bring about acceptable outcomes in light of probable impacts. Actions generated to handle a risk require proper resource loading and scheduling in plans and baseline schedules. This replanning should closely consider the effects on adjacent or dependent work initiatives or activities.

4. Establish a schedule or period of performance for each risk handling activity that includes a start date and anticipated completion date.
5. Provide a continued commitment of resources for each plan to allow the successful execution of risk handling activities.
6. Collect performance measures on risk handling activities.

SUPPLIER AGREEMENT MANAGEMENT

A Project and Work Management Process Area at Maturity Level 2

Purpose

The purpose of Supplier Agreement Management (SAM) is to manage the acquisition of products and services from suppliers.

Introductory Notes

The scope of this process area addresses the acquisition of products, services, and product and service components that can be delivered to the service's customer or included in a product or service system. This process area's practices can also be used for other purposes that benefit the service (e.g., purchasing consumables).

This process area does not apply in all contexts in which commercial off-the-shelf (COTS) components are acquired but does apply in cases where there are modifications to COTS components, government off-the-shelf components, or freeware, that are of significant value to the work or that represent significant risk.

Throughout the process areas, where the terms "product" and "product component" are used, their intended meanings also encompass services, service systems, and their components.

The Supplier Agreement Management process area involves the following activities:

- Determining the type of acquisition
- Selecting suppliers
- Establishing and maintaining agreements with suppliers
- Executing supplier agreements
- Accepting delivery of acquired products
- Ensuring successful transition of acquired products

Examples of both tangible and intangible products that can be acquired by the work group to become part of a service delivered to the customer or to become part of the service system include the following:

- Maintenance of a specialized piece of equipment through a service level agreement with an external supplier as part of a facility maintenance service
- User training for a service, where the training is performed by an internal supplier as part of an operating level agreement (OLA)
- Nursing services at a hospital supplied through an outsourcing agreement
- Meals and refreshments at a conference supplied through a catering contract
- Communications equipment that is purchased and delivered by a purchasing agent on receipt of an order
- Gasoline to be sold at a gas station
- Automobiles to be delivered by a delivery service as ordered
- Automated teller machines at a bank
- Components of a web-based search engine
- Airplanes at an airline
- Automobiles at a car rental outlet

Typically, the products to be acquired are determined during the early stages of planning and development of the service system.

This process area does not directly address arrangements in which the supplier is integrated into the work group and uses the same processes and reports to the same management as the work group members. Typically, these situations are handled by other processes or functions (e.g., work management processes, processes or functions external to the work group) though some of the specific practices of this process area can be useful in managing the supplier agreement.

This process area typically is not implemented to address arrangements in which the work group's customer is also a supplier. These situations are usually handled by either informal agreements with the customer or by specification of the customer furnished items in the overall agreement that the work group has with the customer. In the latter case, some of the specific practices of this process area can be useful in managing the agreement, although others may not, due to the fundamentally different relationship that exists with a customer as opposed to an ordinary supplier. See the CMMI-ACQ model for more information about other types of agreements.

Suppliers can take many forms depending on business needs, including in-house suppliers (i.e., suppliers that are in the same organization but are external to the work group), fabrication departments, suppliers of reuse libraries, and commercial suppliers. (See the definition of "supplier" in the glossary.)

A supplier agreement is established to manage the relationship between the organization and the supplier. A supplier agreement is any written

agreement between the organization (representing the work group) and the supplier. This agreement can be a contract, license, service level agreement, or memorandum of agreement. The acquired product is delivered from the supplier according to the supplier agreement. (See the definition of “supplier agreement” in the glossary.)

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements and developing service systems.

Refer to the Requirements Management process area for more information about maintaining bidirectional traceability of requirements.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan and managing corrective action to closure.

Specific Goal and Practice Summary

SG 1 Establish Supplier Agreements

- SP 1.1 Determine Acquisition Type
- SP 1.2 Select Suppliers
- SP 1.3 Establish Supplier Agreements

SG 2 Satisfy Supplier Agreements

- SP 2.1 Execute the Supplier Agreement
- SP 2.2 Accept the Acquired Product
- SP 2.3 Ensure Transition of Products

Specific Practices by Goal

SG 1 Establish Supplier Agreements

Agreements with the suppliers are established and maintained.

SP 1.1 Determine Acquisition Type

Determine the type of acquisition for each product or product component to be acquired.

Many different types of acquisitions can be used to acquire products and product components that can be used for the work.

Examples of types of acquisitions include the following:

- Obtaining services from another part of the business enterprise
- Purchasing modified COTS products
- Obtaining products through a supplier agreement
- Obtaining products from an in-house supplier
- Obtaining products from the customer
- Obtaining products from a preferred supplier
- Combining some of the above (e.g., contracting for a modification to a COTS product, having another part of the business enterprise co-develop products with an external supplier)

If acquiring modified COTS products of significant value to the work or that represent significant project risk, care in evaluating and selecting these products and the supplier can be critical to the work. Aspects to consider in the selection decision include proprietary issues and the availability of the products.

Example Work Products

1. List of the acquisition types that will be used for all products and product components to be acquired

SP 1.2 Select Suppliers

Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Criteria should be established to address factors that are important to the work.

Examples of factors that can be important to the work include the following:

- Geographical location of the supplier
- Supplier's performance records on similar work
- Engineering capabilities
- Staff and facilities available to perform the work
- Prior experience in similar situations
- Customer satisfaction with similar products delivered by the supplier

Example Work Products

1. Market studies
2. List of candidate suppliers
3. Preferred supplier list
4. Trade study or other record of evaluation criteria, advantages and disadvantages of candidate suppliers, and rationale for selection of suppliers
5. Solicitation materials and requirements

Subpractices

1. Establish and document criteria for evaluating potential suppliers.
2. Identify potential suppliers and distribute solicitation material and requirements to them.

A proactive manner of performing this activity is to conduct market research to identify potential sources of candidate products to be acquired.

3. Evaluate proposals according to evaluation criteria.
4. Evaluate risks associated with each proposed supplier.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

5. Evaluate proposed suppliers' abilities to perform the work.

Examples of methods used to evaluate the proposed supplier's abilities to perform the work include the following:

- Evaluation of prior experience in similar applications
- Evaluation of customer satisfaction with similar products provided
- Evaluation of prior performance on similar work
- Evaluation of management capabilities
- Capability evaluations
- Evaluation of staff available to perform the work
- Evaluation of available facilities and resources
- Evaluation of the work group's ability to work with the proposed supplier
- Evaluation of the impact of candidate COTS products on the work plan and commitments

When modified COTS products are being evaluated, consider the following:

- Cost of the modified COTS products
- Cost and effort to incorporate the modified COTS products into the work
- Security requirements
- Benefits and impacts that can result from future product releases

Future releases of the modified COTS product can provide additional features that support planned or anticipated enhancements for the work, but can result in the supplier discontinuing support of its current release.

6. Select the supplier.

SP 1.3 Establish Supplier Agreements

Establish and maintain supplier agreements.

A supplier agreement is any written agreement between the organization (representing the work) and the supplier. This agreement can be a contract, license, service level agreement, or memorandum of agreement.

The content of the supplier agreement should specify the arrangement for selecting supplier processes and work products to be monitored, analyzed, and evaluated, if the arrangement is appropriate to the acquisition or product being acquired. The supplier agreement should also specify the reviews, monitoring, evaluations, and acceptance testing to be performed.

Supplier processes that are critical to the success of the work (e.g., due to complexity, due to importance) should be monitored.

An acquired service can be delivered directly to the service provider's customer or end user. The content of the supplier agreement for such an acquired service should also specify whether the acceptance process will be performed before, during, or after supplier delivery. If the supplier will continuously or repeatedly deliver the service to the customer, the content should also specify when or how often the acceptance process will be performed (e.g., every time the service is delivered, at specified or random times on a subset of the service deliveries).

Supplier agreements between independent legal entities are typically reviewed by legal or contract advisors prior to approval.

Supplier agreements should address the expected end of service, early end of service, and transition of service as appropriate.

Example Work Products

1. Statements of work
2. Contracts
3. Memoranda of agreement
4. Licensing agreement

Subpractices

1. Revise the requirements (e.g., product requirements, service level requirements) to be fulfilled by the supplier to reflect negotiations with the supplier when necessary.

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Requirements Management process area for more information about managing requirements of the project's products and product components and to ensure alignment between those requirements and the project's plans and work products.

2. Document what the work group will provide to the supplier.

Include the following:

- Work group furnished facilities
- Documentation
- Services

3. Document the supplier agreement.

The supplier agreement should include a statement of work, a specification, terms and conditions, a list of deliverables, a schedule, a budget, and a defined acceptance process.

This subpractice typically includes the following tasks:

- Identifying specific requirements, scope, level of service, and communication processes to be provided by the suppliers
- Aligning subcontract service level agreements with contractor's service level agreements
- Ensuring risk handling responsibilities are flowed down to suppliers as appropriate
- Reviewing the legal aspects of the supplier agreement if necessary to ensure compliance and enforceability
- Identifying the type and depth of oversight of the supplier, including selection of processes to be monitored and work products to be evaluated (and the corresponding procedures and evaluation criteria to be used)
- Establishing the statement of work, specification, terms and conditions, list of deliverables, schedule, budget, and acceptance process
- Identifying who from the work group and supplier are responsible and authorized to make changes to the supplier agreement
- Identifying how requirements changes and changes to the supplier agreement are to be determined, communicated, and addressed
- Identifying standards and procedures that will be followed
- Identifying critical dependencies between the work and the supplier
- Identifying the types of reviews that will be conducted with the supplier
- Identifying the supplier's responsibilities for ongoing maintenance and support of the acquired products
- Identifying warranty, ownership, and rights of use for the acquired products
- Identifying acceptance criteria

In some cases, selection of modified COTS products can require a supplier agreement in addition to the agreements in the product's license. Examples of what could be covered in an agreement with a COTS supplier include the following:

- Discounts for large quantity purchases
- Coverage of relevant stakeholders under the licensing agreement, including suppliers, team members, and the customer
- Plans for future enhancements
- On-site support, such as responses to queries and problem reports
- Additional capabilities that are not in the product
- Maintenance support, including support after the product is withdrawn from general availability

4. Periodically review the supplier agreement to ensure it accurately reflects the work group's relationship with the supplier and current risks and market conditions.
5. Ensure that all parties to the supplier agreement understand and agree to all requirements before implementing the agreement or any changes.
6. Revise the supplier agreement as necessary to reflect changes to the supplier's processes or work products.
7. Revise the work plans and commitments, including changes to the work group's processes or work products, as necessary to reflect the supplier agreement.

Refer to the Work Monitoring and Control process area for more information about monitoring commitments.

SG 2 Satisfy Supplier Agreements

Agreements with suppliers are satisfied by both the work group and the supplier.

SP 2.1 Execute the Supplier Agreement

Perform activities with the supplier as specified in the supplier agreement.

Refer to the Work Monitoring and Control process area for more information about providing an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Example Work Products

1. Supplier progress reports and performance measures
2. Supplier review materials and reports
3. Action items tracked to closure
4. Product and documentation deliveries

Subpractices

1. Monitor supplier progress and performance (e.g., schedule, effort, cost, technical performance) as defined in the supplier agreement.
2. Select, monitor, and analyze processes used by the supplier as defined in the supplier agreement.

Supplier processes that are critical to the success of the work (e.g., due to complexity, due to importance) should be monitored. The selection of processes to monitor should consider the impact of the selection on the supplier.

3. Select and evaluate work products from the supplier as defined in the supplier agreement.

The work products selected for evaluation should include critical products, product components, and work products that provide insight into quality issues as early as possible. In situations of low risk, it may not be necessary to select any work products for evaluation.

4. Conduct reviews with the supplier as specified in the supplier agreement.

Refer to the Work Monitoring and Control process area for more information about conducting milestone reviews and conducting progress reviews.

Reviews cover both formal and informal reviews and include the following steps:

- Preparing for the review
- Ensuring that relevant stakeholders participate
- Conducting the review
- Identifying, documenting, and tracking all action items to closure
- Preparing and distributing to the relevant stakeholders a summary report of the review

5. Conduct technical reviews with the supplier as defined in the supplier agreement.

Technical reviews typically include the following:

- Evaluating the supplier's delivery of services against targets in service agreements (e.g., service level agreements, operating level agreements)
- Providing the supplier with visibility into the needs and desires of the customers and end users as appropriate
- Reviewing the supplier's technical activities and verifying that the supplier's interpretation and implementation of the requirements are consistent with the work group's interpretation
- Ensuring that technical commitments are being met and that technical issues are communicated and resolved in a timely manner
- Obtaining technical information about the supplier's products
- Providing appropriate technical information and support to the supplier

6. Conduct management reviews with the supplier as defined in the supplier agreement.

Management reviews typically include the following:

- Reviewing critical dependencies
- Reviewing work risks involving the supplier
- Reviewing schedule and budget
- Reviewing the supplier's compliance with legal and regulatory requirements

Technical and management reviews can be coordinated and held jointly.

7. Use the results of reviews to improve the supplier's performance and to establish and nurture long-term relationships with preferred suppliers.

Possible sources for improvements to the supplier's performance or the organization-supplier relationship can come from analyzing the results of technical and management reviews as well as a comprehensive review that ensures alignment of business needs and contractual obligations. A comprehensive review of supplier agreements is held periodically to ensure alignment of business needs and contractual obligations. Improvements identified during these reviews can be recorded and included in an improvement plan.

8. Monitor risks involving the supplier and take corrective action as necessary.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

Examples of sources of risks to monitor include the following:

- Supplier's ability to continue effective delivery
- Supplier's viability
- Items covered by non-disclosure agreements
- Contract terms and conditions
- Availability of alternative suppliers

SP 2.2 Accept the Acquired Product

Ensure that the supplier agreement is satisfied before accepting the acquired product.

An acceptance process involving appropriate activities, such as acceptance reviews, tests, and configuration audits, should be completed before accepting the product as defined in the supplier agreement.

When acquiring a service that will be delivered directly to the service provider's customer or end user, this practice can be implemented before, during, or after delivery of the service to the customer or end user. Potentially you can implement this specific practice more than once.

Example Work Products

1. Acceptance procedures
2. Acceptance reviews or test results
3. Discrepancy reports or corrective action plans

Subpractices

1. Define the acceptance procedures.
2. Review and obtain agreement from relevant stakeholders on the acceptance procedures before the acceptance review or test.
3. Verify that the acquired products satisfy their requirements.

Examples of verifying that an acquired service satisfies its requirements include the following:

- Piloting the service and comparing the results against its service level agreement or operating level agreement
- Inspecting the supplier's service system to verify that it meets its requirements
- Monitoring the supplier's delivery (or deliveries) of the service to the customer against the requirements in the supplier agreement

SSD Addition

Refer to the Service System Development process area for more information about verifying and validating service systems.

4. Confirm that the nontechnical commitments associated with the acquired products are satisfied.

This confirmation can include confirming that the appropriate license, warranty, ownership, use, and support or maintenance agreements are in place and that all supporting materials are received.

5. Document the results of the acceptance review or test.

Examples of documenting the results of an acceptance review of a service include the following:

- A report assessing the results of piloting the service
- A report evaluating the results of inspecting the supplier's service system
- A completed checklist recording the results of monitoring the supplier's delivery (or deliveries) of the service to the customer

6. Establish an action plan and obtain supplier agreement to take action to correct acquired products that do not pass their acceptance review or test.

7. Track action items to closure.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

SP 2.3 Ensure Transition of Products***Ensure the transition of products acquired from the supplier.***

Before the acquired product is transferred to the project, customer, or end user, appropriate preparation and evaluation should occur to ensure a smooth transition.

SSD Addition

Refer to the Service System Development process area for more information about integrating service system components.

Example Work Products

1. Descriptions of how ongoing support obligations, such as warranties and licenses, will be satisfied
2. Transition plans
3. Training reports
4. Support and maintenance reports

Subpractices

1. Ensure that facilities exist to receive, store, integrate, and maintain the acquired products as appropriate.
2. Ensure that appropriate training is provided for those who are involved in receiving, storing, integrating, and maintaining acquired products.
3. Ensure that acquired products are stored, distributed, and integrated according to the terms and conditions specified in the supplier agreement or license.

SERVICE CONTINUITY

A Project and Work Management Process Area at Maturity Level 3

Purpose

The purpose of Service Continuity (SCON) is to establish and maintain plans to ensure continuity of services during and following any significant disruption of normal operations.

Introductory Notes

Service continuity is the process of preparing mitigation for significant disruptions to service delivery so that delivery can continue or resume, although perhaps in a degraded fashion. These practices describe how to prepare service systems and the resources they depend on to help ensure that a minimum critical level of service can continue if a significant risk is realized. Part of service continuity is identifying which services cannot be disrupted and which can be disrupted and for what amount of time.

The Service Continuity process area builds on the practices in the Risk Management process area. The Risk Management process area describes a general systematic approach to identifying and mitigating all risks to proactively minimize their impact on the work. Service continuity practices are a specialization of risk management that focuses on dealing with significant disruptions of normal operations. If risk management has been implemented, some of the resulting capability can be used to provide for more effective service continuity. However, generic risk management does not guarantee that service continuity is accomplished. Therefore, the specific practices of the Service Continuity process area are required in addition to the practices of the Risk Management process area.

Service Continuity can be applied at both the organization level and the work group level. Therefore, the use of the term “organization” in this process area can apply to a work group or the organization as appropriate.

Typically, service disruption is a situation that involves an event (or sequence of events) that make it virtually impossible for a service provider to conduct business as usual.

Examples of such events include the following:

- Disruptions to infrastructure such as significant equipment malfunctions and building collapse
- Natural disasters such as hurricanes, tornados, and earthquakes
- Human events such as civil unrest and acts of terrorism

A service provider may only have a short period of time in which to recover and resume providing services.

The Service Continuity process area covers developing, testing, and maintaining a service continuity plan. First, the following should be identified:

- The essential functions that support the services the organization has agreed to deliver
- The resources that are required to deliver services
- The potential hazards or threats to these resources
- The susceptibility of the service provider to the effects of each hazard or threat
- The potential impact of each threat on service continuity

This information is used to develop a service continuity plan that, in the event of a disruption, enables the organization to resume service delivery. Creating the service continuity plan typically involves the following three activities conducted after the information listed above has been collected. All of these activities, including the collection of information, are repeated periodically to keep the plan current:

- Documenting the service continuity plan based on the information previously collected
- Documenting the tests to validate the service continuity plan
- Documenting the training materials and training delivery methods for carrying out the service continuity plan

Finally, service continuity plans should be validated. Because it is unwise to wait until an emergency occurs to first execute the service continuity plan, staff who will perform the procedures in the service continuity plan should be trained in how to perform these procedures. In addition, periodic tests should be conducted to determine whether the service continuity plan would be effective in an actual emergency or significant disruption and what changes to the plan are needed to enable the organization to continue to deliver service reliably.

Related Process Areas

Refer to the Service Delivery process area for more information about delivering services in accordance with service agreements.

Refer to the Decision Analysis and Resolution process area for more information about evaluating alternatives.

Refer to the Organizational Training process area for more information about delivering training.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

Refer to the Work Planning process area for more information about developing a work plan.

Specific Goal and Practice Summary

SG 1 Identify Essential Service Dependencies

- SP 1.1 Identify and Prioritize Essential Functions
- SP 1.2 Identify and Prioritize Essential Resources

SG 2 Prepare for Service Continuity

- SP 2.1 Establish Service Continuity Plans
- SP 2.2 Establish Service Continuity Training
- SP 2.3 Provide and Evaluate Service Continuity Training

SG 3 Verify and Validate the Service Continuity Plan

- SP 3.1 Prepare for the Verification and Validation of the Service Continuity Plan
- SP 3.2 Verify and Validate the Service Continuity Plan
- SP 3.3 Analyze Results of Verification and Validation of the Service Continuity Plan

Specific Practices by Goal

SG 1 Identify Essential Service Dependencies

The essential functions and resources on which services depend are identified and documented.

The first step in service continuity planning is to identify and prioritize essential services so that a plan can be created that enables these services to be provided during an emergency.

The second step is to identify and document the functions and resources on which these services depend. Essential functions can include manual processes, automated processes, end-user activities, and service delivery activities themselves whether prescheduled or a result of on-the-fly service request management.

Identified and prioritized services, functions, and resources are effectively the requirements for service continuity and can be managed as such.

Refer to the Requirements Management process area for more information about managing requirements of products and product components and ensuring alignment between those requirements and the work plans and work products.

SP 1.1 Identify and Prioritize Essential Functions

Identify and prioritize the essential functions that must be performed to ensure service continuity.

To identify essential functions, an intimate understanding of all service system operations is required. Although many functions are important, not every activity performed is an essential function. Essential functions are those functions that must be sustained in an emergency or significant disruption of services.

The priorities of essential functions should reflect which services can be disrupted and for what period of time (i.e., long *versus* short disruption). Understanding which services are critical drives which essential functions are required to provide critical services.

Establishing correct priorities requires involvement of a wide range of stakeholders.

Refer to the Integrated Work Management process area for more information about coordinating and collaborating with relevant stakeholders.

Example Work Products

1. A business impact analysis

Subpractices

1. Identify and prioritize the essential services of the organization.
2. Identify the essential functions on which services rely.
3. Analyze the criticality of providing those functions and the impact to services if the essential functions cannot be performed.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

4. Prioritize the list of essential functions that must be provided despite a significant disruption.

SP 1.2 Identify and Prioritize Essential Resources

Identify and prioritize the essential resources required to ensure service continuity.

Essential resources are resources necessary to the continued functioning or reconstitution of services during and after an emergency. These resources are typically unique and hard to replace. Essential resources therefore include key staff as well as essential assets, data, and systems. Essential resources may need to be protected. Suitable substitutes may need to be provisioned in advance. In the case of data, backups and archives may need to be established.

Many organizations make the mistake of identifying systems, staff, and infrastructure inside the organization while overlooking resources outside the organization on which service continuity also depends. Resources that are commonly overlooked include consumables and vital records (e.g., documents describing legal, financial obligations).

Essential resources can be identified through analyses of the following:

- Delivery of services
- Functions essential to service continuity
- In-service agreements, supplier agreements, and standard service definitions
- Dependencies among service system components, relevant stakeholders, and the delivery environment

Common resource dependencies include information and data sources from both inside and outside the organization and the key staff who make

decisions regarding the service delivery or who are significant contributors to performing service delivery tasks.

Refer to the Integrated Work Management process area for more information about coordinating and collaborating with relevant stakeholders.

Essential resources generally fall into one of the following categories:

- Emergency operating resources (e.g., key staff, equipment, consumables) necessary to resume disrupted services
- Legal and financial resources (e.g., contractual documents) that are essential to protect the rights and interests of the organization and individuals directly affected by the emergency

Refer to the Plan Data Management specific practice in the Work Planning process area for more information about data management activities.

Example Work Products

1. Orders of succession
2. Delegations of authority
3. Directory of critical staff with contact information
4. Data and systems required to support identified essential service functions
5. Records of service agreements and contracts
6. Records of legal operating charters (e.g., articles of incorporation, authorization by local, state, national government agencies)
7. Staff benefit balances, payroll, and insurance records
8. List of internal and external resources required
9. List of dependencies and interdependencies of resources

Subpractices

1. Identify and document internal and external dependencies.
2. Identify and document key staff and their roles in relation to service delivery.
3. Identify and document organizational and relevant stakeholder responsibilities.
4. Identify and document resources required by essential functions to ensure continuity.
5. Prioritize resources based on an evaluation of impact from their loss or from lack of access.
6. Ensure that safety provisions are made for staff, both internal and external, within the delivery environment and for organizational supporting functions.
7. Ensure that records and databases are protected, accessible, and usable in an emergency.

SG 2 Prepare for Service Continuity***Preparations are made for service continuity.***

Preparing for service continuity involves creating a plan, delivering training to execute the plan, and putting resources into place such as back up sites or systems.

Not all services must be resumed immediately following a disruption. The service continuity plan identifies those services that must be resumed and the priority sequence for recovery of those services.

In addition, training to execute the service continuity plan should be developed and delivered to those who may have to implement the plan.

Refer to the Integrated Work Management process area for more information about integrating plans.

Refer to the Work Planning process area for more information about developing a work plan.

SP 2.1 Establish Service Continuity Plans***Establish and maintain service continuity plans that enable the organization to resume performing essential functions.***

A service continuity plan provides explicit guidance to the organization in the event of a significant disruption to normal operations. An organization can maintain multiple plans covering different types of disruptions or different types of services. Conversely, there may be need for only one service continuity plan.

Example Work Products

1. Formal statement of who has the authority to initiate and execute the service continuity plan
2. List of communication mechanisms needed to initiate the execution of the service continuity plan
3. List of threats and vulnerabilities that could impede the ability of the organization to deliver services
4. List of alternate resources and locations that support the organization's essential functions
5. Documentation of the recovery sequence
6. List of key staff roles and responsibilities
7. List of stakeholders and the methods used for communicating with them
8. Documented methods for handling security related material as appropriate

Subpractices

1. Identify and document threats and vulnerabilities to ongoing service delivery.

Information on threats and vulnerabilities is usually developed in other processes and activities and used as an input to the service continuity plan. In the service continuity plan, the events, threats, and vulnerabilities most likely to lead to enacting the plan are recorded. Different actions can be planned for categories of events. Risk information gathered about individual services can also be an input to this portion of the plan.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

2. Document the service continuity plan.
3. Review the service continuity plan with relevant stakeholders.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

4. Ensure that secure storage and access methods exist for the service continuity plan and critical information and functions needed to implement the plan.
5. Ensure that vital data and systems are adequately protected.

Addressing the protection of vital data and systems can include developing additional service system components.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

6. Document the acceptable service level agreed to by the customer for when a shift between the normal delivery environment and the recovery environment (e.g., site affected by disruption, alternate site) is necessary.

Document the acceptable service levels for various outage scenarios (e.g., site, city, country).
7. Plan for returning to normal working conditions.
8. Develop procedures for implementing the service continuity plan.
9. Revise the service continuity plan as necessary.

Examples of when the service continuity plan may need to be revised include the following:

- Major changes to the services are being delivered
- Essential functions or infrastructure change
- Key dependencies on resources, both internal and external, change
- Feedback from training warrants change
- Preparing for verification and validation of the service continuity plan identifies changes that are needed
- Results of verification and validation warrant change
- The delivery environment changes
- New significant threats or vulnerabilities have been identified

SP 2.2 Establish Service Continuity Training

Establish and maintain training for service continuity.

Training the staff who will be involved in executing the service continuity increases the probability of success in the event that the plan must be executed. It may be appropriate to include the customer and end user in service continuity training.

Examples of when customers and end users should be considered include the following:

- Situations in which the customer and end user are co-located with the service provider and could be affected by the same events causing the service provider to initiate its service continuity plan.
- Situations in which a change required by executing a service continuity plan can affect the customer's or end user's way of doing business.

Examples of the types of staff to be trained include the following:

- Staff who respond to service requests
- Staff who provide infrastructure support (e.g., information technology, utilities)
- End users
- Suppliers
- Selected work group and organization managers and staff

Examples of service continuity training methods include the following:

- Role playing
- Scenario based training
- Classroom instruction
- Group discussions

Example Work Products

1. Service continuity training material

Subpractices

1. Develop a strategy for conducting service continuity training.
2. Develop and document service continuity training for each category of threat and vulnerability to service delivery.
3. Review service continuity training material with relevant stakeholders.

SSD Addition

Refer to the Service System Development process area for more information about performing peer reviews.

4. Revise the training material as needed to reflect changes in the service continuity plan and feedback on training effectiveness.

SP 2.3 Provide and Evaluate Service Continuity Training***Provide and evaluate training in the execution of the service continuity plan.***

Training provides instruction to staff who might have to participate in executing the service continuity plan in the event of a significant disruption. In addition, training provides a mechanism for gathering feedback on whether the service continuity plan should be updated or clarified.

Refer to the Organizational Training process area for more information about providing training.

Example Work Products

1. Training records
2. Evaluations of training effectiveness by students and training specialists
3. Suggested improvements to the service continuity plan

Subpractices

1. Deliver training that covers the execution of the service continuity plan to appropriate staff.
2. Maintain records of those who successfully complete service continuity training.
3. Solicit feedback on how well service continuity training prepared those who will execute the service continuity plan.
4. Analyze training feedback and document suggested improvements to the service continuity plan and service continuity training.

SG 3 Verify and Validate the Service Continuity Plan***The service continuity plan is verified and validated.***

Verifying and validating the service continuity plan helps to ensure preparedness for various threats and vulnerabilities before a significant disruption occurs. This practice enables reviews, tests, and demonstrations to be conducted in a relatively benign environment.

Accomplishing verification and validation includes selecting appropriate methods, conducting verification and validation, and analyzing results.

Examples of verification methods include the following:

- Inspections
- Peer reviews
- Audits
- Walkthroughs
- Analyses
- Simulations
- Testing
- Demonstrations

Examples of validation methods include the following:

- Discussions with end users, perhaps in the context of a formal review
- Prototype demonstrations
- Functional demonstrations (e.g., testing a backup file system, exercising an alternative communication network to coordinate service delivery, switching to manual processes)
- Pilots of training materials
- Tests of the service system and its components by end users and other relevant stakeholders

SSD Addition

The Service System Development process area contains practices that focus on verifying and validating service system components and services. The guidance found there can be useful when implementing verification and validation of service continuity plans.

Refer to the Service System Development process area for more information about verifying selected service system components against their specified requirements.

SP 3.1 Prepare for the Verification and Validation of the Service Continuity Plan

Prepare for the verification and validation of the service continuity plan.

Verification and validation should be conducted on a periodic and event-driven basis. Typically, the verification and validation of the service continuity plan is performed periodically (e.g., annually). However, when major changes are made to the service system or to the delivery environment, the service continuity plan should be reviewed or tested to confirm the service continuity plan is still correct and current.

Example Work Products

1. Verification and validation plan for assuring service continuity
2. Evaluation methods used for verification and validation

3. Description of environments necessary to conduct verification and validation
4. Verification and validation procedures
5. Criteria for what constitutes successful verification and validation

Subpractices

1. Develop a plan for conducting service continuity verification and validation.

The strategy for conducting service continuity verification and validation documents the requirements for verification and validation and addresses the key principles, activities, resources, and environments required for effective verification and validation of the service continuity plan.

Verification and validation is not a one-time event. The strategy should address the frequency with which verification and validation should be performed.

The plan for conducting verification and validation of the service continuity plan typically includes the following:

- Strategy used for conducting verification and validation
- Categories of threats and vulnerabilities to be evaluated
- Essential functions and resources to be verified and validated for each category
- Methods to evaluate the adequacy of preparation
- Environments needed to support verification and validation
- Schedule of activities to conduct verification and validation
- Assigned resources

2. Review with relevant stakeholders the verification and validation plan, including evaluation methods and the environments and other resources that will be needed.

Relevant stakeholders should understand and agree to the verification and validation strategy, methods, activities, environments, and resources.

3. Determine the procedures and criteria for verification and validation of the service continuity plan.

Procedures and criteria are used to ensure the elements of the service continuity plan are correct, effective, and current relative to the categories of threats and vulnerabilities.

4. Identify changes to the service continuity plan from the preparation for verification and validation.

SP 3.2 Verify and Validate the Service Continuity Plan

Verify and validate the service continuity plan.

Verification and validation is conducted according to the defined plan, methods, and procedures to confirm that the service continuity plan is complete, reasonable, and effective.

Example Work Products

1. Roster of staff and relevant stakeholders involved in service continuity verification and validation
2. Results of service continuity plan verification and validation

Subpractices

1. Prepare the environment to conduct verification and validation.
2. Conduct verification and validation of the service continuity plan.
3. Record the results of verification and validation activities.

SP 3.3 Analyze Results of Verification and Validation of the Service Continuity Plan

Analyze the results of verifying and validating the service continuity plan.

Results of service continuity plan verification and validation are analyzed against defined verification and validation criteria. Analysis reports identify elements to improve in the service continuity plan and identify problems with verification and validation methods, environments, procedures, and criteria.

Example Work Products

1. Verification and validation analysis reports
2. Improvement recommendations for the service continuity plan
3. Verification and validation improvement recommendations

Subpractices

1. Compare actual to expected results of service continuity plan verification and validation.
2. Evaluate whether restoration to agreed service levels or some other planned state was achieved or not.
3. Document recommendations for improving the service continuity plan.
4. Document recommended improvements to the verification and validation of the service continuity plan.
5. Collect improvement proposals for services or service system components as appropriate based on the analyses of results.
6. Provide information on how defects can be resolved (including verification methods, criteria, and the verification environment) and initiate corrective action.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

SERVICE DELIVERY

A Service Establishment and Delivery Process Area at Maturity Level 2

Purpose

The purpose of Service Delivery (SD) is to deliver services in accordance with service agreements.

Introductory Notes

The Service Delivery process area focuses on the following:

- Establishing and maintaining service agreements
- Preparing and maintaining a service delivery approach
- Preparing for service delivery
- Delivering services
- Receiving and processing service requests
- Maintaining service systems

Service delivery covers establishing and maintaining a written agreement with customers. A “service agreement” describes the service to be delivered to the customer, service level targets, and responsibilities of the service provider, customer, and end user as appropriate.

A service agreement can cover multiple services or multiple customers. It can take the form of a service level agreement (SLA), performance work statement (PWS), statement of objectives (SOO), statement of work (SOW), or other type of agreement. The service agreement can be part of a contract, a memorandum of agreement, an approved requirements document, or some other document. For simple cases, it may be nothing more than a printed menu of services and prices.

The Service Delivery process area supports a positive relationship between the service provider and its customers and end users while meeting the needs of all three. Service delivery processes should encourage open communication without the assignment of blame. The primary focus is on satisfying the documented needs of end users.

A “customer” is a party (i.e., individual, group, organization) responsible for accepting the service or for authorizing payment. Customers identify their needs for services, buy services, and define and agree to service level targets. Customers can be internal or external to the service provider's organization, and may or may not be the same as end users, who are the ultimate beneficiaries of service delivery.

In addition to establishing service agreements, the Service Delivery process area includes practices for preparing for service delivery as well as for operating, monitoring, and maintaining the service system. Service delivery is accomplished through the operation of the service system in response to

service requests, which are communications from customers or end users that identify a need to deliver an agreed service. These requests are made within the context of an accepted service agreement.

The two types of service requests are as follows:

- Those service requests specified on a continuous or scheduled basis as determined by service agreements
- Those service requests identified over time by customers or end users as their needs develop on an ad-hoc basis

Examples of ad-hoc requests include the following:

- Requesting a custom-made query on a database as part of a systems management service
- Calling for a package pick up as part of a package delivery service
- Identifying a broken component of a maintained system as part of a maintenance service
- Requesting a health check as part of a health program

Whatever the nature of a specific service request, it should be recorded, tracked, and resolved through some type of request management system. This approach helps to ensure that all service requests are fulfilled to meet service agreements. The response to service requests also encompasses performing any needed low-level planning as a detailed extension of broader work planning activities.

Related Process Areas

SSD Addition

Refer to the Service System Development process area for more information about analyzing, designing, developing, integrating, verifying, and validating service systems, including service system components, to satisfy existing or anticipated service agreements.

Refer to the Service System Transition process area for more information about deploying new or significantly changed service system components while managing their effect on ongoing service delivery.

Refer to the Configuration Management process area for more information about establishing baselines and tracking and controlling changes.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

Specific Goal and Practice Summary

- SG 1 Establish Service Agreements
 - SP 1.1 Analyze Existing Agreements and Service Data
 - SP 1.2 Establish the Service Agreement
- SG 2 Prepare for Service Delivery
 - SP 2.1 Establish the Service Delivery Approach
 - SP 2.2 Prepare for Service System Operations
 - SP 2.3 Establish a Request Management System
- SG 3 Deliver Services
 - SP 3.1 Receive and Process Service Requests
 - SP 3.2 Operate the Service System
 - SP 3.3 Maintain the Service System

Specific Practices by Goal

SG 1 Establish Service Agreements

Service agreements are established and maintained.

The service agreement between a service provider and a customer is established and maintained. An ongoing collaborative approach to the activities described in this process area encourages a culture that supports service quality improvement in contrast to a culture that focuses on blame and disputing small details of agreements.

The service agreement should be established prior to the start of service delivery. Over time, the service agreement can be revised based on service delivery results (e.g., to reflect needed changes to services delivered, service level targets, the responsibilities of the service provider or customer).

To succeed in maintaining collaboration between the service provider and customer, it is important to define the responsibilities of both parties. It is also important to set realistic expectations for service levels, which requires defining measurable, achievable service levels.

When standard service definitions and baseline service delivery data are available at the organizational level, the service provider should use that information as a basis for establishing and tailoring agreements.

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Strategic Service Management process area for more information about establishing and maintaining standard services in concert with strategic needs and plans.

Refer to the Work Monitoring and Control process area for more information about monitoring commitments.

SP 1.1 Analyze Existing Agreements and Service Data***Analyze existing service agreements and service data to prepare for expected new agreements.***

This practice considers the complete context in which requirements are being established. Customer goals, supplier constraints, service provider concerns, and existing service delivery data and definitions (e.g., performance data, service levels, baselines, resource use, monitoring capabilities, service catalogs, standard services) are included in this analysis.

The analysis of existing agreements and service data is an activity that is repeatedly executed during the service agreement's life. The service agreement is not a static artifact. It is dynamic and must be adjustable because the ongoing analysis of service data and agreements can identify changes over time.

Example Work Products

1. Customer descriptions of plans, goals, and service needs
2. Results of customer and end-user satisfaction surveys and questionnaires
3. Results of assessments of provider capability to meet customer needs

Subpractices

1. Review available customer and end-user need data.

It is important to obtain an understanding of the customer and end-user perceptions of service prior to establishing the service agreement. These perceptions can include customer objectives that are not directly expressed as service requirements.

Examples of sources of customer and end-user need data include the following:

- Face-to-face or telephone interviews
- Customer supplied plans and goals outlining their expected use of services
- Statements of work and related solicitation materials
- Customer and end-user survey results

Refer to the Strategic Service Management process area for more information about gathering and analyzing data.

2. Review concerns of service delivery and support staff.

Prior to establishing the service agreement, it is important to obtain an understanding of the perspectives of the service delivery and support staff who work with customers and end users. These staffs are ultimately responsible for ensuring that service delivery meets requirements. They also have unique operational insight into the potential impacts of new agreements. This information can be collected through face-to-face or telephone interviews, or through other methods of soliciting staff feedback (e.g., staff meetings, email, surveys).

3. Review existing service agreements and supplier agreements.

Reviewing existing agreements includes the following:

- Considering the impact of the customer's supplier agreements on the achievement of the requested service
- Reviewing the requested service requirements against standard service definitions if they exist
- Reviewing existing service level agreements and supplier agreements (e.g., operational level agreements, underpinning contracts) for their ability to meet identified service requirements

4. Review available current service data and service system designs.

Existing service data (e.g., performance data, service levels, baselines, incident histories, data from capacity and availability management) and capabilities (e.g., monitoring capabilities) are reviewed. Available industry benchmarks or other published data can be used, especially in the case of service requirements not previously addressed by the provider.

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

5. Analyze the capability to supply requested services.

Consider the overall approach to how the requested service delivery will be accomplished.

Approaches to service delivery include the following make-buy-reuse approaches:

- Using the resources of an existing service system
- Modifying or creating a service system to meet new requirements
- Outsourcing some services or service system components to external suppliers

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

Refer to the Supplier Agreement Management process area for more information about managing the acquisition of products and services from suppliers.

SP 1.2 Establish the Service Agreement***Establish and maintain the service agreement.***

Depending on the service type, market, and the nature of the service provider's business model, the initial form of a service agreement can be determined by either the customer or the service provider. The content in the agreement can be established by one party or the other, or is jointly negotiated.

The service agreement should cover all terms, conditions, and commitments that are necessary for ongoing successful service delivery, including commitments for which customers and end users are responsible when appropriate.

Examples of items in a service agreement include the following:

- Service types, levels, and measures
- Service availability
- Service acceptance and quality criteria
- Acceptable impact on customer and end-user activities
- Risk and contingency identification
- Intellectual property considerations
- Customer and end-user roles and responsibilities
- Customer supplied resources
- Expected cost, payment, and funding schedules
- Security and safety considerations

Refer to the Strategic Service Management process area for more information about establishing properties of standard services and service levels.

Example Work Products

1. Service agreement

Subpractices

1. Define the structure and format of the service agreement.

It is important to define a structure for the service agreement that will meet the needs of the customer and service provider. The structure of the service agreement complements or reflects the critical attributes, categories, and structure or hierarchy of standard service definitions if they exist.

Examples of structures to consider include the following:

- Service based: The service agreement is organized around a service (e.g., providing corporate email) and can cover several different customers.
- Customer based: The service agreement is organized around a customer and can cover several services for that customer.

In some service contexts (e.g., government contracting), customers provide considerable detail on their expectations for the structure and format of a service

agreement. In those situations, this subpractice amounts to developing an understanding of the customer's expectations and the range of allowable tailoring of the agreement's structure and format.

2. Define, negotiate, and obtain agreement on a draft service agreement.
3. Publish the service agreement and make it available to service providers, customers, and end users as appropriate.
4. Review and revise the service agreement on a periodic and event-driven basis as appropriate.

SG 2 Prepare for Service Delivery

Preparation for service delivery is conducted.

Preparing for service delivery involves developing a detailed approach for receiving and processing service requests and for delivering services specified in the service agreements. The approach includes identifying and integrating the required service delivery activities, ensuring that service systems are ready for service delivery in the appropriate service delivery environments, and ensuring that requisite consumables are on hand.

SP 2.1 Establish the Service Delivery Approach

Establish and maintain the approach to be used for service delivery and service system operations.

The service delivery approach identifies and describes resources, processes, and interfaces that are essential to successful service delivery over time.

A service delivery approach addresses how the following activities should be carried out:

- Delivering services in accordance with an established schedule
- Preparing and updating the schedule for daily operations
- Making and transferring assignments for performing service delivery operations
- Communicating appropriate information to operations staff, management, customers, and end users
- Using methods and tools for performing service delivery operations
- Assigning and transferring responsibility for resolving requests
- Assigning and transferring responsibility for monitoring the status of requests and for tracking the progress of actions related to requests
- Enabling customers and end users to submit requests
- Categorizing requests
- Using methods and tools for request management
- Collecting, distributing, and analyzing performance data

A mature work group or organization treats these items as components of a defined service system and develops them during a rigorous set of service system development practices.

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

SSD Addition

Refer to the Service System Development process area for more information about analyzing, designing, developing, integrating, verifying, and validating service systems, including service system components, to satisfy existing or anticipated service agreements.

Refer to the Work Planning process area for more information about developing a work plan.

Example Work Products

1. Service delivery approach (i.e., approach to request management, service system operations)
2. Contact and roster lists
3. Service request criteria
4. Internal status reporting templates (e.g., dashboards)
5. External status reporting templates (e.g., service request completion notices)

Subpractices

1. Define criteria for determining service requests.

To be able to identify valid service requests, criteria should be defined that enable service providers to determine what is and what is not a service request. In addition, there are typically criteria for differentiating the priority of a service request and its associated impact.

2. Define categories for service requests and criteria for categorizing service requests.

The fulfillment of service requests is facilitated by having an established set of categories. These predetermined categories can enable appropriate and efficient assignment of resources.

Examples of service request categories include the following:

- Administrative service request (e.g., set up new user, change passwords, restore backup files)
- Software request (e.g., install a software package, upgrade a software package)
- Lab request (e.g., radiology analysis, blood analysis)
- Oversized package delivery
- Billing inquiry

3. Describe how responsibility for processing service requests is assigned and transferred.

The description can include the following:

- Who is responsible for addressing the request
- Who is responsible for monitoring and tracking the status of the request
- Who is responsible for tracking the progress of actions related to the request
- How responsibility for all of these activities is assigned and transferred

4. Identify one or more mechanisms that customers and end users can use to submit service requests.

These mechanisms should account for how groups and individuals can submit requests, such as through telephone support, paper forms (mailed or delivered in person), and electronic forms submitted through web pages.

5. Identify requirements on the amount of time defined for the fulfillment of service requests in the service agreement.

Often, the agreed minimum and maximum amount of time needed for fulfillment of service requests is documented in the service agreement before the start of service delivery.

6. Determine the resource requirements for service delivery as required.

Resource requirements are generated by service agreements, by the need to respond to foreseeable service incidents and requests, and by the need to maintain service systems so that service delivery can continue over time. These resources can include staff, consumables, and any other resources that should be controlled to ensure that service is delivered in accordance with service agreements.

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

7. Review, refine, or enhance stakeholder communication mechanisms (e.g., notices, status reports, dashboards) as necessary.

Methods and tools for communicating with customers, end users, service provider staff, and other relevant stakeholders during the course of service delivery are components of a complete service system. These methods and tools (e.g., contact lists) can be created during service system development, but they should be reviewed regularly, tailored, and possibly supplemented to meet ongoing service delivery needs.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

8. Document the service delivery approach.
9. Review and get agreement with relevant stakeholders on the approach for delivering each separately identifiable service.

Information presented to relevant stakeholders about the approach should be in terms that they can understand. The review should allow them to identify concerns about the approach.

10. Revise the approach for delivering services as necessary.

SP 2.2 Prepare for Service System Operations

Confirm the readiness of the service system to enable the delivery of services.

Ensure that the appropriate service system components (e.g., tools, consumables, people, processes, procedures) are ready for service system operations. Service systems can require that consumables be acquired to enable consistent service delivery. Confirming the ongoing readiness for service delivery is not a one-time practice. These activities should be performed repeatedly as needed by the overall service delivery approach, even when the service system is not changing.

Refer to the Service System Transition process area for more information about deploying new or significantly changed service system components while managing their effect on ongoing service delivery.

Example Work Products

1. Monitoring tool thresholds validation report
2. Operating procedures validation report
3. Consumables (e.g., paper media, magnetic media) validation report
4. Logs of consumable acquisition and use
5. Service delivery logs and receipts
6. Results from demonstrated service system operation

Subpractices

1. Confirm that the appropriate service system's components and tools are operational.

Examples of service system tools include the following:

- Monitoring tools
- System management tools
- Tracking systems
- Presentation tools
- Log files
- Analysis tools
- Online knowledge management tools
- Virus scanning tools
- Database management tools

2. Evaluate the results of confirming service system component readiness and determine what corrective action is needed.

Depending on the situation, any deficiencies or issues that are uncovered should be treated as service incidents.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

3. Review the service level requirements in the service agreements and ensure that proper thresholds are set in service system monitoring tools.
4. Develop, review, or refine service delivery procedures.

Detailed processes, standard operating procedures, or work instructions can be created during service system development but they should be reviewed regularly, tailored, and possibly supplemented to meet ongoing service delivery needs.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

5. Ensure that necessary resources are available for performing service delivery activities and tasks.

Service delivery activities and tasks can include the following: operating, monitoring, and repairing service system components; supporting users of the service system; and acquiring and replacing service system components.

6. Prepare and update detailed job execution and monitoring schedules for delivering services as requested.
7. Provide orientation to incoming service delivery and support staff on current service delivery operations during staff member changes.

Whenever there is a change of staff involved in service delivery (e.g., a staff rotation at a shift change), incoming staff are oriented on the current state of operations to ensure that ongoing service delivery is not interrupted.

8. Ensure that any necessary consumables are available for service delivery.

Procedures are documented for replenishing consumables and replacing or upgrading infrastructure components. As necessary, acquire and inspect service system consumables according to documented procedures.

SP 2.3 Establish a Request Management System

Establish and maintain a request management system for processing and tracking request information.

A request management system includes the storage media, procedures, and tools for accessing the request management system. These storage media, procedures, and tools can be automated but are not required to be. For example, storage media might be a filing system where documents are stored. Procedures can be documented on paper, and tools can be hand tools or instruments for performing work without automated help.

Service requests are often submitted through a service desk or help desk function.

Example Work Products

1. A request management system with controlled work products
2. Access control procedures for the request management system

Subpractices

1. Ensure that the request management system allows the reassignment and transfer of requests among groups.

Requests may need to be transferred between different groups because the group that entered the request may not be best suited for taking action to address it.

2. Ensure that the request management system allows the storage, update, and retrieval of request management information.

Examples of request management systems include the following:

- Help desk
- Ticket tracking
- Service log books
- Task status boards

3. Ensure that the request management system enables data reporting that is useful to the fulfillment of requests.
4. Maintain the integrity of the request management system and its contents.

Examples of maintaining the integrity of the request management system include the following:

- Backing up and restoring request records
- Archiving request records
- Maintaining security that prevents unauthorized access

5. Maintain the request management system as necessary.

SG 3 Deliver Services***Services are delivered in accordance with service agreements.***

Services are delivered continuously and in response to service requests in accordance with service agreements. This delivery is accomplished through operation of the service system, which is kept in operation or returned to operation as needed in spite of the occurrence of service incidents. The service system is also subject to varying needs for maintenance.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

SP 3.1 Receive and Process Service Requests***Receive and process service requests in accordance with service agreements.***

Service requests can be submitted through various mechanisms (e.g., web forms, phone calls). Some requests may also be identified in service agreements, especially requests for continuous or repeatedly scheduled services. The receipt and processing of all service requests should be coordinated through an established request management system.

Example Work Products

1. Request management record
2. Action proposal
3. Customer satisfaction data
4. End user receipts confirming request fulfillment

Subpractices

1. Receive service requests and ensure each request is within the scope of the service agreement.

Examples of receiving service requests include the following:

- Service requests submitted by the customer or end user by use of a web form
- Service requests submitted by the customer or end user by calling the help desk or service desk

In organizations that use a help desk function, service requests are usually submitted to such a function.

2. Record information about the service request.

When recording service request information, include sufficient information to properly support the analysis and resolution of the service request.

Examples of service request information to record include the following:

- Name and contact information of the person who submitted the service request
- Description of the service request
- Categories the service request belongs to
- Date and time the service request was submitted
- The configuration items involved in the request
- Closure code and information

3. Categorize and analyze the service request.

Using the categories established in the approach to service delivery, assign the relevant categories to the service request in the request management system. For some service requests, the request analysis can be completed by merely selecting the type of service request. For other service requests (e.g., upgrade operating system software) it may be necessary to assemble a special team to analyze the request.

Examples of when to perform request analysis include the following:

- When the impact of the request on the organization or customer is large
- When resolving a service request will take considerable time or effort

4. Determine which resources are required to resolve the service request.

Which individuals, groups, and other resources are best suited can depend on the type of service request, locations involved, and impact on the organization or customer.

5. Determine the actions to be taken to satisfy the service request.

Using the categories established in the approach to service delivery, determine the appropriate actions to perform. In some cases, the categories themselves can have pre-determined actions associated with them.

Examples of actions include the following:

- Answering a customer inquiry
- Repairing items (as part of a maintenance service)
- Training an end user
- Providing new consumables or tools

6. Plan the actions further as appropriate.

Perform additional scheduling and other planning required to guide the actions that have been selected. When analyzing standard service requests, the actions for resolving a standard service request can be documented in a standard action plan. If the actions taken result in changes to the service system, further actions may also be needed to ensure traceability to requirements.

7. Monitor the status of service requests as appropriate until they are fulfilled as described in the service agreement.

Throughout the life of the service request, the status of the request should be recorded, tracked, transferred as necessary, and closed.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

8. Review service request status and resolution, and confirm results with relevant stakeholders.

Communication is a critical factor when providing services. Communication with the person who requested the service and possibly other relevant stakeholders affected by it should be considered throughout the life of the service request in the request management system. Usually, the result of relevant actions taken should be reviewed with the person that submitted the service request to verify that the actions fulfilled the service request to the satisfaction of the submitter.

In organizations that use a help desk function, the status of service requests is communicated to relevant stakeholders by the help desk.

9. Close the service request and record the actions taken and results.

The actions performed to fulfill the service request and the result of performing the actions are recorded in the request management system to support satisfying similar service requests in future situations.

SP 3.2 Operate the Service System***Operate the service system to deliver services in accordance with service agreements.***

This practice encompasses performing the activities necessary to operate the service system to deliver services based on the agreed service delivery approach. Operation means the integrated performance of a service system and use of its processes and other resources by service provider staff to deliver services to end users.

Example Work Products

1. List of services delivered
2. Service logs
3. Performance reports and dashboards
4. Log of corrective actions
5. Customer satisfaction data
6. Request management database record

Subpractices

1. Operate service system components according to service system procedures.

Operating service system components can include starting or stopping them, providing input to them, controlling them, or handling output from them as appropriate.

2. Perform operations support activities (e.g., revise thresholds).

Among the support activities service providers perform during operation, service providers can provide customer and end user training or orientation as needed.

3. Manage the critical dependencies and paths of the service delivery schedules according to operating procedures.

Management of some service delivery activities can be adequately covered by work management and measurement and analysis activities, especially for service requests identified directly in service agreements.

4. Manage and control the security of service delivery.

Security can include monitoring for security breaches, ensuring that vulnerabilities are corrected, and controlling access to services.

When delivering services, the service systems should ensure that only approved services as specified in the service agreement are delivered to authorized staff.

5. Manage and control other operationally oriented quality attributes associated with service delivery.

In addition to security, other operationally oriented service system quality attributes should be managed. Example quality attributes include capacity, availability, responsiveness, usability, reliability, and safety. The management of some of these other operationally oriented service system quality attributes is addressed in other process areas.

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

6. Perform low-level monitoring of service system components using monitoring and data collection tools as appropriate.

Some monitoring of service system operation can be adequately covered by work group level monitoring and control or measurement and analysis. However, some services can require monitoring and data collection at the level of individual service requests or continuously within the scope of a single service request. Such low-level monitoring can require its own tools to handle data collection, analysis, and reporting appropriately. These tools are often automated.

7. As appropriate, perform the activities needed to fulfill service requests or resolve service incidents according to the service agreement.

Throughout the life of a service request or service incident, its status should be recorded, tracked, escalated as necessary, and closed. The appropriate resolution of an incident can be a simple operational procedure (e.g., restarting a failed service system component) or it can involve some degree of service system maintenance.

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

8. Communicate the status of service requests until closed.
9. Collect customer satisfaction information immediately after services are delivered or service requests are fulfilled.

SP 3.3 Maintain the Service System

Maintain the service system to ensure the continuation of service delivery.

Operational service systems should be maintained to ensure a continuing capability to deliver services in accordance with service agreements over time. This practice can encompass a variety of types of maintenance, including the following:

- Corrective maintenance (i.e., correcting and repairing components that degrade the operational capability of the service system)
- Preventive maintenance (i.e., preventing service incidents and defects from occurring through pre-planned activities)
- Adaptive maintenance (i.e., adapting the service system to a changing or different service delivery environment)
- Perfective maintenance (i.e., developing or acquiring additional or improved operational capability of the service system)

Corrective maintenance can be performed to address service incidents or to resolve their underlying causes.

Depending on the type and scope of actual instances of service system maintenance, other process areas can contribute practices that are relevant to accomplishing this effort, especially for any maintenance that has the following characteristics:

- Represents a change to the requirements or design of the service system (e.g., perfective maintenance)
- Entails significant risks to implement changes required by maintenance activities

Maintenance can be performed on any portion of a service system, including consumables, processes, and people. The maintenance of people as service system components is often accomplished through training, although other methods can be appropriate as well (e.g., transferring staff members to roles that better match their skills).

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Service System Transition process area for more information about preparing for service system transition.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

Example Work Products

1. Corrective or preventive maintenance change requests
2. Maintenance notifications
3. Preventive maintenance schedules

Subpractices

1. Review maintenance requests and prioritize requests based on criteria identified when establishing the service delivery approach.

SSD Addition

Significant maintenance activities—ones that result in changes to the requirements or design of the service system—benefit from Service System Development practices as well.

2. Analyze impacts on service systems and services delivery.
3. Develop a plan to implement maintenance.

Non-routine maintenance requests should be scheduled into agreed maintenance slots to ensure that the availability of services is not adversely affected.

4. Release maintenance notifications to relevant stakeholders.
5. Update service system documentation as appropriate.
6. Implement and test corrective or preventive maintenance according to the plan and operating procedures.

Testing should be performed outside the service delivery environment when appropriate. Significant maintenance changes to a service system should apply Service System Transition practices as well.

7. Submit maintenance documentation and configuration changes to a configuration management repository.

SSD Addition**SERVICE SYSTEM DEVELOPMENT**

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of Service System Development (SSD) is to analyze, design, develop, integrate, verify, and validate service systems, including service system components, to satisfy existing or anticipated service agreements.

Introductory Notes

The Service System Development process area is applicable to all aspects of a service system. It applies to new service systems as well as changes to existing service systems.

A “service system” is an integrated and interdependent combination of service system components that satisfies stakeholder requirements.

A “service system component” is a process, work product, person, consumable, or customer or other resource required for a service system to deliver value. Service system components can include components owned by the customer or a third party.

A “service system consumable” is anything usable by the service provider that ceases to be available or becomes permanently changed by its use during the delivery of a service.

The people who are considered service system components are those who perform tasks as part of the service system, including provider staff and end users, to enable the system to operate and thereby deliver services. (See the definitions of “service system,” “service system component,” “service system consumable,” and “work product” in the glossary.)

Organizations that wish to improve and appraise their product development processes should rely on the complete CMMI-DEV model, which specifically focuses on development as an area of interest.

Service provider organizations can also choose to use the CMMI-DEV model as the basis for improving and appraising their service system development processes. This use of the CMMI-DEV model is preferred for organizations that are already experienced with CMMI-DEV and for organizations that develop large-scale, complex service systems.

SSD Addition

However, the Service System Development process area offers an alternative means of achieving somewhat similar ends by covering requirements development as well as service system development, integration, verification, and validation in a single process area. Using SSD may be preferred by service provider organizations that are new to CMMI, especially those service providers that are developing simple services with relatively few components and interfaces. Even organizations that use the CMMI-DEV model for service system development may wish to refer to the Service System Development process area for helpful guidance on applying development practices to service system components such as people, processes, and consumables.

It is especially important to remember that the components of some service systems can be limited to people and the processes they perform. In those contexts and similar ones in which service systems are fairly simple, exercise care when interpreting the specific practices of this process area so that the implementations that result provide business value to the service provider organization.

The service system development process is driven by service and service system requirements that are collected from various sources such as service agreements and defects and problems identified during both service delivery and incident resolution and prevention processes.

The Service System Development process area focuses on the following activities:

- Collecting, coordinating, analyzing, validating, and allocating stakeholder requirements for service systems
- Evaluating and selecting from alternative service system solutions
- Designing and building or composing (as needed), integrating, and documenting service systems that meet requirements
- Verifying and validating service systems to confirm they satisfy their intended requirements and they will satisfy customer and end-user expectations during actual service delivery

CMMI does not endorse particular methods for service system development. How the service organization chooses to develop the service system can range from internal development to outsourcing to commercial product integration. Most service organizations in their efforts to build their service system will engage a development team and a particular development approach. The choice of development method(s) depends on the requirements to be achieved and what service system components will need to be developed. Agile methods constitute one possible family of approaches, but may not be appropriate for all (or any) components. (The phrase “Agile method” is shorthand for any development or management method that adheres to the *Manifesto for Agile Development* [Beck 2001] and that typically

SSD Addition

addresses software development.) For organizations that choose to use Agile, the following paragraphs can be helpful in implementing the practices of SSD.

In Agile environments, the requirements, design, development, and validation process is performed incrementally and through continuing engagement with relevant stakeholders, particularly customers and end users. Customer needs and ideas are iteratively elicited, elaborated, analyzed, and validated. Requirements are documented in forms such as user stories, scenarios, use cases, product backlogs, and iteration results. These requirements are prioritized into cycles of development from which design models, operational concepts, and diagrams are evolved to produce service system components. Agile methods give emphasis to a strong working relationship between the development staff, the service provision staff, and the customer (or end user). This iterative and cooperative development approach is used to select and refine the service system solution to provide high degrees of quality and efficiency during service delivery.

Short daily meetings or communications are held to obtain near real-time validation of the technical selections and decisions. End of cycle reviews are also conducted to validate current development and review requirements prioritization for the subsequent cycle of development. Due to the emphasis on early exploration and validation of needs and expectations, stakeholder commitment and availability is essential. Also, it is important that all parties understand their role and are willing to share in addressing the risks that arise from such collaborative work.

Further, when deciding to use an Agile method, consider the implications for other process areas. In particular, the effects on service system transition and delivery may need to be understood upfront; and discussions held on how best to mitigate any impacts.

For more information on how to apply Agile methods, see CMMI-DEV Section 5.0 Interpreting CMMI When Using Agile Approaches.

For standard services, the development processes described in this process area can also be applied at the organizational level to identify, develop, and maintain core assets (e.g., components, tools, architectures, operating procedures, service system representations, software) used in developing or customizing service systems for delivery of standard services (or tailored services).

Refer to the Strategic Service Management process area for more information about establishing strategic needs and plans for standard services.

SSD Addition

Related Process Areas

Refer to the Service Delivery process area for more information about maintaining the service system.

Refer to the Service System Transition process area for more information about deploying the service system.

Refer to the Strategic Service Management process area for more information about establishing standard services.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Refer to the Organizational Performance Management process area for more information about selecting improvements and deploying improvements.

Refer to the Requirements Management process area for more information about managing requirements of products and product components and ensuring alignment between those requirements and the work plans and work products.

Specific Goal and Practice Summary

SG 1 Develop and Analyze Stakeholder Requirements

- SP 1.1 Develop Stakeholder Requirements
- SP 1.2 Develop Service System Requirements
- SP 1.3 Analyze and Validate Requirements

SG 2 Develop Service Systems

- SP 2.1 Select Service System Solutions
- SP 2.2 Develop the Design
- SP 2.3 Ensure Interface Compatibility
- SP 2.4 Implement the Service System Design
- SP 2.5 Integrate Service System Components

SG 3 Verify and Validate Service Systems

- SP 3.1 Prepare for Verification and Validation
- SP 3.2 Perform Peer Reviews
- SP 3.3 Verify Selected Service System Components
- SP 3.4 Validate the Service System

Specific Practices by Goal

SG 1 Develop and Analyze Stakeholder Requirements

Stakeholder needs, expectations, constraints, and interfaces are collected, analyzed, and transformed into validated service system requirements.

SSD Addition

This goal covers the transformation of collected stakeholder needs, expectations, and constraints into requirements that can be used to develop a service system that enables service delivery.

Needs are collected from sources that can include service agreements; standard defined services; organizational policies; and communication with end users, customers, and other relevant stakeholders. These service needs can define stakeholder expectations of what is to be delivered, specify particular levels or grades of service, or identify constraints on how, when, how often, or to whom services are to be delivered. In particular, the quality attribute related needs, expectations, and constraints of relevant stakeholders should be determined. Quality attributes are properties of the service and service system (e.g., responsiveness, availability, security) that are critical to customer satisfaction and to meeting the needs of relevant stakeholders. (See the definition of “quality attributes” in the glossary.)

These needs, expectations, and constraints in turn may need to be analyzed and elaborated to identify needed details of delivered services not considered by the original sources. The result is a set of stakeholder requirements specified in the language of service system developers, not in the language of those who submitted the requirements.

For example, a customer might establish a requirement to “maintain the equipment listed in Table 25 in working order” with additional details of availability rates, average repair times, and other service levels. However, this requirement may also imply a need for a variety of specialized sub-services, such as diagnostics, field support, and preventive maintenance, each with their own implied sub-service requirements. These refinements may not be of interest or even visible to the original stakeholders but their full specification is needed to identify everything that a service system must do to meet the service delivery requirements.

As service requirements are analyzed and elaborated, they eventually yield derived service system requirements, which define and constrain what the service system must accomplish to ensure the required service is delivered. For example, if the service has a response time requirement, the service system must have derived requirements that enable it to support that response time.

The process of developing and analyzing requirements can involve multiple iterations that include all relevant stakeholders in communicating requirements and their ramifications so that everyone agrees on a consistent defined set of requirements for the service system. Changes can be driven by changes to stakeholder expectations, or by new needs discovered during subsequent service system development activities, service system transition, or service

SSD Addition

delivery. Since needs often change throughout the service lifecycle, the development and analysis of requirements should rarely be considered a one-time process.

As with all requirements, appropriate steps are taken to ensure that the approved set of service and service system requirements is effectively managed to support development of the service and service system.

Refer to the Requirements Management process area for more information about managing requirements changes.

SP 1.1 Develop Stakeholder Requirements

Collect and transform stakeholder needs, expectations, constraints, and interfaces into prioritized stakeholder requirements.

The needs of relevant stakeholders (e.g., customers, end users, suppliers, builders, testers, manufacturers, logistics support staff, service delivery staff, the organization) are the basis for determining stakeholder requirements. Stakeholder needs, expectations, constraints, interfaces, operational concepts, and service concepts are analyzed, harmonized, refined, prioritized, and elaborated for translation into a set of stakeholder requirements.

Requirements collected from customers and end users of the service to be delivered are documented in the service agreement. These requirements are also used to derive requirements for the service system. These derived requirements are combined with other requirements collected for the service system to result in the complete set of stakeholder requirements.

Refer to the Service Delivery process area for more information about analyzing existing agreements and service data.

These stakeholder requirements should be stated in language that relevant stakeholders can understand, yet precise enough for the needs of those who develop the service or service system.

Examples of stakeholder requirements include the following:

- Operations requirements
- Customer delivery requirements
- Monitoring requirements
- Instrumentation requirements
- Documentation requirements
- Operating level agreement requirements
- Organizational standards for product lines and standard services
- Requirements from agreements with other relevant stakeholders

SSD Addition

Example Work Products

1. Customer requirements
2. End-user requirements
3. Customer and end-user constraints on the conduct of verification and validation
4. Staffing level constraints

Subpractices

1. Engage relevant stakeholders using methods for eliciting needs, expectations, constraints, and external interfaces.

Eliciting goes beyond collecting requirements by proactively identifying additional requirements not explicitly provided by customers through methods such as surveys, analyses of customer satisfaction data, prototypes, simulations, or quality attribute elicitation workshops.

2. Transform stakeholder needs, expectations, constraints, and interfaces into prioritized stakeholder requirements.

The various inputs from relevant stakeholders should be consolidated and prioritized, missing information should be obtained, and conflicts should be resolved in documenting the recognized set of stakeholder requirements.

3. Define constraints for verification and validation.

SP 1.2 Develop Service System Requirements

Refine and elaborate stakeholder requirements to develop service system requirements.

Stakeholder requirements are analyzed in conjunction with the development of the operational concept to derive more detailed and precise sets of requirements called “derived requirements.” These requirements address all aspects of the service system associated with service delivery, including work products, services, processes, consumables, and customer and other resources; as well as the functionality and quality attribute needs of relevant stakeholders.

Derived requirements arise from constraints, consideration of issues implied but not explicitly stated in the stakeholder requirements baseline, and factors introduced by the selected service system architecture, the design, the developer’s unique business considerations, and strategic priorities, including industry market trends. The extent and depth of derived requirements vary with the complexity of the service system needed to meet stakeholder requirements.

Refer to the Strategic Service Management process area for more information about establishing standard services.

SSD Addition

In some service contexts, derived requirements can be as simple as identification and quantification of required resources. For complex service systems with many types of components and interfaces, the initial requirements are iteratively refined into lower level sets of more detailed requirements that can be allocated to service system components as the preferred solution is refined.

Through such analysis, refinement, derivation, and allocation activities, the functionality and quality attribute requirements for the service system are established.

Example Work Products

1. Derived requirements with relationships and priorities
2. Service requirements
3. Service system requirements
4. Requirement allocations
5. Architectural requirements, which specify or constrain the relationships among service system components
6. Interface requirements
7. Skill level requirements

Subpractices

1. Develop requirements and express them in the terms necessary for service and service system design.

In particular, these requirements include architectural requirements that specify critical quality attributes.

2. Derive requirements that result from solution selections and design decisions.
3. Establish and maintain relationships among requirements for consideration during change management and requirements allocation.

Relationships include dependencies in which a change in one requirement can affect other requirements.

Relationships among requirements can aid in design and in evaluating the impact of changes.

4. Prioritize derived requirements.

Prioritization of requirements can assist in defining iterative development cycles.

5. Allocate the requirements to logical entities, service system components, and other entities as appropriate.

As the operational concept evolves, requirements are allocated to logical entities (e.g., functions, processes) that aid in relating the requirements to the operational

SSD Addition

concept. These logical entities also serve to organize the requirements and assist in synthesis of the technical solution. As the technical solution is selected or emerges, requirements are allocated to service system components (or the architecture, in the case of many nonfunctional requirements) as appropriate.

In the case of an iterative or incremental approach to developing the service system, requirements are also allocated to iterations or increments.

6. Identify interfaces both external and internal to the service system.
7. Develop requirements for the identified interfaces.

SP 1.3 Analyze and Validate Requirements

Analyze and validate requirements, and define required service system functionality and quality attributes.

Requirements analyses are performed to determine the impact the intended service delivery environment will have on the ability to satisfy the stakeholders' needs, expectations, constraints, and interfaces. Depending on the service delivery context, factors such as feasibility, mission needs, cost constraints, end-user heterogeneity, potential market size, and procurement strategy should be taken into account. A definition of required functionality and quality attributes is also established. The objectives of the analyses are to determine candidate requirements for service system concepts that will satisfy stakeholder needs, expectations, and constraints and then to translate these concepts into comprehensive service system requirements. In parallel with this activity, the parameters used to evaluate the effectiveness of service delivery are determined based on customer and end-user input and the preliminary service delivery concept.

Requirements are validated by working with relevant stakeholders to increase the probability that the resulting service system will deliver services as intended in the expected delivery environment.

Example Work Products

1. Operational concepts and scenarios, use cases; and activity diagrams, user stories
2. Service system and service system component installation; training, operational, maintenance, support, and disposal concepts
3. Definition of required functionality and quality attributes
4. Architecturally significant quality attribute requirements
5. New requirements
6. Requirements defects reports and proposed changes to resolve
7. Assessment of risks related to requirements
8. Record of analysis methods and results

SSD Addition

Subpractices

1. Develop operational concepts and scenarios that include operations, installation, development, maintenance, support, and disposal as appropriate.

Identify and develop scenarios that are consistent with the level of detail in the stakeholder needs, expectations, and constraints in which the proposed service system is expected to operate.

2. Develop a detailed operational concept that defines the interaction of the service system, end users, and the environment, and that satisfies operational, maintenance, support, and disposal needs.

Operational concept and scenarios are iteratively refined to include more detail as solution decisions are made and as lower level requirements are developed (e.g., to further describe interactions among the service system, end users, and the environment). Reviews of operational concepts and scenarios are held periodically to ensure that they address the functionality and quality attribute needs of relevant stakeholders, different lifecycle phases, and modes of service system usage. Reviews can be in the form of a walkthrough.

3. Establish and maintain a definition of required functionality and quality attributes.

This definition of required functionality and quality attributes describes what the product is to do. (See the definition of “definition of required functionality and quality attributes” in the glossary.) This definition can include descriptions, decompositions, and partitioning of the functions of the product.

In addition, the definition specifies design considerations or constraints on how the required functionality will be realized in the service system. Quality attributes address such things as service system availability; maintainability; modifiability; timeliness, throughput, and responsiveness; reliability; security; and scalability. Some quality attributes will emerge as architecturally significant and thus drive subsequent service system high-level design activities. A clear understanding of the quality attributes and their importance based on mission or business needs is an essential input to the design process.

4. Analyze requirements to ensure that they are necessary, sufficient, and balance stakeholder needs and constraints.

As requirements are defined, their relationship to higher level requirements and the higher level defined functionality should be understood. Key requirements that will be used to track progress are determined. A cost benefit analysis can be performed to assess the impact of architecturally significant quality attribute requirements on service and service system cost, schedule, performance, and risk. Higher level requirements that are found to result in unacceptable costs or risks may need to be renegotiated.

5. Validate requirements to ensure the resulting service system will perform as intended in the end user’s environment.

SSD Addition**SG 2 Develop Service Systems**

Service system components are selected, designed, implemented, and integrated.

A service system can encompass work products, processes, people, consumables, and customer and other resources.

An important and often overlooked component of service systems is the human aspect. People who perform tasks as part of a service system enable the system to operate, and both provider staff and end users can fill this role. For example, a service system that processes incoming calls for a service should have available trained staff that can receive the calls and process them appropriately using the other components of the service system. In another example, end users of an insurance service may need to follow a prescribed claims process to receive service benefits from the service system.

A consumable is anything usable by the service provider that ceases to be available or becomes permanently changed because of its use during the delivery of a service. An example is gasoline for a transportation service system that uses gasoline powered vehicles. Even service systems that are composed primarily of people and manual processes often use consumables such as office supplies. The role of consumables in service systems should always be considered.

This goal focuses on the following activities:

- Evaluating and selecting solutions that potentially satisfy an appropriate set of requirements
- Developing detailed designs for the selected solutions (detailed enough to implement the design as a service system)
- Implementing the designs of service system components as needed
- Integrating the service system so that its functions and quality attributes can be verified and validated

Typically, these activities overlap, recur, and support one another. Some level of design, at times fairly detailed, may be needed to select solutions. Prototypes, pilots, and stand-alone functional tests can be used as a means of gaining sufficient knowledge to develop a complete set of requirements or to select from among available alternatives.

SSD Addition

From a people perspective, designs can be skill level specifications and staffing plans, and prototypes or pilots may try out different staffing plans to determine which one works best under certain conditions. From a consumables perspective, designs can be specifications of necessary consumable characteristics and quantities. Some consumables can even require implementation. For example, specific paper forms may need to be designed and printed to test them as part of the service system later.

Development processes are implemented repeatedly on a service system as needed to respond to changes in requirements, or to problems uncovered during verification, validation, transition, or delivery. For example, some questions that are raised by verification and validation processes can be resolved by requirements development processes. Recursion and iteration of these processes enable the work group to ensure quality in all service system components before it begins to deliver services to end users.

SP 2.1 Select Service System Solutions

Select service system solutions from alternative solutions.

Alternative solutions and their relative merits are considered in advance of selecting a solution. Key requirements (including quality attribute requirements), design issues, and constraints are established for use in alternative solution analysis. Architectural features that provide a foundation for service system improvement and evolution are considered.

Refer to the Decision Analysis and Resolution process area for more information about analyzing possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

A potentially ineffective approach to implementing this practice is to generate solutions that are based on only the way services have been delivered in the past. It is important to consider alternatives that represent different ways of allocating and performing necessary functions (e.g., manual vs. automated processes, end user vs. service delivery staff responsibilities, prescheduled vs. on-the-fly service request management).

Components of the service system, including service delivery and support functions, can be allocated to external suppliers. As a result, prospective supplier agreements are investigated. The use of externally supplied components is considered relative to cost, schedule, performance, and risk. Externally supplied alternatives can be used with or without modification. Sometimes such items can require modifications to aspects such as interfaces or a customization of some of their features to better meet service or service system requirements.

SSD Addition

Refer to the Supplier Agreement Management process area for more information about managing the acquisition of products and services from suppliers.

Example Work Products

1. Alternative solution screening criteria
2. Selection criteria
3. Service system component selection decisions and rationale
4. Documented relationships between requirements and service system components
5. Documented solutions, evaluations, and rationale

Subpractices

1. Establish defined criteria for selection.
2. Develop alternative solutions.

The development of alternative solutions can involve the use of architectural patterns, reuse of components, investigation of commercial off-the-shelf (COTS) solutions, service outsourcing, and consideration of technology maturation and obsolescence.

3. Select the service system solutions that best satisfy the criteria established.

The selection is based on an evaluation of alternatives using the defined criteria. In high-risk situations, simulations, prototypes, or pilots can be used to assist in the evaluation.

Selecting service system solutions that best satisfy the criteria is the basis for allocating requirements to the different aspects of the service system. Lower level requirements are generated from the selected alternative and used to develop the design of service system components. Interface requirements among service system components are described.

SP 2.2 Develop the Design

Develop designs for the service system and service system components.

The term “design” in this practice refers to the definition of the service system’s components and their intended set of relationships; these components will collectively interact in intended ways to achieve actual service delivery.

Service system designs should provide the appropriate content not only for implementation, but also for other aspects of the service system lifecycle such as modification; transition and rollout; maintenance; sustainment; and service delivery. The design documentation provides a reference to support mutual understanding of the design by relevant

SSD Addition

stakeholders and supports making future changes to the design both during development and in subsequent phases of the lifecycle.

A complete design description is documented in a “design package” that includes a full range of features and parameters including functions, interfaces, operating thresholds, manufacturing and service process characteristics (e.g., which functions are automated versus manually performed), and other parameters. Established design standards (e.g., checklists, templates, process frameworks) form the basis for achieving a high degree of definition and completeness in design documentation.

Examples of other service system design related work products include the following:

- Descriptions of roles, responsibilities, authorities, accountabilities, and skills of people required to deliver the service
- Functional use cases describing roles and activities of service participants
- Designs or templates for manuals, paper forms, training materials, and guides for end users, operators, and administrators

“Designing people” in this context means specifying the skills and skill levels necessary to accomplish needed tasks and can include appropriate staffing levels as well as training needs (if training is necessary to achieve needed skill levels). “Designing consumables” in this context means specifying the consumable properties and characteristics necessary to support service delivery as well as resource utilization estimates for service system operation.

Example Work Products

1. Service system architecture
2. Designs of service system components and consumables
3. Skill descriptions and details of the staffing solution (e.g., allocated from available staff, hired as permanent or temporary staff)
4. Interface design specifications and control documents
5. Criteria for design and service system component reuse
6. Results of make-or-buy analyses

Subpractices

1. Develop a design for the service system.

Service system design typically consists of two broad phases that can overlap in execution: preliminary and detailed design. Preliminary design establishes service system capabilities and the architecture. Detailed design fully defines the structure and capabilities of the service system components.

SSD Addition

2. Ensure that the design adheres to allocated functionality and quality attribute requirements.
3. Document the design.
4. Design interfaces for the service system components using established criteria.

The criteria for interfaces frequently reflect critical parameters that should be defined, or at least investigated, to ascertain their applicability. These parameters are often peculiar to a given type of service system and are often associated with quality attribute requirements (e.g., safety, security, durability, mission critical characteristics). Carefully determine which processes should be automated or partially automated and which processes should be performed manually.

5. Evaluate whether the components of the service system should be developed, purchased, or reused based on established criteria.

SP 2.3 Ensure Interface Compatibility

Manage internal and external interface definitions, designs, and changes for service systems.

Many integration problems arise from unknown or uncontrolled aspects of both internal and external interfaces. Effective management of interface requirements, specifications, and designs helps to ensure that implemented interfaces will be complete and compatible.

In the context of service systems, interfaces can be broadly characterized according to one of four major groups:

- Person-to-person interfaces are interfaces that represent direct or indirect communication between two or more people, any of whom might be service provider staff or end users. For example, a call script, which defines how a help desk operator should interact with an end user, defines a direct person-to-person interface. Log books and instructional signage are examples of indirect person-to-person interfaces.
- Person-to-component interfaces are interfaces that encompass interactions between a person and one or more service system components. These interfaces can include both graphical user interfaces for automated components (e.g., software applications), and operator control mechanisms for automated, partially automated, and non-automated components (e.g., equipment, vehicles).
- Component-to-component interfaces are interfaces that do not include direct human interaction. The interfaces of many interactions between automated components belong to this group but other possibilities exist, such as specifications constraining the physical mating of two components (e.g., a delivery truck, a loading dock).

SSD Addition

- Compound interfaces are interfaces that merge or layer together interfaces from more than one of the other three groups. For example, an online help system with “live” chat support might have a compound interface built on an integrated combination of person-to-person, person-to-component, and component-to-component interfaces.

Interfaces can also be characterized as external or internal interfaces. “External interfaces” are interactions among components of the service system and any other entity external to the service system, including people, organizations, and systems. Internal interfaces can include the interactions among the staff, teams, and functions of the service provider organization. “Internal interfaces” can also include interaction between the staff or end users and service system components.

Examples of user interface work products include the following:

- Customer interaction scripts
- Reporting types and frequency
- Application program interfaces

Example Work Products

1. Categories of interfaces with lists of interfaces per category
2. Table or mapping of interface relationships among service system components and the external environment
3. List of agreed interfaces defined for each pair of service system components when applicable
4. Reports from meetings of the interface control working group
5. Action items for updating interfaces
6. Updated interface description or agreement

Subpractices

1. Review interface descriptions for coverage and completeness.

The interface descriptions should be reviewed with relevant stakeholders to avoid misinterpretations, reduce delays, and prevent the development of interfaces that do not work properly.

2. Manage internal and external interface definitions, designs, and changes for service system components.

Management of the interfaces includes maintenance of the consistency of the interfaces throughout the life of the service system, compliance with architectural decisions and constraints, and resolution of conflict, noncompliance, and change issues. It is also important to manage the interfaces between components acquired from suppliers and other service system components.

SSD Addition

SP 2.4 Implement the Service System Design

Implement the service system design.

The term “implement” in this practice refers to the actual creation of designed components of the service system in a form that can subsequently be integrated, verified, and validated. “Implement” does not refer to putting the service system into place in the delivery environment. That deployment process occurs later during service system transition.

In some cases consumables and people (e.g., provider staff) may be “implemented.” For example, specialized paper forms may need to be printed. The “implementation” of people may involve hiring new staff or putting into place a new organizational or team structure to handle new kinds of responsibilities. Such new structures should be integrated, verified, and validated prior to the start of service transition.

Refer to the Service System Transition process area for more information about deploying the service system.

Service system components are implemented from previously established designs and interfaces. The implementation can include standalone testing of service system components and usually includes the development of any necessary training materials for staff and end users.

Example activities during implementation include the following:

- Interface compatibility is confirmed.
- Component functionality is incrementally delivered.
- Software is coded.
- Training materials are developed.
- Electrical and mechanical parts are fabricated.
- Procedures that implement process designs are written.
- Facilities are constructed.
- Supplier agreements are established.
- Staff are hired or transferred.
- Organizational and team structures are established.
- Custom consumables are produced (e.g., disposable packaging materials).

Example Work Products

1. Implemented service system components
2. Training materials
3. User, operator, and maintenance manuals
4. Procedure descriptions

SSD Addition

5. Records of new hires and staff transfers
6. Records of communications about organizational changes

Subpractices

1. Use effective methods to implement the service system design.
2. Adhere to applicable standards and criteria.
3. Conduct peer reviews of selected service system components.
4. Perform standalone testing of service system components as appropriate.
5. Revise the service system as necessary.

SP 2.5 Integrate Service System Components***Assemble and integrate implemented service system components into a verifiable service system.***

Integration of the service system should proceed according to a planned integration strategy and procedures. Before integration, each service system component should be verified for compliance with its interface requirements. Service system components that are manual processes should be performed while making appropriate use of any other necessary service system components to verify compliance with requirements.

During integration, subordinate components are combined into larger, more complex service system assemblies and more complete service delivery functions are performed. These combined service system assemblies are checked for correct interoperation. This process continues until service system integration is complete. During this process, if problems are identified, the problems are documented and corrective actions are initiated.

Some service systems can require assembly with customer or end-user resources to complete full integration. When these resources are available under the terms of a service agreement, they should be incorporated as appropriate in integration activities. When such resources are not available from customers and end users, substitute equivalent resources can be employed temporarily to enable full service system integration.

Example Work Products

1. Service system integration strategy with rationale
2. Documented and verified environment for service system integration
3. Service system integration procedures and criteria
4. Exception reports

SSD Addition

5. Assembled service system components
6. Interface evaluation reports
7. Service system integration summary reports
8. Staffing plans that show the sequence of where and when staff are provided

Subpractices

1. Develop a service system integration strategy.

The integration strategy describes the approach for receiving, assembling, and evaluating service system components that comprise the service system.

The integration strategy should be aligned with the service strategy described in the Work Planning process area and harmonized with the service system solution and design. The results of developing a service system integration strategy can be documented in a service system integration plan, which is reviewed with stakeholders to promote commitment and understanding.

2. Ensure the readiness of the integration environment.
3. Confirm that each service system component required for integration has been properly identified, behaves according to its description, and that all interfaces comply with their interface descriptions.
4. Evaluate the assembled service system for interface compatibility, and behavior (functionality and quality attributes).

SG 3 Verify and Validate Service Systems

Selected service system components and services are verified and validated to ensure correct service delivery.

Some service providers refer to all verification and validation as “testing.” However, in CMMI, “testing” is considered a specific method used for verification or validation. Verification and validation are described separately in this process area to ensure that both aspects are treated adequately.

SSD Addition

Examples of verification methods include the following:

- Inspections
- Peer reviews
- Audits
- Walkthroughs
- Analyses
- Architecture evaluations
- Simulations
- Testing
- Demonstrations
- Continuous integration (i.e., Agile approach to identify integration issues early)

Examples of validation methods include the following:

- Discussions with users, perhaps in the context of a formal review
- Prototype demonstrations
- Functional presentations (e.g., service delivery run-throughs, end-user interface demonstrations)
- Pilots of training materials
- Tests of services and service system components by end users and other relevant stakeholders
- Cycle reviews for incremental development

Verification practices include verification preparation, conduct of verification, and identification of corrective action. Verification includes testing of the service system and selected service system components against all selected requirements, including existing service agreements, service requirements, and service system requirements.

Examples of service system components that may be verified and validated include the following:

- People
- Processes
- Equipment
- Software
- Consumables

Validation demonstrates that the service system, as developed, will deliver services as intended. Verification addresses whether the service system properly reflects the specified requirements. In other words, verification ensures that “you built it right.” Validation ensures that “you built the right thing.”

SSD Addition

Validation activities use approaches similar to verification (e.g., test, analysis, inspection, demonstration, simulation). These activities focus on ensuring the service system enables the delivery of services as intended in the expected delivery environment. End users and other relevant stakeholders are usually involved in validation activities. Both validation and verification activities often run concurrently and can use portions of the same environment. Validation and verification activities can take place repeatedly in multiple phases of the service system development process.

SP 3.1 Prepare for Verification and Validation

Establish and maintain an approach and an environment for verification and validation.

Preparation is necessary to ensure that verification provisions are embedded in service and service system requirements, designs, developmental plans, and schedules. Verification encompasses selection, inspection, testing, analysis, and demonstration of all service system components, including work products, processes, and consumable resources.

Similar preparation activities are necessary for validation to be meaningful and successful. These activities include selecting services and service system components and establishing and maintaining the validation environment, procedures, and criteria. It is particularly important to involve end users and front-line service delivery staff in validation activities because their perspectives on successful service delivery can vary significantly from one another and from service system developers.

Example Work Products

1. Lists of the service system components selected for verification and validation
2. Verification and validation methods for each selected component
3. Verification and validation environment
4. Verification and validation procedures
5. Verification and validation criteria

Subpractices

1. Select the components to be verified and validated and the verification and validation methods that will be used for each.

Service system components are selected based on their contribution to meeting service objectives and requirements and to addressing risks.

2. Establish and maintain the environments needed to support verification and validation.

SSD Addition

3. Establish and maintain verification and validation procedures and criteria for selected service system components.

SP 3.2 Perform Peer Reviews***Perform peer reviews on selected service system components.***

Peer reviews involve a methodical examination of service system components by the producers' peers to identify defects for removal and to recommend changes.

A peer review is an important and effective verification method implemented via inspections, structured walkthroughs, or a number of other collegial review methods.

Example Work Products

1. Peer review schedule
2. Peer review checklist
3. Entry and exit criteria for service system components and work products
4. Criteria for requiring another peer review
5. Peer review training material
6. Service system components selected for peer review
7. Peer review results, including issues and action items
8. Peer review data

Subpractices

1. Determine what type of peer review will be conducted.

Examples of types of peer reviews include the following:

- Inspections
- Structured walkthroughs
- Active reviews

2. Establish and maintain peer review procedures and criteria for the selected service system components and work products.
3. Define requirements for the peer review.

Peer reviews should address the following guidelines:

- The preparation should be sufficient.
- The conduct should be managed and controlled.
- Consistent and sufficient data should be recorded.
- Action items should be recorded.

SSD Addition

Examples of requirements for peer reviews include the following:

- Data collection
- Entry and exit criteria
- Criteria for requiring another peer review

4. Establish and maintain checklists to ensure that service system components and work products are reviewed consistently.

Examples of items addressed by checklists include the following:

- Rules of construction
- Design guidelines
- Completeness
- Correctness
- Maintainability
- Common defect types

Checklists are modified as necessary to address the specific type of work product and peer review. Peers of checklist developers and potential end-users review the checklists.

5. Develop a detailed peer review schedule, including dates for peer review training and for when materials for peer reviews will be available.
6. Prepare for the peer review.

Preparation activities for peer reviews typically include the following:

- Identifying the staff who will be invited to participate in the peer review of each service system component or work product
- Identifying the key reviewers who should participate in the peer review
- Preparing and updating the materials to be used during the peer reviews, such as checklists and review criteria

7. Ensure that the service system component or work product satisfies the peer review entry criteria and make the component or work product available for review to participants early enough to enable them to adequately prepare for the peer review.
8. Assign roles for the peer review as appropriate.

Examples of roles include the following:

- Leader
- Reader
- Recorder
- Author

SSD Addition

9. Conduct peer reviews on selected service system components and work products, and identify issues resulting from the peer review.

One purpose of conducting a peer review is to find and remove defects early. Peer reviews are performed incrementally as service system components and work products are being developed.

Peer reviews can be performed on key work products of specification, design, test, and implementation activities and specific planning work products. Peer reviews can be performed on staffing plans, competency descriptions, organizational structure, and other people oriented aspects of a service system. However, they should be used to review individual performance and competency with caution, and should be employed only in coordination with other methods of individual evaluation that the organization already has in place.

When issues arise during a peer review, they should be communicated to the primary developer or manager of the service system component or work product for correction.

10. Conduct an additional peer review if the defined criteria indicate the need.
11. Ensure that exit criteria for the peer review are satisfied.
12. Record and store data related to the preparation, conduct, and results of the peer reviews.

Typical data are service system component or work product name, composition of the peer review team, type of peer review, preparation time per reviewer, length of the review meeting, number of defects found, type and origin of defect, and so on. Additional information on the service system component or work product being peer reviewed can be collected.

Protect the data to ensure that peer review data are not used inappropriately. The purpose of peer reviews is to verify proper development and identify defects to ensure greater quality, not to provide reasons for disciplining staff or publicly criticizing performance. Failure to protect peer review data properly can ultimately compromise the effectiveness of peer reviews by leading participants to be less than fully candid about their evaluations.

13. Analyze peer review data.

Examples of peer review data that can be analyzed include the following:

- Actual preparation time or rate versus expected time or rate
- Actual number of defects versus expected number of defects
- Types of defects detected
- Causes of defects
- Defect resolution impact

SSD Addition

SP 3.3 Verify Selected Service System Components

Verify selected service system components against their specified requirements.

The verification methods, procedures, criteria, and environment are used to verify the selected service system and any associated maintenance, training, and support processes. Verification activities should be performed throughout the service system lifecycle.

Example Work Products

1. Verification results and logs
2. Verification reports
3. Analysis report (e.g., statistics on performance, causal analysis of nonconformance, comparison of the behavior between the real service system and models, trends)
4. Trouble reports
5. Change requests for verification methods, criteria, and the environment

Subpractices

1. Perform verification of selected service system components and work products against their requirements.
Verification of the selected components includes verification of their integrated operation with one another and with appropriate external interfaces.
2. Record the results of verification activities.
3. Identify action items resulting from the verification of service system components and work products.
4. Document the “as-run” verification method and deviations from the available methods and procedures discovered during its performance.
5. Analyze and record the results of all verification activities.

SP 3.4 Validate the Service System

Validate the service system to ensure that it is suitable for use in the intended delivery environment and meets stakeholder expectations.

The validation methods, procedures, and criteria are used to validate selected services, service system components, and any associated maintenance, training, and support processes using the appropriate validation environment. Validation activities are performed throughout the service system lifecycle.

Validation of overall service system operation should take place in an

SSD Addition

environment that provides enough similarities to the delivery environment to confirm the service system will fulfill its intended use. The delivery environment is the complete set of circumstances and conditions under which services are actually delivered in accordance with service agreements. Sometimes validation can be effectively performed in a simulated environment but in other contexts it can only be performed in a portion of the delivery environment. In the latter cases, care should be taken to ensure that validation activities do not perturb ongoing service activities to the point of risking failures of agreed service delivery. (See the definition of “delivery environment” in the glossary.)

Example Work Products

1. Validation reports and results
2. Validation cross reference matrix
3. Validation deficiency reports and other issues
4. Change requests for validation methods, criteria, and the environment
5. User acceptance (i.e., sign off) for service delivery validation
6. Focus group reports

Subpractices

1. Perform functionality and quality attribute validation on selected service system components to ensure that they are suitable for use in their intended delivery environment.

The validation methods, procedures, criteria, and environment are used to validate the selected service system components and any associated maintenance, training, and support services.

2. Analyze the results of validation activities.

The data resulting from validation tests, inspections, demonstrations, or evaluations are analyzed against defined validation criteria. Analysis reports indicate whether the needs were met. In the case of deficiencies, these reports document the degree of success or failure and categorize probable cause of failure. The collected test, inspection, or review results are compared with established criteria to determine whether to proceed or to address requirements or design issues.

SERVICE SYSTEM TRANSITION

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of Service System Transition (SST) is to deploy new or significantly changed service system components while managing their effect on ongoing service delivery.

Introductory Notes

The Service System Transition process area addresses all aspects of planning, communicating, managing, deploying, and confirming that service system components effectively make the transition to the delivery environment. The scope of this process area covers both new components and significant changes to existing components.

“Significant” is defined as a change that introduces unacceptable risk that the service system will not meet its objectives. Although these practices center on the transition of service system components, the transition of an entire service system (i.e., an interdependent and integrated collection of components) can also be managed using these practices.

In this process area, the term “transition” refers to the comprehensive process of preparing for, executing, and confirming a deployment of service system components to a fully operational state while maintaining service delivery. The term “deploy” or “deployment” is more specific and refers to the activity of moving service system components into the delivery environment. In some domains, a deployment is also called a “roll-out.”

Deployments generally fall into one of three categories:

- New installation
- Replacement
- Retirement

Transition planning ensures that relevant stakeholders are properly informed of upcoming changes. Preparing for transition also encompasses compatibility evaluations of the to-be service system within the current delivery environment as constrained by existing service agreements and ongoing service delivery activities. Impacts on a service system that will be replaced or phased out over time by a new service system are considered. Impacts on service systems that share interfaces or resources with a new one are also considered, as are impacts on service continuity.

Critical aspects of service system transition include the following:

- Configuration control of service system components
- Management of internal and external interfaces
- Deployment of service system components into the delivery environment
- Stakeholder acceptance of new or revised service system components
- Management of impacts of the transition

Emergency changes to a service system can be made when approved by a designated authority according to established policies. The normal, expected order of service system transition processes can be altered to accommodate the unique needs of an emergency situation, but all relevant processes should eventually be completed once the situation returns to normal. This approach allows any unanticipated impacts associated with emergency changes to be identified and addressed.

Related Process Areas

Refer to the Incident Resolution and Prevention process area for more information about identifying, controlling, and addressing incidents.

Refer to the Service Continuity process area for more information about establishing and maintaining plans to ensure continuity of services during and following any significant disruption of normal operations.

Refer to the Service Delivery process area for more information about operating the service system.

SSD Addition

Refer to the Service System Development process area for more information about analyzing, designing, developing, integrating, verifying, and validating service systems, including service system components, to satisfy existing or anticipated service agreements.

Refer to the Causal Analysis and Resolution process area for more information about identifying causes of selected outcomes and take action to improve process performance.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

Specific Goal and Practice Summary

SG 1 Prepare for Service System Transition

- SP 1.1 Analyze Service System Transition Needs
- SP 1.2 Develop Service System Transition Plans
- SP 1.3 Prepare Stakeholders for Changes

SG 2 Deploy the Service System

- SP 2.1 Deploy Service System Components
- SP 2.2 Assess and Control the Impacts of the Transition

Specific Practices by Goal

SG 1 Prepare for Service System Transition

Preparation for service system transition is conducted.

Thorough planning enables a smooth transition of service system components into the delivery environment. Compatibility analysis is critical to this preparation and is addressed in this goal. Additionally, proactive, well thought-out transition plans with accompanying notification and training strategies clarify the transition, thus eliciting buy-in from relevant stakeholders.

As part of preparing for service system transition, review the operational concepts and scenarios for the service system and tailor them as necessary to help ensure that planning is sufficiently thorough. Also review the criteria for service system acceptance to ensure that the service system meets those criteria.

Preparing for service system transition also requires an evaluation of the potential impact of the transition on quality attributes. Quality attributes are key properties of the service and service system (e.g., responsiveness, availability, security) important to achieving business or mission objectives. (See the definition of “quality attributes” in the glossary.) For example, a poorly planned transition can negatively affect service availability or security of service delivery.

The practices that address this goal should begin while new or changed service system components are still under development. By doing so, the needs and constraints for transition can be considered during the component's development.

SP 1.1 Analyze Service System Transition Needs

Analyze the functionality, quality attributes, and compatibility of the current and future service systems to minimize impact on service delivery.

The purpose of this practice is to identify and mitigate issues associated with the transition. This identification and mitigation is accomplished in part by analyzing how the current (as-is) service system will be affected by the changes anticipated for the post-transition (to-be) service system.

The transition of new or modified service system components affects the service delivery environment. Some of these effects may have been anticipated during the development of the service system.

Similarly, ongoing service delivery activities (if any), ad hoc service requests, and environmental circumstances can lead to deployment failure if the constraints they impose are not considered. Actual deployment of new or changed service delivery capabilities may need to be phased in over time because of these constraints. The service system design may need to be adjusted to make the transition feasible. Consequently, this practice should be conducted in parallel with service system development practices and should continue throughout transition to an operational state.

Refer to the Service Delivery process area for more information about preparing for service system operations.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems, including ensuring interface compatibility.

Example Work Products

1. Compatibility analysis of current and post-transition service systems
2. Issues to be addressed and risks to be mitigated associated with the transition

Subpractices

1. Establish a baseline of the current service system, if it has not been done previously.

Refer to the Configuration Management process area for more information about establishing baselines.

2. Analyze the current service system as it operates within the current delivery environment.

In some cases, documentation and operational concepts can exist for the current service system. These documentation and operational concepts can be used to better understand current operations. If the current service system is undocumented or does not exist, elicit as much input as possible from relevant stakeholders regarding current operations.

3. Analyze the service system components that are proposed for transition (e.g., the post-transition or to-be service system) for potential compatibility, functionality, quality attribute, or interface issues.

This analysis should use development documentation for the proposed service system components. This documentation can include operational concepts, scenarios, design documents, and workflow diagrams.

If necessary, define procedures to ensure service system compatibility prior to actual deployment. These procedures can reuse applicable verification and validation methods employed during service system development, but they should also account for additional real world constraints that are in place once service system transition begins. Depending on the complexity of the service system and the risks associated with the transition, these procedures can range from a simple analysis and resolution of potential compatibility issues to a formal test and evaluation regimen.

4. Identify and mitigate potential issues.

Refer to the Risk Management process area for more information about mitigating risks.

SP 1.2 Develop Service System Transition Plans

Establish and maintain plans for specific transitions of the service system.

For each specific transition of the service system, a plan is established that encompasses all activities from accepting service system components to resolution of impacts on end users and the delivery environment. A transition plan should identify all activities and resources that are required for a specific transition.

The following should be included in transition plans when appropriate:

- Identification of service system components ready for transition
- Deployment type (e.g., new, replacement, retirement)
- Acquisition approach
- Installation and integration of service system components within the delivery environment
- Identification and resolution of warranty considerations
- Phasing of deployment over time that satisfies operational dependencies between service system components
- Deployment acceptance criteria
- Resource constraints and restrictions
- Initial provisioning of consumables
- Rollback (or backout) procedures to “undo” the transition and restore the delivery environment to its former stable operating status
- Training of service delivery and support staff
- Communication of transition status and service changes to relevant stakeholders

The depth of a transition plan should be appropriate for the type of transition and the criticality of the components going through transition. For example, the transition of new business critical components can require detailed plans and schedules, risk assessment, deployment back-out procedures, and a formal review of planning materials by relevant stakeholders. Less significant transitions, such as retirement of an outdated service, can need less planning rigor.

If similar transitions were performed in the past, the results of their post-deployment reviews should be considered during transition planning. This information can speed up the planning process and help identify issues that might otherwise be overlooked.

Refer to the Work Planning process area for more information about developing a work plan.

Example Work Products

1. Plans for service system transition

Subpractices

1. Define the deployment approach for each specific service system transition.

Consider the type of deployment (e.g., new installation, replacement, retirement) when defining an approach, taking into account that a transition can include a combination of

these types of deployments. Consider priorities and constraints of relevant stakeholders.

Also define a rollback or backout strategy in the event that a deployment is unsuccessful and the service system must be restored to its former state. Include criteria for what constitutes a successful deployment versus when to back out changes.

If a service system is being retired, address topics such as end-user notification, error handling, archival methods, demolition, and recycling.

2. Determine the cost, resources, and schedule required for transition of the service system to a new or changed operational state.

Schedule transition activities in a way that balances work and available resources against customer and end-user needs, including the need to have time to prepare for and conduct the transition. When appropriate, use actual data from similar transitions to estimate cost, resources, and schedule.

3. Identify relevant stakeholders for transition activities.

When identifying transition stakeholders and defining their roles and responsibilities, be sure to consider outsourced stakeholders.

4. Develop a service system transition plan.

Based on the deployment approach and estimates for a transition, document a plan for the transition.

5. Obtain stakeholder commitment to the plan.

Ensure that the service system transition plan is reviewed by relevant stakeholders to obtain buy-in. Respond to review comments.

6. Establish a baseline of the transition plan.

7. If new or significantly changed essential functions are part of a transition, ensure that the service continuity plan is refreshed to include the new essential functions.

Refer to the Service Continuity process area for more information about establishing service continuity plans.

Refer to the Integrated Work Management process area for more information about integrating plans and coordinating and collaborating with relevant stakeholders.

SP 1.3 Prepare Stakeholders for Changes

Prepare relevant stakeholders for changes in services and service systems.

This practice ensures that the service system transition is not impaired because of failure to prepare relevant stakeholders for all of the changes caused by introducing new or modified service system components. Relevant stakeholders should always include customers, end users, provider staff, senior management, external suppliers, and anyone else that should be aware of expected changes.

Example Work Products

1. Transition notification strategy
2. Transition training strategy

Subpractices

1. Establish and maintain a transition notification strategy.
2. Implement the notification strategy to keep relevant stakeholders informed about scheduled changes in services and service availability during the transition.

Ensure the notification strategy addresses how rollback or backout will be communicated, if appropriate.

3. Establish and maintain a transition training strategy.

The transition training strategy can encompass a broad range of orientation and training activities involving customers, end users, service delivery and support staff, managers, and senior leadership as appropriate. The transition training strategy should also encompass activities that ensure the effectiveness of the training after it has been provided, such as testing, piloting, or surveys.

Examples of information that should be incorporated in orientation and training include the following:

- New or changed services and how to request them
- Procedures and tools for customer and end-user feedback
- Procedures and tools for maintenance, tuning, and end-user support
- Use of tools selected for service delivery
- Design of the service system
- Anticipated operating thresholds
- Procedures and tools for service system scheduling, monitoring, and resource management
- Procedures for handling service incidents that occur during transition

4. Implement the training strategy.

Refer to the Organizational Training process area for more information about establishing an organizational training tactical plan.

SG 2 Deploy the Service System

The service system is deployed to the delivery environment.

This goal focuses on obtaining service system components (from the configuration control authority when appropriate) and installing and integrating them into the delivery environment. This process is conducted according to the tactical plan for service system transition.

Deployment can cause both planned and unplanned effects on service system operation. Identifying, assessing, and controlling these effects is an essential part of achieving a successful deployment.

SP 2.1 Deploy Service System Components

Systematically deploy service system components into the delivery environment based on transition planning.

The preparation for transition, including the tactical plan for service system transition, is used to guide the deployment.

Example Work Products

1. Installation records
2. Deployment evaluation artifacts

Subpractices

1. Confirm that service system components to be deployed are placed under configuration control as appropriate.

Refer to the Configuration Management process area for more information about establishing baselines.

2. Install the service system into the delivery environment.

This subpractice involves packaging, distributing, integrating, and installing service system components into the delivery environment. Installation and integration details should be included in the tactical plan for service system transition.

3. Validate service system components in the delivery environment.

Ensure that the deployed components operate as expected. Operational scenarios and procedures can be used to evaluate the new or modified service system. Deployment acceptance criteria, which were defined as part of the tactical plan for transition, may need to be revised as part of this evaluation.

Refer to the Service Delivery process area for more information about preparing for service system operations.

SSD Addition

Refer to the Service System Development process area for more information about verifying and validating service systems.

4. In the case of service system component retirement, archive the service system components appropriately and remove them from the delivery environment.

Ensure that interfaces with the retired service system components are adequately handled.

SP 2.2 Assess and Control the Impacts of the Transition

Assess the impacts of the transition on stakeholders and service delivery, and take appropriate corrective action.

Transition activities extend past installation of new service system components in the delivery environment. The service provider ensures that service operations are not adversely affected by recent changes.

Often this assessment period can extend for some time to help ensure that unintended effects of the transition are not realized. For example, in the medical domain a pediatric clinic can implement specific services to support parents of children with special needs. Services could include a facilitated parents' group, centralized therapy sessions, and educational guidance. Assessing the impacts of these new service system changes would require gathering input from families with children of various ages and diagnoses. It can take some time to gather this data and ensure that the new services are positively affecting relevant stakeholders.

Additionally, this practice ensures that a deployment does not degrade other aspects of the service system or service delivery in general. Unanticipated impacts are addressed in a timely manner and as detailed in the tactical plan for transition. Back-out plans can be implemented as needed based on adverse system impacts.

Refer to the Incident Resolution and Prevention process area for more information about ensuring timely and effective resolution of service incidents and prevention of service incidents as appropriate.

Example Work Products

1. Post deployment review
2. Deployment assessment artifacts

Subpractices

1. Use data gathering methods to obtain input from relevant stakeholders about the deployment.

Examples methods include the following:

- Survey
- Comments box
- Web-based input form

2. Proactively communicate information about deployment impacts.

Communication should be handled as determined by the tactical plan for service system transition and should, at a minimum, include confirming with relevant stakeholders that a transition has completed successfully.

Multiple communication vehicles can be used to ensure that relevant stakeholders are made aware of deployment issues:

- Email notification
- Embedded system notifications
- Frequently asked questions (FAQ) documentation
- Visible signage in the delivery environment
- Meetings

3. For significant impacts, refer to the tactical plan for details about how and when deployment backout or rollback should be performed.

4. Continue to assess and control impacts until deployment issues are resolved.

Impacts that potentially or actually interfere with service delivery are service incidents that should be handled through the incident management system.

5. Conduct a post-deployment review.

This review identifies, collects, and documents lessons learned from the deployment. This information can be useful both for current service system operation and for future transitions.

Relevant stakeholders should be included to address questions such as the following:

- Is the new functionality operating effectively?
- Have other aspects of the service system been degraded?
- Have stakeholders been negatively affected?
- Have the new functionality and quality attributes of the service system been thoroughly evaluated through sufficient use?

STRATEGIC SERVICE MANAGEMENT

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of Strategic Service Management (STSM) is to establish and maintain standard services in concert with strategic needs and plans.

Introductory Notes

The Strategic Service Management process area involves the following activities:

- Analyzing capabilities and needs for services that span multiple customers and agreements
- Establishing and maintaining standard services, service levels, and descriptions that reflect these capabilities and needs

Strategic service management processes improve alignment between the set of services offered by a service provider organization and its strategic business objectives. If the organization is small or has a narrow focus, the standard services can consist of a single service or small related group of services. Larger organizations can have a more complex set of standard services.

Active analysis of customer and competitor data, market trends and opportunities, and organizational characteristics such as capabilities and strengths yield information that the organization uses to establish standard services. Standard services are one enabler of consistent service performance across the organization. The objective of this process area is not to manage individual services but to get the information needed to make effective strategic decisions about the set of standard services the organization maintains.

Standard services provide a basis for making the most of the service provider organization's capabilities to meet its business objectives. Standard services can also improve service quality, business capture, and satisfaction of both customers and end users while reducing costs, errors, and time to develop and deliver services. Standard service levels are a key component of standard services. Service levels make expectations and responsibilities clear, specific, and measurable between the service organization and the customer.

In this process area, when customer needs are mentioned, end-user needs are also implied. The needs of the customer and end user can differ. Both are critical when collecting and analyzing data to develop standard services and understand strategic needs and plans.

Standard services are typically described in a service catalog that is oriented to the information needs of customers. In addition, standard

service descriptions oriented to the needs of the service provider organization's staff can be maintained.

Attention to satisfaction with and use of current services allows the organization to adjust or correct some services and can contribute to planning for future services. The organization can also identify requirements for new service systems or changes to existing systems. These systems can support single or multiple customers.

The specific practices in this process area complement the practices in Organizational Process Definition, Organizational Process Focus, and Organizational Process Performance. In these process areas, the organization defines, improves, and quantitatively understands its standard processes. In contrast, the broader focus of STSM is on services rather than only on service system components that can be processes.

Related Process Areas

Refer to the Incident Resolution and Prevention process area for more information about monitoring the status of incidents to closure.

Refer to the Service Delivery process area for more information about delivering services in accordance with service agreements.

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

Refer to the Organizational Process Definition process area for more information about establishing standard processes.

Refer to the Requirements Management process area for more information about understanding requirements.

Refer to the Work Monitoring and Control process area for more information about monitoring the work against the plan.

Specific Goal and Practice Summary

SG 1 Establish Strategic Needs and Plans for Standard Services

SP 1.1 Gather and Analyze Data

SP 1.2 Establish Plans for Standard Services

SG 2 Establish Standard Services

SP 2.1 Establish Properties of Standard Services and Service Levels

SP 2.2 Establish Descriptions of Standard Services

Specific Practices by Goal

SG 1 Establish Strategic Needs and Plans for Standard Services

Strategic needs and plans for standard services are established and maintained.

“Strategic needs” are conditions or objectives in the organization often driven by factors in the environment. An organization may need to increase

revenue, profitability, or market share. Customers may need a different or new set of services, or expect a change in an organization's service offerings based on what competitors are providing or based on shifts in their own objectives. The organization considers the range of needs in light of its capabilities, makes decisions about which objectives to pursue, and reflects these needs and objectives in plans for standard services.

In many organizations, strategic planning information can be proprietary, sensitive, and subject to non-disclosure requirements or other controls. Anyone participating in developing plans for standard services should exercise care in complying with controls to protect sensitive strategic information.

SP 1.1 Gather and Analyze Data

Gather and analyze data about the strategic needs and capabilities of the organization.

The organization gathers and analyzes data that can help with planning the standard services that the organization will establish and maintain. The appropriate data can vary for different services, market segments, and organizational characteristics such as size. The data will offer insights into both the organization's capabilities and the needs of its market, including customers and end users.

Examples of sources and techniques for gathering and analyzing relevant data include the following:

- Business plans
- Market research
- Surveys
- Business intelligence
- Data from service reviews and account management
- Service use trends and patterns
- Customer complaints and compliments
- Service incident and request patterns
- Breaches of service levels
- Competitor data
- Trade studies
- Plans
- Strategic planning techniques such as strengths, weaknesses, opportunities, and threats (SWOT) analysis
- Core competence analysis
- Scenario planning

Example Work Products

1. Analyzed data on the organization's capabilities
2. Analyzed data on strategic needs

3. Descriptions of the organization's capabilities
4. Descriptions of strategic needs

Subpractices

1. Gather and analyze data on the organization's capabilities.
2. Gather and analyze data on the organization's strategic needs.
3. Describe the organization's capabilities and strategic needs.
4. Communicate the descriptions to relevant stakeholders.

SP 1.2 Establish Plans for Standard Services

Establish and maintain plans for standard services.

Standard service planning translates information about the organization's capabilities and strategic needs into decisions about standard services. Plans for standard services reflect actions needed to balance capabilities of the organization; strategic needs, including the needs of customers and end users; and the conditions of the competitive market.

Example Work Products

1. Descriptions of strategic business objectives
2. Prospective service descriptions
3. Analysis of service system needs
4. Decision or approval packages for selected services
5. Plans for standard services

Subpractices

1. Confirm strategic business objectives.

Strategic business objectives for a service organization may be explicit and available. If they are not, the planners executing this activity document their understanding of the implicit goals as part of their planning. This understanding should be reviewed and approved by senior management.

2. Recommend requirements for standard services based on strategic business objectives, the organization's capabilities, and strategic needs.

3. Identify needed actions on standard services.

Needed actions can include development of new standard services, revision or improvement of current standard services, or retirement of standard services. A known failure mode in managing services is inattention to managing the obsolescence of services. Standard services that no longer fit the needs of the organization's customer or the current capabilities of the organization should be retired or altered so that they do fit. The organization should set priorities and decide on the phasing of actions as appropriate.

Refer to the Organizational Performance Management process area for more information about selecting improvements.

Refer to the Work Monitoring and Control process area for more information about managing corrective action to closure.

New or changed standard services can require new or changed service systems. These service systems can support single or multiple customers and single or multiple standard services. Thus, needed actions can also include establishing and maintaining "core assets" (e.g., components, tools, architectures, operating procedures, service system representations, software) to more effectively and efficiently develop or customize service systems that deliver standard services to multiple customers.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

4. Review and get agreement from relevant stakeholders on the standard services to be established and maintained.

SG 2 Establish Standard Services

A set of standard services is established and maintained.

SP 2.1 Establish Properties of Standard Services and Service Levels

Establish and maintain properties of the organization's set of standard services and service levels.

Multiple standard services and service levels may be required to address the needs of different customers, units of the organization, markets, or application domains. In addition to establishing standard services, services can be grouped into service lines when the size and complexity of the set of services warrants further organization. The organization develops standard processes to deliver standard services.

Refer to the Organizational Process Definition process area for more information about establishing standard processes.

Example Work Products

1. Critical attributes of standard services
2. Organization's set of standard service levels
3. Templates for service level agreements (SLAs)
4. Tailoring criteria
5. Common and variable parts of standard services
6. Grouping of services into service lines
7. Needs and expectations for service systems that deliver standard services

Subpractices

1. Select standard services.

The selected standard services should adhere to organizational policies, standards, and models.

2. Specify the critical attributes of each service.

Examples of critical attributes include the following:

- Features and benefits
- Available service levels and categories
- Costs
- Current users
- Intended users
- Service components
- Service delivery system
- Related services

3. Determine common and variable parts of standard services.

Variable parts of a standard service can be assigned categories and parameters. Standard service levels can represent some of the degrees of variability in standard services.

Examples of allowable variations include the following:

- Pricing
- Subservice providers
- Criteria for using customer components

4. Organize services into service lines as needed.

This organization of services into service lines can include ensuring an appropriate integration among services.

5. Define service levels.

Defined service levels make the levels of service that are offered specific and measurable. Service levels can help to balance cost and demand for services, and make roles and responsibilities between the service provider and user clear.

Determining service levels includes the following service requirements:

- The maximum acceptable continuous period of lost service
- The maximum acceptable period of degraded service
- Acceptable degraded service levels during the period of service recovery
- Redundancy requirements

Standard service levels can be reflected in standard SLAs or templates for SLAs.

Service level information includes the following:

- Provider and user responsibilities
- Availability of the service
- Agreed service hours and exceptions
- Anticipated service volume
- Response times for service incidents and requests
- Performance or quality targets
- Key measures to monitor
- Reporting and escalation procedures
- Consequences of failure to achieve a service level
- Variations available (e.g., “gold” service)

6. Establish tailoring criteria as appropriate.

The organization uses knowledge of variability in customer needs to develop tailoring options that limit risk and improve customer satisfaction and time to market while maintaining consistency across the organization.

The tailoring criteria and guidelines describe the following:

- How the organization’s set of standard services are used to guide the development of individual services
- Mandatory requirements that must be satisfied by the defined services
- Options that can be exercised and criteria for selecting among the options
- Procedures that must be followed in performing and documenting tailoring

Examples of tailoring criteria and procedures include the following:

- Criteria for selecting standard services from the services approved by the organization
- Criteria for selecting service components from the organization’s set of standard services
- Procedures for tailoring the selected services and service components to accommodate specific needs

Examples of tailoring actions include the following:

- Modifying a service level
- Combining components of different services
- Modifying service components
- Replacing service components
- Reordering service components

Examples of reasons for tailoring include the following:

- Adapting the service for a new customer need or work environment
- Customizing the service for a specific use or class of similar uses

7. Identify needs and expectations for service systems that deliver standard services as appropriate.

In situations in which the organization will need to develop and maintain multiple service systems to deliver its standard services, it can be beneficial to establish core assets at the organizational level for developing and customizing such service systems.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

SP 2.2 Establish Descriptions of Standard Services

Establish and maintain descriptions of the organization's defined standard services.

Establishing the properties of standard services is not sufficient. These properties should also be packaged into specific descriptions. In addition to a set of descriptions used by the service provider, a separate version is typically needed for customer use. A common failure mode with the use of standard services is that they are defined and described to meet the needs of some staff in the service provider organization but not described in a manner that is effective and appropriate for all intended users of standard services. For successful use, standard services should be appropriately described for the full range of intended users of the descriptions.

Example Work Products

1. Descriptions of services
2. Service catalog or menu
3. Adjunct materials such as instructions for delivery staff, sales force instructions, proposal and pricing information, and contracting information

Subpractices

1. Develop the descriptions of standard services for all relevant users.

Additional materials related to the standard services can also be developed if they do not already exist. These materials can include information for those who develop specific services, service delivery staff, or sales and other business staff.

2. Conduct peer reviews on the descriptions with relevant stakeholders.

Customer and end-user representatives can be included in these peer reviews to ensure that the descriptions meet their information needs.

3. Revise the descriptions as necessary.
4. Store the descriptions in a location and medium where all intended users have access.

To be effective, standard service descriptions should be available and accessible in a consistent location that encourages use by the full range of intended users. The

location can be a large, complex online repository or a single sheet of paper, depending on the characteristics of the services and organization.

While the catalog or menu of services is often in an electronic format, many organizations also produce a paper version. Adjunct materials can be stored along with the descriptions, such as the tailoring guidelines or instructions for the delivery staff, sales force, proposal authors, and contract specialists. Variants of the service catalog or menu may be required for customers and staff of the service provider organization.

Examples of locations for a standard service repository include the following:

- Configuration management database
- Web pages
- Document portfolio or library
- Process asset library

WORK MONITORING AND CONTROL

A Project and Work Management Process Area at Maturity Level 2

Purpose

The purpose of Work Monitoring and Control (WMC) is to provide an understanding of the ongoing work so that appropriate corrective actions can be taken when the performance deviates significantly from the plan.

Introductory Notes

A documented work plan is the basis for monitoring activities, communicating status, and taking corrective action. Progress or status is primarily determined by comparing actual work product and task attributes, effort, cost, and schedule to the plan at prescribed intervals, milestones, or control levels in the schedule or WBS. Appropriate visibility of progress enables timely corrective action to be taken when performance deviates significantly from the plan. A deviation is significant if, when left unresolved, it precludes the work activities from meeting its objectives.

The term “work plan” is used throughout this process area to refer to the overall plan for controlling the work.

When actual status deviates significantly from expected values, corrective actions are taken as appropriate. These actions can require replanning, which can include revising the original plan, establishing new agreements, or including additional mitigation activities in the current plan.

Related Process Areas

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

Refer to the Measurement and Analysis process area for more information about providing measurement results.

Refer to the Work Planning process area for more information about establishing and maintaining plans that define work activities.

Specific Goal and Practice Summary

SG 1 Monitor the Work Against the Plan

- SP 1.1 Monitor Work Planning Parameters
- SP 1.2 Monitor Commitments
- SP 1.3 Monitor Risks
- SP 1.4 Monitor Data Management
- SP 1.5 Monitor Stakeholder Involvement
- SP 1.6 Conduct Progress Reviews
- SP 1.7 Conduct Milestone Reviews

SG 2 Manage Corrective Action to Closure

- SP 2.1 Analyze Issues
- SP 2.2 Take Corrective Action
- SP 2.3 Manage Corrective Actions

Specific Practices by Goal

SG 1 Monitor the Work Against the Plan

Actual progress and performance are monitored against the work plan.

SP 1.1 Monitor Work Planning Parameters

Monitor actual values of planning parameters against the work plan.

Work planning parameters constitute typical indicators of work progress and performance and include attributes of work products and tasks, costs, effort, and schedule. Attributes of the work products and tasks include size, complexity, service level, availability, weight, form, fit, and function. The frequency of monitoring parameters should be considered.

Frequency considerations can include the possible need for monitoring each service request or incident, and possibly even continuous monitoring for continuously delivered services.

Monitoring typically involves measuring actual values of planning parameters, comparing actual values to estimates in the plan, and identifying significant deviations. Recording actual values of planning parameters includes recording associated contextual information to help understand measures. An analysis of the impact that significant deviations have on determining the corrective actions to take is handled in specific goal 2 and its specific practices in this process area.

Example Work Products

1. Records of performance
2. Records of significant deviations
3. Cost performance reports

Subpractices

1. Monitor progress against the schedule.

Progress monitoring typically includes the following:

- Periodically measuring the actual completion of activities and milestones
- Comparing actual completion of activities and milestones against the planned schedule
- Identifying significant deviations from the planned schedule estimates

2. Monitor the costs and expended effort of the work.

Effort and cost monitoring typically includes the following:

- Periodically measuring the actual effort and costs expended and staff assigned
- Comparing actual effort, costs, staffing, and training to the planned budget and estimates
- Identifying significant deviations from the planned budget and estimates

3. Monitor the attributes of work products and tasks.

Refer to the Measurement and Analysis process area for more information about developing and sustaining a measurement capability used to support management information needs.

Refer to the Work Planning process area for more information about establishing estimates of work product and task attributes.

Monitoring the attributes of work products and tasks typically includes the following:

- Periodically measuring the actual attributes of work products and tasks, such as size, complexity, or service levels (and changes to these attributes)
- Comparing the actual attributes of work products and tasks (and changes to these attributes) to the work plan estimates
- Identifying significant deviations from the work plan estimates

4. Monitor resources provided and used.

Refer to the Capacity and Availability Management process area for more information about monitoring and analyzing capacity and availability.

Refer to the Work Planning process area for more information about planning the resources.

Examples of resources include the following:

- Physical facilities
- Computers, peripherals, and software
- Networks
- Security environment
- Staff
- Processes

5. Monitor the knowledge and skills of work group members.

Refer to the Work Planning process area for more information about planning needed knowledge and skills.

Monitoring the knowledge and skills of work group staff typically includes the following:

- Periodically measuring the acquisition of knowledge and skills by work group staff
- Comparing the actual training obtained to that documented in the work plan
- Identifying significant deviations from the work plan estimates

6. Document significant deviations in planning parameters.

SP 1.2 Monitor Commitments

Monitor commitments against those identified in the work plan.

Example Work Products

1. Records of commitment reviews

Subpractices

1. Regularly review commitments (both external and internal).
2. Identify commitments that have not been satisfied or are at significant risk of not being satisfied.
3. Document the results of commitment reviews.

SP 1.3 Monitor Risks

Monitor risks against those identified in the work plan.

Refer to the Risk Management process area for more information about identifying potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or work to mitigate adverse impacts on achieving objectives.

Refer to the Work Planning process area for more information about identifying risks.

Example Work Products

1. Records of risk monitoring

Subpractices

1. Periodically review the documentation of risks in the context of the current status and circumstances of the work.

An example risk whose status might change is a threat to the continuity of operations, or a change to the average mix of service request types coming from end users. If the risk has become more likely or the possible impact more severe, then corrective action may be necessary.

2. Revise the documentation of risks as additional information becomes available.

As work continues (especially work of long duration or continuous operation), new risks arise. It is important to identify and analyze these new risks. For example, software, equipment, and tools in use can become obsolete; or key staff can gradually

lose skills in areas of particular long-term importance to the work group and organization.

3. Communicate the risk status to relevant stakeholders.

Examples of risk status include the following:

- A change in the probability that the risk occurs
- A change in risk priority

SP 1.4 Monitor Data Management

Monitor the management of data against the work plan.

Refer to the Plan Data Management specific practice in the Work Planning process area for more information about identifying types of data to be managed and how to plan for their management.

Data management activities should be monitored to ensure that data management requirements are being satisfied. Depending on the results of monitoring and changes in requirements, situation, or status, it may be necessary to re-plan the work group's data management activities.

Example Work Products

1. Records of data management

Subpractices

1. Periodically review data management activities against their description in the work plan.
2. Identify and document significant issues and their impacts.

An example of a significant issue is when stakeholders do not have the access to data they need to fulfill their roles as relevant stakeholders.

3. Document results of data management activity reviews.

SP 1.5 Monitor Stakeholder Involvement

Monitor stakeholder involvement against the plan.

Refer to the Plan Stakeholder Involvement specific practice in the Work Planning process area for more information about identifying relevant stakeholders and planning appropriate involvement with them.

Stakeholder involvement should be monitored to ensure that appropriate interactions occur. Depending on the results of monitoring and changes in work requirements, situation, or status, it may be necessary to re-plan stakeholder involvement.

Example Work Products

1. Records of stakeholder involvement

Subpractices

1. Periodically review the status of stakeholder involvement.

2. Identify and document significant issues and their impacts.
3. Document the results of stakeholder involvement status reviews.

SP 1.6 Conduct Progress Reviews

Periodically review the work progress, performance, and issues.

The work "progress" is the status of the work as viewed at a particular time when the work activities performed so far and their results and impacts are reviewed with relevant stakeholders (especially work group representatives and work group management) to determine whether there are significant issues or performance shortfalls to be addressed.

Status or progress reviews are work reviews to keep relevant stakeholders informed. These reviews can be informal and may not be specified explicitly in work plans.

Example Work Products

1. Documented work review results

Subpractices

1. Regularly communicate status on assigned activities and work products to relevant stakeholders.

Managers, staff, customers, end users, suppliers, and other relevant stakeholders are included in reviews as appropriate.

2. Review the results of collecting and analyzing measures for controlling the work.

The measurements reviewed include those measurements collected for service parameter measures identified in work planning (e.g., availability, number of users) and can include those measurements collected for measures of customer satisfaction.

Refer to the Measurement and Analysis process area for more information about aligning measurement and analysis activities and providing measurement results.

3. Identify and document significant issues and deviations from the plan.
4. Document change requests and problems identified in work products and processes.

Refer to the Configuration Management process area for more information about tracking and controlling changes.

5. Document the results of reviews.
6. Track change requests and problem reports to closure.

SP 1.7 Conduct Milestone Reviews

Review accomplishments and results at selected milestones.

Refer to the Establish the Budget and Schedule specific practice in the Work Planning process area for more information about identifying major milestones.

Milestones are pre-planned events or points in time at which a thorough review of status is conducted to understand how well stakeholder requirements are being met. (If the work includes a developmental milestone, then the review is conducted to ensure that the assumptions and requirements associated with that milestone are being met.) Milestones can be associated with the overall work or a particular service type or instance. Milestones can thus be event based or calendar based.

Milestone reviews are planned during work planning and are typically formal reviews.

Progress reviews and milestone reviews need not be held separately. A single review can address the intent of both. For example, a single pre-planned review can evaluate progress, issues, and performance up through a planned time period (or milestone) against the plan's expectations.

Depending on the work, "startup" and "close-out" could be phases covered by milestone reviews.

Example Work Products

1. Documented milestone review results

Subpractices

1. Conduct milestone reviews with relevant stakeholders at meaningful points in the work schedule, such as the completion of selected phases.

Managers, staff, customers, end users, suppliers, and other relevant stakeholders are included in milestone reviews as appropriate.

2. Review commitments, the plan, status, and risks of the work.
3. Identify and document significant issues and their impacts.
4. Document results of the review, action items, and decisions.
5. Track action items to closure.

SG 2 Manage Corrective Action to Closure

Corrective actions are managed to closure when the work performance or results deviate significantly from the plan.

SP 2.1 Analyze Issues

Collect and analyze issues and determine corrective actions to address them.

This analysis is performed for a different purpose and generally on different issues than the analysis performed as part of incident analysis, or change request analysis. However, the same or a similar mechanism can be used to analyze each of these types of issues and to manage them to closure. How best to implement a common solution for their analysis and management to closure depends on the risk of failing to handle each appropriately and the costs incurred by alternative solutions.

Example Work Products

1. List of issues requiring corrective actions

Subpractices

1. Gather issues for analysis.

Issues are collected from reviews and the execution of other processes.

Examples of issues to be gathered include the following:

- Issues discovered when performing verification and validation
- Significant deviations in planning parameters from estimates in the work plan
- Commitments (either internal or external) that have not been satisfied
- Significant changes in risk status
- Data access, collection, privacy, or security issues
- Stakeholder representation or involvement issues
- Product, tool, or environment transition assumptions (or other customer or supplier commitments) that have not been achieved

2. Analyze issues to determine the need for corrective action.

Refer to the Establish the Budget and Schedule specific practice in the Work Planning process area for more information about corrective action criteria.

Corrective action is required when the issue, if left unresolved, may prevent the work from meeting its objectives.

SP 2.2 Take Corrective Action

Take corrective action on identified issues.
Example Work Products

1. Corrective action plans

Subpractices

1. Determine and document the appropriate actions needed to address identified issues.

Refer to the Work Planning process area for more information about developing a work plan.

Examples of potential actions include the following:

- Modifying the statement of work
- Modifying requirements
- Revising estimates and plans
- Renegotiating commitments
- Adding resources
- Changing processes
- Revising risks

2. Review and get agreement with relevant stakeholders on the actions to be taken.
3. Negotiate changes to internal and external commitments.

SP 2.3 Manage Corrective Actions

Manage corrective actions to closure.

Example Work Products

1. Corrective action results

Subpractices

1. Monitor corrective actions for their completion.

Refer to the Incident Resolution and Prevention process area for more information about monitoring the status of incidents to closure.

2. Analyze results of corrective actions to determine the effectiveness of the corrective actions.
3. Determine and document appropriate actions to correct deviations from planned results from performing corrective actions.

Lessons learned as a result of taking corrective action can be inputs to planning and risk management processes.

WORK PLANNING

A Project and Work Management Process Area at Maturity Level 2

Purpose

The purpose of Work Planning (WP) is to establish and maintain plans that define work activities.

Introductory Notes

Planning is one of the keys to effectively managing work. The Work Planning process area involves the following activities:

- Developing the work plan
- Interacting with relevant stakeholders appropriately
- Getting commitment to the plan
- Maintaining the plan

Planning includes estimating the attributes of work products and tasks, determining the resources needed, negotiating commitments, producing a schedule, and identifying and analyzing risks. Iterating through these activities may be necessary to establish the work plan. The work plan provides the basis for performing and controlling work activities that address commitments with the customer.

The work plan is usually revised as the work progresses to address changes in requirements and commitments, inaccurate estimates, corrective actions, and process changes. Specific practices describing both planning and replanning are contained in this process area.

The term “work plan” is used throughout this process area to refer to the overall plan for controlling the work. The work plan can be a stand-alone document or be distributed across multiple documents. In either case, a coherent picture of who does what should be included. Likewise, monitoring and control can be centralized or distributed, as long as at the work group level a coherent picture of work status can be maintained.

Work groups that respond to service requests generated over time by end users may require an entire level of detailed and frequently revised plans for resource-to-task allocation and task queue management (e.g., the assignment of repair jobs in a maintenance shop). These low-level operating plans can be considered a detailed extension of the overall work plan.

For product lines and standard services, multiple sets of work activities could benefit from the practices of this process area. These activities include creating and maintaining core assets (e.g., components, tools, architectures, operating procedures, service system representations, software) and supporting their use; developing each individual service

system from core assets; and orchestrating the overall effort of developing, using, and improving standard services.

Related Process Areas

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

Refer to the Service Delivery process area for more information about preparing for service system operations.

SSD Addition

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements and developing service systems.

Refer to the Strategic Service Management process area for more information about gathering and analyzing data.

Refer to the Measurement and Analysis process area for more information about specifying measures.

Refer to the Requirements Management process area for more information about managing requirements.

Refer to the Risk Management process area for more information about identifying and analyzing risks and mitigating risks.

Specific Goal and Practice Summary

SG 1 Establish Estimates

- SP 1.1 Establish the Service Strategy
- SP 1.2 Estimate the Scope of the Work
- SP 1.3 Establish Estimates of Work Product and Task Attributes
- SP 1.4 Define Lifecycle Phases
- SP 1.5 Estimate Effort and Cost

SG 2 Develop a Work Plan

- SP 2.1 Establish the Budget and Schedule
- SP 2.2 Identify Risks
- SP 2.3 Plan Data Management
- SP 2.4 Plan the Resources
- SP 2.5 Plan Needed Knowledge and Skills
- SP 2.6 Plan Stakeholder Involvement
- SP 2.7 Establish the Work Plan

SG 3 Obtain Commitment to the Plan

- SP 3.1 Review Plans That Affect the Work
- SP 3.2 Reconcile Work and Resource Levels
- SP 3.3 Obtain Plan Commitment

Specific Practices by Goal

SG 1 Establish Estimates

Estimates of work planning parameters are established and maintained.

Work planning parameters include all information needed by the work group to perform necessary planning, organizing, staffing, directing, coordinating, reporting, and budgeting.

Estimates of planning parameters should have a sound basis to instill confidence that plans based on these estimates are capable of supporting work objectives.

Factors to consider when estimating these parameters include work requirements, including product requirements, requirements imposed by the organization, requirements imposed by the customer, and other requirements that affect the work.

Additional factors for services include the service strategy, identified services and service levels, and how incidents and requests are to be handled.

Documentation of the estimating rationale and supporting data is needed for stakeholder review and commitment to the plan and for maintenance of the plan as the work progresses.

SP 1.1 Establish the Service Strategy

Establish and maintain the service strategy.

The service strategy provides the business framework for planning and managing the work. The strategy includes consideration of the following factors at an appropriate level of abstraction:

- The objectives and constraints for the service
- Possible approaches to meeting those objectives and constraints
- The resources (e.g., skills, environment, tools, new technologies) that will be needed
- Risks associated with these factors and how they are addressed

The service strategy typically takes a long-term view of a service, reflects its entire scope, considers long-term risks, and addresses the roles to be played by multiple stakeholders, including suppliers, the customer, and other work groups.

The service strategy can play various roles, but typically and initially, it serves as the basis for senior management approving a service and committing resources to it. As work planning proceeds, and the solution, processes, resources, and risks are explored and developed, the service strategy may need to be revised.

For a short duration service, a strategy may not be developed or only developed once, in which case it is replaced by the work plan as the service work progresses and more detailed planning becomes possible.

For a long duration service, the strategy plays a continuing role in helping to maintain a long-term view of the service and its rationale, touching on various elements of the work plan but at a higher level of abstraction; whereas the work plan will typically reflect a much lower level of detail over a shorter time horizon.

A service strategy can initially be created by the organization or by prospective service staff perhaps in collaboration with potential customers and suppliers, or some other combination of parties with a strategic business view of the prospects for the service.

The service strategy can include a top-level description of the services to be provided, the approach to developing the service system, and the approach to service delivery as appropriate.

Example Work Products

1. Service strategy

Subpractices

1. Identify the objectives of the service and the capabilities it intends to provide.

The organization can maintain an overall business strategy in which the service plays a role in establishing capabilities needed by the organization. The service related objectives and capabilities described in this subpractice can be derived from such considerations for the overall business, but will tend to have a specific or near-term set of objectives and capabilities.

Refer to the Strategic Service Management process area for more information about establishing and maintaining standard services in concert with strategic needs and plans.

2. Identify the approach used to achieve the objectives or provide the capabilities.

There will often be an approach to developing the infrastructure needed to deliver services (i.e., technical approach) and an approach to delivery that accounts for customer satisfaction, skill levels needed, skill levels available, costs, and risks.

Refer to the Service Delivery process area for more information about establishing the service delivery approach.

3. Document business considerations.

Business considerations include potential costs and benefits, intellectual property, competitive climate, aging of the industry and impact on long-term needs and profit margins, core competencies of the organization to be enhanced, core competencies needed from other parties, and future trends in society, trade, and technology.

4. Identify major resource needs.

A review of the service approach helps to identify categories of resources needed for the service and the suppliers of these resources (e.g., other business groups in the organization, specific functional groups, human resources, intellectual property experts, the legal department, the marketing department, business partners, external suppliers).

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

5. Identify stakeholders that will play major roles in the service.

The Plan Stakeholder Involvement specific practice provides a more detailed, though perhaps shorter term, consideration of which stakeholders to involve in the service and in what way.

The service approach may be able to leverage external stakeholders (e.g., existing and potential customers and business partners) to provide some of the needed resources.

6. Identify the agreement types to be used.

To be successful, the service should establish agreements with its major stakeholders. The nature of those agreements is determined, in part, by considering each party's needs, objectives, expectations, constraints, and risks. The types of agreements selected should be part of business considerations and thus help answer how various parties will share in the risks, costs, and benefits of the service.

7. Identify risks and how those risks can be allocated to various stakeholders.

The Identify Risks specific practice in this process area provides a more detailed, though perhaps shorter term, consideration of the risks that the service may encounter.

8. Identify the approach used to maintain safety and security in the service.

Attention to safety and security should be present in all major planning activities (e.g., those planning activities related to service objectives, resources, risks, stakeholders) but this subpractice suggests taking a holistic view and focus on safety and security issues and risks, and the activities the service might include to address them.

9. Review the service strategy with senior management and obtain its agreement.

Review the service strategy from the following key business perspectives:

- Are these objectives the right ones?
- Is the approach feasible?
- Is this strategy an appropriate allocation of the organization's resources for a prolonged period of time?
- What is the return on investment?
- What opportunities open up as a result of this strategy?
- Will the organization be subjected to excessive risk?
- What roles might some not-yet-identified major stakeholders play in service success?
- How might customers, suppliers, and competitors react?

10. Revise the service strategy as necessary.

Depending on the duration of the service, it may be necessary to refine the service strategy to reflect changes in the objectives, approach, availability of resources, market conditions, customer needs, process and product technologies, etc.

SP 1.2 Estimate the Scope of the Work

Establish a top-level work breakdown structure (WBS) to estimate the scope of the work.

The WBS evolves with the work. A top-level WBS can serve to structure initial estimating. The development of a WBS divides the overall work into an interconnected set of manageable components.

Typically, the WBS is a product, work product, or task-oriented structure that provides a scheme for identifying and organizing the logical units of work to be managed, which are called “work packages.” The WBS provides a reference and organizational mechanism for assigning effort, schedule, and responsibility and is used as the underlying framework to plan, organize, and control the work.

The activities in a WBS can be organized in different ways but are typically scoped by time or duration and address both service system development and maintenance as well as service delivery as appropriate. Some of the services identified can be continuously delivered; others can be in response to ad-hoc requests. Both are specified in a (possibly future) service agreement.

Activities can be further organized along one or more dimensions. For example, in the case of product maintenance, activities could further be distinguished according to those activities that persist through the end of the life of the product (from product delivery through product disposal), activities related to managing and executing the service agreement, and activities related to an individual incident or service request.

Example Work Products

1. Task descriptions
2. Work package descriptions
3. WBS

Subpractices

1. Develop a WBS based on the service strategy.

The WBS provides a scheme for organizing the work. The WBS should permit the identification of the following items:

- Risks and their mitigation tasks
- Tasks for deliverables and supporting activities
- Tasks for skill and knowledge acquisition
- Tasks for the development of needed support plans, such as configuration management, quality assurance, and verification plans
- Tasks for the integration and management of nondevelopmental items

2. Define the work packages in sufficient detail so that estimates of tasks, responsibilities, and schedule can be specified.

The top-level WBS is intended to help gauge the work effort for tasks and organizational roles and responsibilities. The amount of detail in the WBS at this level helps in developing realistic schedules, thereby minimizing the need for management reserve.

3. Identify products and product components to be externally acquired.

Refer to the Supplier Agreement Management process area for more information about managing the acquisition of products and services from suppliers.

4. Identify work products to be reused.

SP 1.3 Establish Estimates of Work Product and Task Attributes

Establish and maintain estimates of work product and task attributes.

Size is the primary input to many models used to estimate effort, cost, and schedule. Models can also be based on other attributes such as service level, connectivity, complexity, availability, and structure.

Examples of attributes to estimate include the following:

- Number of requirements
- Number and complexity of interfaces
- Volume of data
- Number of risk items
- Number of service levels
- Availability of services, by service level (e.g., turnaround time, operational availability ratio, number of calls the help desk should be able to handle per hour)
- Number of stakeholders affected by a service level
- Experience of work group participants
- Team velocity or productivity
- Geographic dispersal of work group members
- Proximity of customers, end users, and suppliers

The estimates should be consistent with requirements to determine the effort, cost, and schedule for the work. A relative level of difficulty or complexity should be assigned for each size attribute.

Example Work Products

1. Size and complexity of tasks and work products
2. Estimating models
3. Attribute estimates

Subpractices

1. Use appropriate methods to determine the attributes of the work products and tasks to be used to estimate resource requirements.

Methods for determining size and complexity should be based on validated models or historical data.

The methods for determining attributes evolve as the understanding of the relationship of service development and delivery characteristics to attributes increases.

2. Estimate the attributes of work products and tasks.

Examples of tasks for which size estimates are made include the following:

- Service system development and delivery
- Service system monitoring
- Preventative maintenance or repair
- Training in operations
- Incident management and resolution
- Monitoring for and addressing obsolescence
- Updating equipment and supplies used by service teams
- Logistical support
- Facilities maintenance
- System disposal

SP 1.4 Define Lifecycle Phases***Define lifecycle phases on which to scope the planning effort.***

The determination of lifecycle phases provides for planned periods of evaluation and decision making. These periods are normally defined to support logical decision points at which the appropriateness of continued reliance on the work plan and strategy is determined and significant commitments are made concerning resources. Such points provide planned events at which course corrections and determinations of future scope and cost can be made.

Understanding the lifecycle is crucial in determining the scope of the planning effort and the timing of initial planning, as well as the timing and criteria (critical milestones) for replanning.

The selection of a lifecycle for development and delivery of services will depend on the characteristics of the services and their environment. Some service providers will define phases based on their standard service definitions. Depending on the nature of the service, explicit phases for “startup” and “close-out” can be included.

Refer to the Strategic Service Management process area for more information about establishing standard services.

Often, individual services have implicit lifecycles associated with them that involve points of communication, evaluation, and decision and should be

considered when estimating what is required to support delivery of such a service.

Example Work Products

1. Lifecycle phases

SP 1.5 Estimate Effort and Cost

Estimate effort and cost for work products and tasks based on estimation rationale.

Estimates of effort and cost are generally based on results of analysis using models or historical data applied to size, activities, and other planning parameters. Confidence in these estimates is based on rationale for the selected model and the nature of the data. There can be occasions when available historical data do not apply, such as when efforts are unprecedented or when the type of task does not fit available models. For example, an effort can be considered unprecedented if the organization has no experience with such a product or task.

Unprecedented efforts are more risky, require more research to develop reasonable bases of estimate, and require more management reserve. The uniqueness of the work is documented when using these models to ensure a common understanding of any assumptions made in the initial planning phases.

Example Work Products

1. Estimation rationale
2. Effort estimates
3. Cost estimates

Subpractices

1. Collect models or historical data to be used to transform the attributes of work products and tasks into estimates of labor hours and costs.

Many parametric models have been developed to help estimate cost and schedule. The use of these models as the sole source of estimation is not recommended because these models are based on historical work data that may or may not be pertinent to the planned work. Multiple models and methods can be used to ensure a high level of confidence in the estimate.

Historical data should include the cost, effort, and schedule data from previously executed work and appropriate scaling data to account for differing sizes and complexity.

2. Include supporting infrastructure needs when estimating effort and cost.

The supporting infrastructure includes resources needed from a development and sustainment perspective for the product.

Consider the infrastructure resource needs in the development environment, the test environment, the production environment, the operational environment, or any appropriate combination of these environments when estimating effort and cost.

Examples of infrastructure resources include the following:

- Critical computer resources
- Tools with which service teams will be equipped
- Facilities, machinery, and equipment

3. Estimate effort and cost using models, historical data, or a combination of both.

Examples of effort and cost inputs used for estimating typically include the following:

- Estimates provided by an expert or group of experts (e.g., Delphi Method)
- Risks, including the extent to which the effort is unprecedented
- Critical competencies and roles needed to perform the work
- Travel
- WBS
- Selected work lifecycle model and processes
- Lifecycle cost estimates
- Skill levels of managers and staff needed to perform the work
- Knowledge, skill, and training needs
- Service agreements for call centers and warranty work
- Direct labor and overhead
- Level of security required for tasks, work products, hardware, software, staff, and work environment
- Facilities needed (e.g., for developing and maintaining the service system and for service delivery)
- Service and service system requirements
- Product and product component requirements
- Service strategy
- Size estimates of work products, tasks, and anticipated changes
- Cost of externally acquired products
- Capability of tools provided
- Capability of manufacturing processes

SG 2 Develop a Work Plan

A work plan is established and maintained as the basis for managing the work.

A work plan is a formal, approved document used to manage and control the execution of the work. It is based on requirements and established estimates.

The work plan should consider all phases of the lifecycle. Work planning should ensure that all plans affecting the work are consistent with the overall work plan.

SP 2.1 Establish the Budget and Schedule***Establish and maintain the budget and schedule.***

The budget and schedule are based on developed estimates and ensure that budget allocation, task complexity, and task dependencies are appropriately addressed.

Event driven, resource-limited schedules have proven to be effective in dealing with risk. Identifying accomplishments to be demonstrated before initiation of an event provides some flexibility in the timing of the event, a common understanding of what is expected, a better vision of the state of the work, and a more accurate status of the work tasks.

The subpractices and example work products of this specific practice should be interpreted both at the overall service level and within each service type as appropriate. That is, individual service requests (e.g., to repair a piece of equipment in a remote facility, transport a package to a destination) can have individual milestones, task dependencies, resource allocations, and scheduling constraints that should be considered together and in coordination with the larger budgeting and scheduling activities.

Example Work Products

1. Schedules
2. Schedule dependencies
3. Budget

Subpractices

1. Identify major milestones.

Milestones are pre-planned events or points in time at which a thorough review of status is conducted to understand how well stakeholder requirements are being met. (If the work includes a developmental milestone, then the review is conducted to ensure that the assumptions and requirements associated with that milestone are being met.) Milestones can be associated with the overall service or a particular service type or instance. Milestones can thus be event based or calendar based. If calendar based, once agreed, milestone dates are often difficult to change.

2. Identify schedule assumptions.

When schedules are initially developed, it is common to make assumptions about the duration of certain activities. These assumptions are frequently made on items for which little if any estimation data are available. Identifying these assumptions provides insight into the level of confidence (i.e., uncertainties) in the overall schedule.

3. Identify constraints.

Factors that limit the flexibility of management options should be identified as early as possible. The examination of the attributes of work products and tasks often bring these issues to the surface. Such attributes can include task duration, resources, inputs, and outputs.

4. Identify task dependencies.

Frequently, the tasks for a project or service can be accomplished in some ordered sequence that minimizes the duration. This sequencing involves the identification of predecessor and successor tasks to determine optimal ordering.

Examples of tools and inputs that can help determine optimal ordering of task activities include the following:

- Critical Path Method (CPM)
- Program Evaluation and Review Technique (PERT)
- Resource-limited scheduling
- Customer priorities
- User value

5. Establish and maintain the budget and schedule.

Establishing and maintaining the budget and schedule typically includes the following:

- Defining the committed or expected availability of resources and facilities
- Determining the time phasing of activities
- Determining a breakout of subordinate schedules
- Defining dependencies among activities (predecessor or successor relationships)
- Defining schedule activities and milestones to support work monitoring and control
- Identifying milestones, releases, or increments for the delivery of products to the customer
- Defining activities of appropriate duration
- Defining milestones of appropriate time separation
- Defining a management reserve based on the confidence level in meeting the schedule and budget
- Using appropriate historical data to verify the schedule
- Defining incremental funding requirements
- Documenting assumptions and rationale

6. Establish corrective action criteria.

Criteria are established for determining what constitutes a significant deviation from the work plan. A basis for gauging issues and problems is necessary to determine when corrective action should be taken. Corrective actions can lead to replanning, which may include revising the original plan, establishing new agreements, or including mitigation activities in the current plan. The work plan defines when (e.g., under what circumstances, with what frequency) the criteria will be applied and by whom.

SP 2.2 Identify Risks

Identify and analyze risks.

Refer to the Risk Management process area for more information about identifying potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or work to mitigate adverse impacts on achieving objectives.

Refer to the Monitor Risks specific practice in the Work Monitoring and Control process area for more information about risk monitoring activities.

Risks are identified or discovered and analyzed to support work planning. This specific practice should be extended to all plans that affect the work to ensure that appropriate interfacing is taking place among all relevant stakeholders on identified risks.

Work planning risk identification and analysis typically include the following:

- Identifying risks
- Analyzing risks to determine the impact, probability of occurrence, and time frame in which problems are likely to occur
- Prioritizing risks

Example Work Products

1. Identified risks
2. Risk impacts and probability of occurrence
3. Risk priorities

Subpractices

1. Identify risks.

The identification of risks involves the identification of potential issues, hazards, threats, vulnerabilities, and so on that could negatively affect work efforts and plans. Risks should be identified and described understandably before they can be analyzed and managed properly. When identifying risks, it is a good idea to use a standard method for defining risks. Risk identification and analysis tools can be used to help identify possible problems.

Examples of risk identification and analysis tools include the following:

- Risk taxonomies
- Risk assessments
- Checklists
- Structured interviews
- Brainstorming
- Process, product, and work performance models
- Cost models
- Network analysis
- Quality factor analysis

2. Document risks.
3. Review and obtain agreement with relevant stakeholders on the completeness and correctness of documented risks.
4. Revise risks as appropriate.

Examples of when identified risks may need to be revised include the following:

- When new risks are identified
- When risks become problems
- When risks are retired
- When work circumstances change significantly

SP 2.3 Plan Data Management

Plan for the management of data.

Data are forms of documentation required to support the work in all of its areas (e.g., administration, engineering, configuration management, finance, logistics, quality, safety, manufacturing, procurement). The data can take any form (e.g., reports, manuals, notebooks, charts, drawings, specifications, files, correspondence). The data can exist in any medium (e.g., printed or drawn on various materials, photographs, electronic, multimedia).

Data can be deliverable (e.g., items identified by contract data requirements) or data can be nondeliverable (e.g., informal data, trade studies, analyses, internal meeting minutes, internal design review documentation, lessons learned, action items). Distribution can take many forms, including electronic transmission.

Data requirements for the work should be established for both data items to be created and their content and form, based on a common or standard set of data requirements. Uniform content and format requirements for data items facilitate understanding of data content and help with consistent management of data resources.

The reason for collecting each document should be clear. This task includes the analysis and verification of deliverables and nondeliverables, data requirements, and customer supplied data. Often, data are collected with no clear understanding of how they will be used. Data are costly and should be collected only when needed.

Example Work Products

1. Data management plan
2. Master list of managed data
3. Data content and format description
4. Lists of data requirements for acquirers and suppliers
5. Privacy requirements
6. Security requirements
7. Security procedures
8. Mechanisms for data retrieval, reproduction, and distribution
9. Schedule for the collection of data
10. List of data to be collected

Subpractices

1. Establish requirements and procedures to ensure privacy and the security of data.

Not everyone will have the need or clearance necessary to access data. Procedures should be established to identify who has access to which data as well as when they have access to which data.

Requirements and procedures can cover service staff who will have the responsibility for the security of data under the terms of a service agreement.

2. Establish a mechanism to archive data and to access archived data.

Accessed information should be in an understandable form (e.g., electronic or computer output from a database) or represented as originally generated.

3. Determine the data to be identified, collected, and distributed.

4. Determine the requirements for providing access to and distribution of data to relevant stakeholders.

A review of other elements of the work plan can help to determine who requires access to or receipt of data as well as which data are involved.

5. Decide which data and plans require version control or other levels of configuration control and establish mechanisms to ensure data are controlled.

SP 2.4 Plan the Resources

Plan for resources to perform the work.

Defining resources (e.g., labor, equipment, materials, methods) and quantities needed to perform work activities builds on initial estimates and provides additional information that can be applied to expand the WBS used to manage the work.

The top-level WBS developed earlier as an estimation mechanism is typically expanded by decomposing these top levels into work packages that represent single work units that can be separately assigned, performed, and tracked. This subdivision is done to distribute management responsibility and provide better management control.

Each work package in the WBS should be assigned a unique identifier (e.g., number) to permit tracking. A WBS can be based on requirements, activities, work products, services, or a combination of these items. A dictionary that describes the work for each work package in the WBS should accompany the work breakdown structure.

Example Work Products

1. Work packages
2. WBS task dictionary
3. Staffing requirements based on work size and scope
4. Critical facilities and equipment list

5. Process and workflow definitions and diagrams
6. Work administration requirements list
7. Status reports

Subpractices

1. Determine process requirements.

The processes used to manage the work are identified, defined, and coordinated with all relevant stakeholders to ensure efficient operations during work execution.

2. Determine communication requirements.

These requirements address the kinds of mechanisms to be used for communicating with customers, end users, service provider staff, and other relevant stakeholders.

Communication mechanisms can be created during service system development and should be regularly reviewed, tailored, and possibly supplemented to meet ongoing service delivery needs.

SSD Addition

Refer to the Service System Development process area for more information about developing service systems.

3. Determine staffing requirements.

The staffing for work depends on the decomposition of requirements into tasks, roles, and responsibilities for accomplishing requirements as laid out in the work packages of the WBS.

Staffing requirements should consider the knowledge and skills required for each identified position as defined in the Plan Needed Knowledge and Skills specific practice.

Refer to the Capacity and Availability Management process area for more information about ensuring effective service system performance and ensuring that resources are provided and used effectively to support service requirements.

4. Determine facility, equipment, and component requirements.

Most work groups are unique in some way and require a set of unique assets to accomplish work objectives. The determination and acquisition of these assets in a timely manner are crucial to work success.

It is best to identify lead-time items early to determine how they will be addressed. Even when required assets are not unique, compiling a list of all facilities, equipment, and parts (e.g., number of computers for the staff working on the work group, software applications, office space) provides insight into aspects of the scope of an effort that are often overlooked.

5. Determine other continuing resource requirements.

Beyond determining processes, reporting templates, staffing, facilities, and equipment, there may be a continuing need for other types of resources to effectively carry out work activities, including the following:

- Consumables (e.g., electricity, office supplies)
- Access to intellectual property
- Access to transportation (for people and equipment)

The requirements for such resources are derived from the requirements found in (existing and future) agreements (e.g., customer agreements, service agreements, supplier agreements), the strategic approach, and the need to manage and maintain operations for a period of time.

SP 2.5 Plan Needed Knowledge and Skills

Plan for knowledge and skills needed to perform the work.

Refer to the Organizational Training process area for more information about developing skills and knowledge of people so they can perform their roles effectively and efficiently.

Knowledge delivery to work groups involves training staff and acquiring knowledge from outside sources.

Staffing requirements are dependent on the knowledge and skills available to support the execution of the work.

Planning for training addresses the knowledge and skills required by work group members and support staff to perform their tasks. Knowledge and skill needs can be derived from identified risks.

For example, if the work group is providing a service whose successful delivery requires detailed familiarity with a piece of complicated equipment, planning for training ensures that staff assigned to the work have the appropriate expertise with such equipment or provides training for the work group team in those areas.

Training can also include orientation in the work group's processes and the domain knowledge required to execute work tasks. The work group can also identify and plan for the knowledge and skills needed by its suppliers. Planning includes ensuring that costs and funding sources to pay for training are available and lead times are sufficient to obtain funding and training.

For long-duration and continuous-operation services, the knowledge and skills needed will evolve as the following occur:

- Staff members rotate in and out of the work group (or from one service type to another)
- The technology used in the service system or an individual service changes
- The processes and technology used in the development or customer environments change

For example, a staff change creates the need to determine the knowledge and skills needed by new work group members. New knowledge and skills are needed during different phases of the service lifecycle (or as new services or service levels are added). Planning for needed knowledge and skills should address these sources of change.

Refer to the Service System Transition process area for more information about preparing for service system transition and preparing stakeholders for changes.

Example Work Products

1. Inventory of skill needs
2. Staffing and new hire plans
3. Databases (e.g., skills, training)
4. Training plans

Subpractices

1. Identify the knowledge and skills needed to perform the work.
2. Assess the knowledge and skills available.
3. Select mechanisms for providing needed knowledge and skills.

Example mechanisms include the following:

- In-house training (both organizational and work group)
- External training
- Staffing and new hires
- External skill acquisition

The choice of in-house training or outsourced training for needed knowledge and skills is determined by the availability of training expertise, the work schedule, and business objectives.

4. Incorporate selected mechanisms into the work plan.

SP 2.6 Plan Stakeholder Involvement

Plan the involvement of identified stakeholders.

Stakeholders are identified from all phases of the work lifecycle identifying the people and functions that should be represented in the work and describing their relevance and the degree of interaction for work activities. A two-dimensional matrix with stakeholders along one axis and work activities along the other axis is a convenient format for accomplishing this identification. Relevance of the stakeholder to the activity in a particular phase and the amount of interaction expected would be shown at the intersection of the phase activity axis and the stakeholder axis.

For inputs of stakeholders to be useful, careful selection of relevant stakeholders is necessary. For each major activity, identify stakeholders who are affected by the activity and those who have expertise that is needed to conduct the activity. This list of relevant stakeholders will

probably change as the work moves through phases of the work lifecycle. It is important, however, to ensure that relevant stakeholders in the latter phases of the lifecycle have early input to requirements and design decisions that affect them.

Refer to the Service Delivery process area for more information about establishing service agreements.

Examples of the type of material that should be included in a plan for stakeholder interaction include the following:

- List of all relevant stakeholders
- Rationale for stakeholder involvement
- Relationships among stakeholders
- Resources (e.g., training, materials, time, funding) needed to ensure stakeholder interaction
- Schedule for the phasing of stakeholder interaction
- Roles and responsibilities of relevant stakeholders with respect to the work by lifecycle phase
- Relative importance of the stakeholder to the success of the work by lifecycle phase

Implementing this specific practice relies on shared or exchanged information with the previous Plan Needed Knowledge and Skills specific practice.

Example Work Products

1. Stakeholder involvement plan

SP 2.7 Establish the Work Plan

Establish and maintain the overall work plan.

A documented plan that addresses all relevant planning items is necessary to achieve the mutual understanding and commitment of individuals, groups, and organizations that execute or support the plans.

The plan generated for the work defines all aspects of the effort, tying together the following in a logical manner:

- Work lifecycle considerations
- Tasks
- Budgets and schedules
- Milestones
- Data management
- Risk identification
- Resource and skill requirements
- Stakeholder identification and interaction
- Infrastructure considerations

Infrastructure considerations include responsibility and authority relationships for work group members, management, and support organizations.

Example Work Products

1. Overall work plan

Subpractices

1. Document the work plan.

Work groups can consist of other, lower level work groups. A service can consist of a service system development work group and a service delivery work group. Service delivery can consist of several services that can benefit from separate planning and the practices of this process area. When work groups consist of other groups, the overall work plan should refer to the plans of the lower level work groups and all related plans should be compatible and appropriately support one another.

2. Include, reference, and reconcile the results of planning activities as appropriate.

To gain the support of relevant stakeholders, the work plan should document a realistic and sensible approach to meeting their needs, expectations, and constraints. Such a plan requires various planning elements to be reasonably complete and consistent (at least until the next plan revision, which may be weeks or months away).

If implemented appropriately, the specific practices of this process area address the Plan the Process generic practice as applied to other process areas within the scope of the process improvement effort, but otherwise the results of implementing that generic practice should also be considered in this subpractice.

3. Review the work plan with relevant stakeholders and get its agreement.

The specific practices of the next specific goal, Obtain Commitment to the Plan, describe activities to help ensure that the work plan describes a realistic approach for meeting the needs, expectations, and constraints of relevant stakeholders and to help ensure that these relevant stakeholders will fulfill their roles as described in the work plan, including the provision of resources and other forms of support during work execution.

4. Revise the work plan as necessary.

In general, when revising the work plan, it may be necessary to repeat many of the planning activities described in this process area to help ensure that relevant stakeholder commitments to the plan are maintained.

SG 3 Obtain Commitment to the Plan

Commitments to the work plan are established and maintained.

To be effective, plans require commitment by those who are responsible for implementing and supporting the plan.

SP 3.1 Review Plans That Affect the Work

Review all plans that affect the work to understand work commitments.

Plans developed in other process areas typically contain information similar to that called for in the overall work plan. These plans can provide additional detailed guidance and should be compatible with and support the overall work plan to indicate who has the authority, responsibility, accountability, and control. All plans that affect the work should be reviewed to ensure they contain a common understanding of the scope, objectives, roles, and relationships that are required for the work to be successful. Many of these plans are described by the Plan the Process generic practice.

Example Work Products

1. Record of the reviews of plans that affect the work

SP 3.2 Reconcile Work and Resource Levels

Adjust the work plan to reconcile available and estimated resources.

To establish work that is feasible, obtain commitment from relevant stakeholders and reconcile differences between estimates and available resources. Reconciliation is typically accomplished by modifying or deferring requirements, negotiating more resources, finding ways to increase productivity, outsourcing, adjusting the staff skill mix, or revising all plans that affect the work or its schedules.

Example Work Products

1. Revised methods and corresponding estimating parameters (e.g., better tools, the use of off-the-shelf components)
2. Renegotiated budgets
3. Revised schedules
4. Revised requirements list
5. Renegotiated stakeholder agreements

SP 3.3 Obtain Plan Commitment

Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.

Obtaining commitment involves interaction among all relevant stakeholders, both internal and external to the work group. The individual or group making a commitment should have confidence that the work can be performed within cost, schedule, and performance constraints. Often, a provisional commitment is adequate to allow the effort to begin and to permit research to be performed to increase confidence to the appropriate level needed to obtain a full commitment.

Example Work Products

1. Documented requests for commitments
2. Documented commitments

Subpractices

1. Identify needed support and negotiate commitments with relevant stakeholders.

The WBS can be used as a checklist for ensuring that commitments are obtained for all tasks.

The plan for stakeholder interaction should identify all parties from whom commitment should be obtained.

2. Document all organizational commitments, both full and provisional, ensuring the appropriate level of signatories.

Commitments should be documented to ensure a consistent mutual understanding and for work tracking and maintenance. Provisional commitments should be accompanied by a description of risks associated with the relationship.

3. Review internal commitments with senior management as appropriate.
4. Review external commitments with senior management as appropriate.

Management can have the necessary insight and authority to reduce risks associated with external commitments.

5. Identify commitments regarding interfaces between work elements and other work groups and organizational units so that these commitments can be monitored.

Well-defined interface specifications form the basis for commitments.

Part Three: **The Appendices**

Appendix A: References

- Ahern 2005** Ahern, Dennis M.; Armstrong, Jim; Clouse, Aaron; Ferguson, Jack R.; Hayes, Will; & Nidiffer, Kenneth E. *CMMI SCAMPI Distilled: Appraisals for Process Improvement*. Boston, MA: Addison-Wesley, 2005.
- Ahern 2008** Ahern, Dennis M.; Clouse, Aaron; & Turner, Richard. *CMMI Distilled: A Practical Introduction to Integrated Process Improvement, 3rd Edition*. Boston: Addison-Wesley, 2008.
- Beck 2001** Beck, Kent et. al. Manifesto for Agile Software Development. 2001. <http://agilemanifesto.org/>.
- Chrissis 2011** Chrissis, Mary Beth; Konrad, Mike; & Shrum, Sandy. *CMMI: Guidelines for Process Integration and Product Improvement, 3rd Edition*. Boston: Addison-Wesley, 2011.
- Crosby 1979** Crosby, Philip B. *Quality Is Free: The Art of Making Quality Certain*. New York: McGraw-Hill, 1979.
- Curtis 2009** Curtis, Bill; Hefley, William E.; & Miller, Sally A. *The People CMM: A Framework for Human Capital Management, 2nd Edition*. Boston, MA: Addison-Wesley, 2009.
- Deming 1986** Deming, W. Edwards. *Out of the Crisis*. Cambridge, MA: MIT Press, 1986.
- EIA 2002a** Electronic Industries Alliance. *Systems Engineering Capability Model (EIA/IS-731.1)*. Washington, DC, 2002.
- EIA 2002b** Government Electronics and Information Technology Alliance. *Earned Value Management Systems (ANSI/EIA-748)*. New York, NY, 2002.
<http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FEIA-748-B>.
- EIA 2003** Electronic Industries Alliance. *EIA Interim Standard: Systems Engineering (EIA/IS-632)*. Washington, DC, 2003.
- Forrester 2011** Forrester, Eileen; Buteau, Brandon; & Shrum, Sandy. *CMMI for Services: Guidelines for Superior Service, 2nd Edition*. Boston: Addison-Wesley, 2011.

- Gallagher 2011** Gallagher, Brian; Phillips, Mike; Richter, Karen; & Shrum, Sandy. *CMMI-ACQ: Guidelines for Improving the Acquisition of Products and Services, 2nd Edition*. Boston: Addison-Wesley, 2011.
- GEIA 2004** Government Electronic Industries Alliance. *Data Management (GEIA-859)*. Washington, DC, 2004.
<http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FGEIA+859-2009>.
- Gibson 2006** Gibson, Diane L.; Goldenson, Dennis R.; & Kost, Keith. *Performance Results of CMMI-Based Process Improvement (CMU/SEI-2006-TR-004, ADA454687)*. Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon® University, August 2006.
<http://www.sei.cmu.edu/library/abstracts/reports/06tr004.cfm>.
- Glazer 2008** Glazer, Hillel; Dalton, Jeff; Anderson, David; Konrad, Mike; & Shrum, Sandy. *CMMI or Agile: Why Not Embrace Both!* (CMU/SEI-2008-TN-003). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, November 2008.
<http://www.sei.cmu.edu/library/abstracts/reports/08tn003.cfm>.
- Humphrey 1989** Humphrey, Watts S. *Managing the Software Process*. Boston, MA: Addison-Wesley, 1989.
- IEEE 1991** Institute of Electrical and Electronics Engineers. *IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries*. New York, NY: IEEE, 1991.
- ISO 2005a** International Organization for Standardization. *ISO 9000: International Standard*. 1987.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42180.
- ISO 2005b** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 20000-1 Information Technology – Service Management, Part 1: Specification; ISO/IEC 20000-2 Information Technology – Service Management, Part 2: Code of Practice*, 2005.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.

- ISO 2006a** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 15504 Information Technology—Process Assessment Part 1: Concepts and Vocabulary, Part 2: Performing an Assessment, Part 3: Guidance on Performing an Assessment, Part 4: Guidance on Use for Process Improvement and Process Capability Determination, Part 5: An Exemplar Process Assessment Model*, 2003-2006.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.
- ISO 2006b** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 14764 Software Engineering – Software Life Cycle Processes – Maintenance*, 2006.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.
- ISO 2007** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 15939 Systems and Software Engineering—Measurement Process*, 2007.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.
- ISO 2008a** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 12207 Systems and Software Engineering—Software Life Cycle Processes*, 2008.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.
- ISO 2008b** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 15288 Systems and Software Engineering—System Life Cycle Processes*, 2008.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=45086.
- ISO 2008c** International Organization for Standardization. *ISO 9001, Quality Management Systems—Requirements*, 2008.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=53896.
- IT Governance 2005** IT Governance Institute. *CobiT 4.0*. Rolling Meadows, IL: IT Governance Institute, 2005.
http://www.isaca.org/Content/NavigationMenu/Members_and_Leaders/COBIT6/Obtain_COBIT/Obtain_COBIT.htm.
- Juran 1988** Juran, Joseph M. *Juran on Planning for Quality*. New York: Macmillan, 1988.

- McFeeley 1996** McFeeley, Robert. *IDEAL: A User's Guide for Software Process Improvement* (CMU/SEI-96-HB-001, ADA305472). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, February 1996.
<http://www.sei.cmu.edu/library/abstracts/reports/96hb001.cfm>.
- McGarry 2001** McGarry, John; Card, David; Jones, Cheryl; Layman, Beth; Clark, Elizabeth; Dean, Joseph; & Hall, Fred. *Practical Software Measurement: Objective Information for Decision Makers*. Boston: Addison-Wesley, 2001.
- Office of Government Commerce 2007a** Office of Government Commerce. *ITIL: Continual Service Improvement*. London, UK: Office of Government Commerce, 2007.
- Office of Government Commerce 2007b** Office of Government Commerce. *ITIL: Service Design*. London, UK: Office of Government Commerce, 2007.
- Office of Government Commerce 2007c** Office of Government Commerce. *ITIL: Service Operation*. London, UK: Office of Government Commerce, 2007.
- Office of Government Commerce 2007d** Office of Government Commerce. *ITIL: Service Strategy*. London, UK: Office of Government Commerce, 2007.
- Office of Government Commerce 2007e** Office of Government Commerce. *ITIL: Service Transition*. London, UK: Office of Government Commerce, 2007.
- SEI 1995** Software Engineering Institute. *The Capability Maturity Model: Guidelines for Improving the Software Process*. Reading, MA: Addison-Wesley, 1995.
- SEI 2002** Software Engineering Institute. *Software Acquisition Capability Maturity Model (SA-CMM) Version 1.03* (CMU/SEI-2002-TR-010, ADA399794). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, March 2002.
<http://www.sei.cmu.edu/library/abstracts/reports/02tr010.cfm>.
- SEI 2010a** CMMI Product Team. *CMMI for Development, Version 1.3* (CMU/SEI-2010-TR-033). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, November 2010.
<http://www.sei.cmu.edu/library/abstracts/reports/10tr033.cfm>.
- SEI 2010b** CMMI Product Team. *CMMI for Acquisition, Version 1.3* (CMU/SEI-2010-TR-032). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, November 2010.
<http://www.sei.cmu.edu/library/abstracts/reports/10tr032.cfm>.

- SEI 2010c** Caralli, Richard; Allen, Julia; Curtis, Pamela; White, David; and Young, Lisa. *CERT® Resilience Management Model, Version 1.0* (CMU/SEI-2010-TR-012). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, May 2010. <http://www.sei.cmu.edu/library/abstracts/reports/10tr012.cfm>.
- SEI 2011a** SCAMPI Upgrade Team. *Standard CMMI Appraisal Method for Process Improvement (SCAMPI) A, Version 1.3: Method Definition Document* (CMU/SEI-2011-HB-001). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, expected January 2011. <http://www.sei.cmu.edu/library/abstracts/reports/11hb001.cfm>.
- SEI 2011b** SCAMPI Upgrade Team. *Appraisal Requirements for CMMI, Version 1.2 (ARC, V1.3)* (CMU/SEI-2011-TR-001). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, expected January 2011. <http://www.sei.cmu.edu/library/abstracts/reports/11tr001.cfm>.
- SEI 2009** CMMI Product Team. *CMMI for Services, Version 1.2* (CMU/SEI-2009-TR-001). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, February 2009. <http://www.sei.cmu.edu/library/abstracts/reports/09tr001.cfm>.
- Shewhart 1931** Shewhart, Walter A. *Economic Control of Quality of Manufactured Product*. New York: Van Nostrand, 1931.

Information Assurance/Information Security Related Sources

- DHS 2009** Department of Homeland Security. *Assurance Focus for CMMI (Summary of Assurance for CMMI Efforts)*, 2009. https://buildsecurityin.us-cert.gov/swa/proself_assm.html.
- DoD and DHS 2008** Department of Defense and Department of Homeland Security. *Software Assurance in Acquisition: Mitigating Risks to the Enterprise*, 2008. https://buildsecurityin.us-cert.gov/swa/downloads/SwA_in_Acquisition_102208.pdf.
- ISO/IEC 2005** International Organization for Standardization and International Electrotechnical Commission. *ISO/IEC 27001 Information Technology – Security Techniques – Information Security Management Systems – Requirements*, 2005. http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42103.

NDIA 2008

NDIA System Assurance Committee. Engineering for System Assurance. Arlington, VA: NDIA, 2008.
<http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Documents/Studies/SA-Guidebook-v1-Oct2008-REV.pdf>.

Appendix B: Acronyms

ANSI	American National Standards Institute
ARC	Appraisal Requirements for CMMI
CAM	Capacity and Availability Management (process area)
CAR	Causal Analysis and Resolution (process area)
CCB	configuration control board
CL	capability level
CM	Configuration Management (process area)
CMF	CMMI Model Foundation
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
CMMI-ACQ	CMMI for Acquisition
CMMI-DEV	CMMI for Development
CMMI-SVC	CMMI for Services
CMU	Carnegie Mellon University
CobIT	Control Objectives for Information and related Technology
COTS	commercial off-the-shelf
CPI	cost performance index
CPM	critical path method
DAR	Decision Analysis and Resolution (process area)
DHS	Department of Homeland Security
DoD	Department of Defense

EIA	Electronic Industries Alliance
EIA/IS	Electronic Industries Alliance/Interim Standard
FAQ	frequently asked question
FCA	functional configuration audit
FMEA	failure mode and effects analysis
GG	generic goal
GP	generic practice
IBM	International Business Machines
IDEAL	Initiating, Diagnosing, Establishing, Acting, Learning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
INCOSE	International Council on Systems Engineering
IPD-CMM	Integrated Product Development Capability Maturity Model
IRP	Incident Resolution and Prevention (process area)
ISO	International Organization for Standardization
ISO/IEC	International Organization for Standardization and International Electrotechnical Commission
IT	information technology
ITIL	Information Technology Infrastructure Library
ITSCMM	Information Technology Services Capability Maturity Model
IWM	Integrated Work Management (process area)
MA	Measurement and Analysis (process area)
MDD	Method Definition Document
ML	maturity level
MTBF	mean time between failure
NDIA	National Defense Industrial Association

OID	Organizational Innovation and Deployment (former process area)
OLA	operating level agreement
OPD	Organizational Process Definition (process area)
OPF	Organizational Process Focus (process area)
OPM	Organizational Performance Management (process area)
OPP	Organizational Process Performance (process area)
OT	Organizational Training (process area)
PCA	physical configuration audit
P-CMM	People Capability Maturity Model
PERT	Program Evaluation and Review Technique
PPQA	Process and Product Quality Assurance (process area)
PWS	performance work statement
QFD	Quality Function Deployment
QWM	Quantitative Work Management (process area)
REQM	Requirements Management (process area)
RSKM	Risk Management (process area)
RSS	rich site summary
SaaS	software as a service
SAM	Supplier Agreement Management (process area)
SCAMPI	Standard CMMI Appraisal Method for Process Improvement
SCON	Service Continuity (process area)
SD	Service Delivery (process area)
SECAM	Systems Engineering Capability Assessment Model
SECM	Software Engineering Capability Model
SEI	Software Engineering Institute

SG	specific goal
SEI	Software Engineering Institute
SG	specific goal
SLA	service level agreement
SOA	service-oriented architecture
SOO	statement of objectives
SOW	statement of work
SP	specific practice
SPI	schedule performance index
SSD	Service System Development (process area)
SSE-CMM	Systems Security Engineering Capability Maturity Model
SST	Service System Transition (process area)
STSM	Strategic Service Management (process area)
SW-CMM	Capability Maturity Model for Software or Software Capability Maturity Model
SWOT	strengths, weaknesses, opportunities, and threats
WBS	work breakdown structure
WMC	Work Monitoring and Control (process area)
WP	Work Planning (process area)

Appendix C: CMMI Version 1.3 Project Participants

Many talented people were part of the product team that developed CMMI Version 1.3 models. Listed below are those who participated in one or more of the following teams during the development of CMMI Version 1.3. The organizations listed by members' names are those they represented at the time of their team membership.

The following are the primary groups involved in the development of this model:

- CMMI Steering Group
- CMMI for Services Advisory Group
- CMMI V1.3 Coordination Team
- CMMI V1.3 Configuration Control Board
- CMMI V1.3 Core Model Team
- CMMI V1.3 Translation Team
- CMMI V1.3 High Maturity Team
- CMMI V1.3 Acquisition Mini Team
- CMMI V1.3 Services Mini Team
- CMMI V1.3 SCAMPI Upgrade Team
- CMMI V1.3 Training Teams
- CMMI V1.3 Quality Team

CMMI Steering Group

The CMMI Steering Group guides and approves the plans of the CMMI Product Team, provides consultation on significant CMMI project issues, ensures involvement from a variety of interested communities, and approves the final release of the model.

Steering Group Members

- Alan Bemish, US Air Force
- Anita Carleton, Software Engineering Institute
- Clyde Chittister, Software Engineering Institute
- James Gill, Boeing Integrated Defense Systems
- John C. Kelly, NASA
- Kathryn Lundeen, Defense Contract Management Agency

- Larry McCarthy, Motorola, Inc.
- Lawrence Osiecki, US Army
- Robert Rassa, Raytheon Space and Airborne Systems (lead)
- Karen Richter, Institute for Defense Analyses
- Joan Wieszka, Lockheed Martin Corporation
- Harold Wilson, Northrop Grumman
- Brenda Zettervall, US Navy

Ex-Officio Steering Group Members

- Mike Konrad, Software Engineering Institute
- Susan LaFortune, National Security Agency
- David (Mike) Phillips, Software Engineering Institute

Steering Group Support

- Mary Beth Chrissis, Software Engineering Institute (CCB)
- Eric Hayes, Software Engineering Institute (secretary)
- Rawdon Young, Software Engineering Institute (Appraisal program)

CMMI for Services Advisory Group

The Services Advisory Group provides advice to the product development team about service industries.

- Brandon Buteau, Northrop Grumman Corporation
- Christian Carmody, University of Pittsburgh Medical Center
- Sandra Cepeda, Cepeda Systems & Software Analysis/RDECOM SED
- Annie Combelles, DNV IT Global Services
- Jeff Dutton, Jacobs Technology, Inc.
- Eileen Forrester, Software Engineering Institute
- Craig Hollenbach, Northrop Grumman Corporation (lead)
- Bradley Nelson, Department of Defense
- Lawrence Osiecki, US Army ARDEC
- David (Mike) Phillips, Software Engineering Institute
- Timothy Salerno, Lockheed Martin Corporation
- Sandy Shrum, Software Engineering Institute
- Nidhi Srivastava, Tata Consultancy Services
- Elizabeth Sumpter, NSA
- David Swidorsky, Bank of America

CMMI V1.3 Coordination Team

The Coordination team brings together members of other product development teams to ensure coordination across the project.

- Rhonda Brown, Software Engineering Institute
- Mary Beth Chrissis, Software Engineering Institute
- Eileen Forrester, Software Engineering Institute
- Will Hayes, Software Engineering Institute
- Mike Konrad, Software Engineering Institute
- So Norimatsu, Norimatsu Process Engineering Lab, Inc.
- Mary Lynn Penn, Lockheed Martin Corporation
- David (Mike) Phillips, Software Engineering Institute (lead)
- Sandy Shrum, Software Engineering Institute
- Kathy Smith, Hewlett Packard
- Barbara Tyson, Software Engineering Institute
- Rawdon Young, Software Engineering Institute
- Mary Lynn Russo, Software Engineering Institute (non-voting member)

CMMI V1.3 Configuration Control Board

The Configuration Control Board approves all changes to CMMI materials, including the models, the SCAMPI MDD, and introductory model training.

- Rhonda Brown, Software Engineering Institute
- Michael Campo, Raytheon
- Mary Beth Chrissis, Software Engineering Institute (lead)
- Kirsten Dauplaise, NAVAIR
- Mike Evanoo, Systems and Software Consortium, Inc.
- Rich Frost, General Motors
- Brian Gallagher, Northrop Grumman
- Sally Godfrey, NASA
- Stephen Gristock, JP Morgan Chase and Co.
- Eric Hayes (non-voting member)
- Nils Jacobsen, Motorola
- Steve Kapurch, NASA
- Mike Konrad, Software Engineering Institute
- Chris Moore, US Air Force
- Wendell Mullison, General Dynamics Land Systems
- David (Mike) Phillips, Software Engineering Institute
- Robert Rassa, Raytheon Space and Airborne Systems
- Karen Richter, Institute for Defense Analyses
- Mary Lou Russo (non-voting member)

- Warren Schwoemeyer, Lockheed Martin Corporation
- John Scibilia, US Army
- Dave Swidorsky, Bank of America
- Barbara Tyson, Software Engineering Institute
- Mary Van Tyne, Software Engineering Institute (non-voting member)
- Rawdon Young, Software Engineering Institute

CMMI V1.3 Core Model Team

The Core Model Team develops the model material for all three constellations.

- Jim Armstrong, Stevens Institute of Technology
- Rhonda Brown, Software Engineering Institute (co-lead)
- Brandon Buteau, Northrop Grumman
- Michael Campo, Raytheon
- Sandra Cepeda, Cepeda Systems & Software Analysis/RDECOM SED
- Mary Beth Chrissis, Software Engineering Institute
- Mike D'Ambrosia, Process Performance Professionals
- Eileen Forrester, Software Engineering Institute
- Will Hayes, Software Engineering Institute
- Mike Konrad, Software Engineering Institute (co-lead)
- So Norimatsu, Norimatsu Process Engineering Lab, Inc.
- Mary Lynn Penn, Lockheed Martin Corporation
- David (Mike) Phillips, Software Engineering Institute
- Karen Richter, Institute for Defense Analyses
- Mary Lynn Russo, Software Engineering Institute (non-voting member)
- John Scibilia, US Army
- Sandy Shrum, Software Engineering Institute (co-lead)
- Kathy Smith, Hewlett Packard
- Katie Smith-McGarty, US Navy

CMMI V1.3 Translation Team

The Translation Team coordinates translation work on CMMI materials.

- Richard Basque, Alcyonix
- Jose Antonio Calvo-Manzano, Universidad Politecnica de Madrid
- Carlos Caram, Integrated Systems Diagnostics Brazil
- Gonzalo Cuevas, Universidad Politecnica de Madrid
- Mike Konrad, Software Engineering Institute
- Antoine Nardeze, Alcyonix

- So Norimatsu, Norimatsu Process Engineering Lab, Inc. (lead)
- Seven Ou, Institute for Information Industry
- Ricardo Panero Lamothe, Accenture
- Mary Lynn Russo, Software Engineering Institute (non-voting member)
- Winfried Russwurm, Siemens AG
- Tomas San Feliu, Universidad Politecnica de Madrid

CMMI V1.3 High Maturity Team

The High Maturity team developed high maturity model material.

- Dan Bennett, US Air Force
- Will Hayes, Software Engineering Institute
- Rick Hefner, Northrop Grumman
- Jim Kubeck, Lockheed Martin Corporation
- Alice Parry, Raytheon
- Mary Lynn Penn, Lockheed Martin Corporation (lead)
- Kathy Smith, Hewlett Packard
- Rawdon Young, Software Engineering Institute

CMMI V1.3 Acquisition Mini Team

The Acquisition Mini Team provides acquisition expertise for model development work.

- Rich Frost, General Motors
- Tom Keuten, Keuten and Associates
- David (Mike) Phillips, Software Engineering Institute (lead)
- Karen Richter, Institute for Defense Analyses
- John Scibilia, US Army

CMMI V1.3 Services Mini Team

The Services Mini Team provides service expertise for model development work.

- Drew Allison, Systems and Software Consortium, Inc.
- Brandon Buteau, Northrop Grumman
- Eileen Forrester, Software Engineering Institute (lead)
- Christian Hertneck, Anywhere.24 GmbH
- Pam Schoppert, Science Applications International Corporation

CMMI V1.3 SCAMPI Upgrade Team

The SCAMPI Upgrade team develops the Appraisal Requirements for CMMI (ARC) document and SCAMPI Method Definition Document (MDD).

- Mary Busby, Lockheed Martin Corporation
- Palma Buttles-Valdez, Software Engineering Institute
- Paul Byrnes, Integrated System Diagnostics
- Will Hayes, Software Engineering Institute (leader)
- Ravi Khetan, Northrop Grumman
- Denise Kirkham, The Boeing Company
- Lisa Ming, The Boeing Company
- Charlie Ryan, Software Engineering Institute
- Kevin Schaaff, Software Engineering Institute
- Alexander Stall, Software Engineering Institute
- Agapi Svolou, Software Engineering Institute
- Ron Ulrich, Northrop Grumman

CMMI Version 1.3 Training Teams

The two training teams (one for CMMI-DEV and CMMI-ACQ and the other for CMMI-SVC) developed model training materials.

ACQ and DEV Training Team

- Barbara Baldwin, Software Engineering Institute
- Bonnie Bollinger, Process Focus Management
- Cat Brandt-Zaccardi, Software Engineering Institute
- Rhonda Brown, Software Engineering Institute
- Michael Campo, Raytheon
- Mary Beth Chrissis, Software Engineering Institute (lead)
- Stacey Cope, Software Engineering Institute
- Eric Dorsett, Jeppesen
- Dan Foster, PF Williamson
- Eric Hayes, Software Engineering Institute
- Kurt Hess, Software Engineering Institute
- Mike Konrad, Software Engineering Institute
- Steve Masters, Software Engineering Institute
- Robert McFeeley, Software Engineering Institute
- Diane Mizukami-Williams, Northrop Grumman
- Daniel Pipitone, Software Engineering Institute
- Mary Lou Russo, Software Engineering Institute (non-voting member)
- Sandy Shrum, Software Engineering Institute

- Katie Smith-McGarty, US Navy
- Barbara Tyson, Software Engineering Institute

SVC Training Team

- Drew Allison, Systems and Software Consortium, Inc.
- Mike Bridges, University of Pittsburgh Medical Center
- Paul Byrnes, Integrated System Diagnostics
- Sandra Cepeda, Cepeda Systems & Software Analysis/RDECOM SED
- Eileen Clark, Tidewaters Consulting
- Kieran Doyle, Excellence in Measurement
- Eileen Forrester, Software Engineering Institute (lead of SVC training)
- Suzanne Miller, Software Engineering Institute
- Hillel Glazer, Entinex
- Christian Hertneck, Anywhere.24 GmbH
- Pat Kirwan, Software Engineering Institute
- Judah Mogilensky, PEP
- Heather Oppenheimer, Oppenheimer Partners
- Pat O'Toole, PACT
- Agapi Svolou, Alexanna
- Jeff Welch, Software Engineering Institute

CMMI V1.3 Quality Team

The Quality team conducts various quality assurance checks on the model material to ensure its accuracy, readability, and consistency.

- Rhonda Brown, Software Engineering Institute (co-lead)
- Erin Harper, Software Engineering Institute
- Mike Konrad, Software Engineering Institute
- Mary Lou Russo, Software Engineering Institute
- Mary Lynn Russo, Software Engineering Institute
- Sandy Shrum, Software Engineering Institute (co-lead)

Appendix D: Glossary

The glossary defines the basic terms used in CMMI models. Glossary entries are typically multiple-word terms consisting of a noun and one or more restrictive modifiers. (There are some exceptions to this rule that account for one-word terms in the glossary.)

The CMMI glossary of terms is not a required, expected, or informative component of CMMI models. Interpret the terms in the glossary in the context of the model component in which they appear.

To formulate definitions appropriate for CMMI, we consulted multiple sources. We first consulted the *Merriam-Webster OnLine* dictionary (<http://www.merriam-webster.com/>). We also consulted other standards as needed, including the following:

- ISO 9000 [ISO 2005a]
- ISO/IEC 12207 [ISO 2008a]
- ISO/IEC 15504 [ISO 2006a]
- ISO/IEC 15288 [ISO 2008b]
- ISO/IEC 15939 [ISO 2007]
- ISO 20000-1 [ISO 2005b]
- IEEE [IEEE 1991]
- CMM for Software (SW-CMM) v1.1
- EIA 632 [EIA 2003]
- SA-CMM [SEI 2002]
- People CMM (P-CMM) [Curtis 2009]
- CobiT v. 4.0 [IT Governance 2005]
- ITIL v3 (Service Improvement, Service Design, Service Operation, Service Strategy, and Service Transition) [Office of Government Commerce 2007]

We developed the glossary recognizing the importance of using terminology that all model users can understand. We also recognized that words and terms can have different meanings in different contexts and environments. The glossary in CMMI models is designed to document the meanings of words and terms that should have the widest use and understanding by users of CMMI products.

Even though the term “product” includes services as well as products and the term “service” is defined as a type of product, many of the terms in the glossary contain both the words “product” and “service” to emphasize that CMMI applies to both products and services.

Every glossary entry has two to three components. There is always a term and always a definition. Sometimes additional notes are provided.

The term defined is listed on the left side of the page. The definition appears first in a type size similar to the term listed. Glossary notes follow the definition and are in a smaller type size.

acceptance criteria	The criteria that a deliverable must satisfy to be accepted by a user, customer, or other authorized entity. (See also “deliverable.”)
acceptance testing	Formal testing conducted to enable a user, customer, or other authorized entity to determine whether to accept a deliverable. (See also “unit testing.”)
achievement profile	A list of process areas and their corresponding capability levels that represent the organization’s progress for each process area while advancing through the capability levels. (See also “capability level profile,” “target profile,” and “target staging.”)
acquirer	The stakeholder that acquires or procures a product or service from a supplier. (See also “stakeholder.”)
acquisition	The process of obtaining products or services through supplier agreements. (See also “supplier agreement.”)
acquisition strategy	The specific approach to acquiring products and services that is based on considerations of supply sources, acquisition methods, requirements specification types, agreement types, and related acquisition risks.
addition	A clearly marked model component that contains information of interest to particular users. In a CMMI model, all additions bearing the same name can be optionally selected as a group for use. In CMMI for Services, the Service System Development (SSD) process area is an addition.
allocated requirement	Requirement that results from levying all or part of a higher level requirement on a lower level architectural element or design component. More generally, requirements can be allocated to other logical or physical components including people, consumables, delivery increments, or the architecture as a whole, depending on what best enables the product or service to achieve the requirements.

appraisal	An examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining, at a minimum, strengths and weaknesses. This term has a special meaning in the CMMI Product Suite besides its common standard English meaning.
appraisal findings	The results of an appraisal that identify the most important issues, problems, or opportunities for process improvement within the appraisal scope. Appraisal findings are inferences drawn from corroborated objective evidence.
appraisal participants	Members of the organizational unit who participate in providing information during an appraisal.
appraisal rating	The value assigned by an appraisal team to (a) a CMMI goal or process area, (b) the capability level of a process area, or (c) the maturity level of an organizational unit. This term is used in CMMI appraisal materials such as the SCAMPI MDD. A rating is determined by enacting the defined rating process for the appraisal method being employed.
appraisal reference model	The CMMI model to which an appraisal team correlates implemented process activities. This term is used in CMMI appraisal materials such as the SCAMPI MDD.
appraisal scope	The definition of the boundaries of an appraisal encompassing the organizational limits and CMMI model limits within which the processes to be investigated operate. This term is used in CMMI appraisal materials such as the SCAMPI MDD.
architecture	The set of structures needed to reason about a product. These structures are comprised of elements, relations among them, and properties of both. In a service context, the architecture is often applied to the service system. Note that functionality is only one aspect of the product. Quality attributes, such as responsiveness, reliability, and security, are also important to reason about. Structures provide the means for highlighting different portions of the architecture. (See also “functional architecture.”)

audit	An objective examination of a work product or set of work products against specific criteria (e.g., requirements). (See also “objectively evaluate.”) This is a term used in several ways in CMMI, including configuration audits and process compliance audits.
baseline	A set of specifications or work products that has been formally reviewed and agreed on, which thereafter serves as the basis for further development, and which can be changed only through change control procedures. (See also “configuration baseline” and “product baseline.”)
base measure	Measure defined in terms of an attribute and the method for quantifying it. (See also “derived measure.”) A base measure is functionally independent of other measures.
bidirectional traceability	An association among two or more logical entities that is discernable in either direction (i.e., to and from an entity). (See also “requirements traceability” and “traceability.”)
business objectives	(See “organization’s business objectives.”)
capability level	Achievement of process improvement within an individual process area. (See also “generic goal,” “specific goal,” “maturity level,” and “process area.”) A capability level is defined by appropriate specific and generic goals for a process area.
capability level profile	A list of process areas and their corresponding capability levels. (See also “achievement profile,” “target profile,” and “target staging.”) A capability level profile can be an “achievement profile” when it represents the organization’s progress for each process area while advancing through the capability levels. Or, it can be a “target profile” when it represents an objective for process improvement.
capability maturity model	A model that contains the essential elements of effective processes for one or more areas of interest and describes an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness.
capable process	A process that can satisfy its specified product quality, service quality, and process performance objectives. (See also “stable process” and “standard process.”)
causal analysis	The analysis of outcomes to determine their causes.

change management	Judicious use of means to effect a change, or a proposed change, to a product or service. (See also “configuration management.”)
CMMI Framework	The basic structure that organizes CMMI components, including elements of current CMMI models as well as rules and methods for generating models, appraisal methods (including associated artifacts), and training materials. (See also “CMMI model” and “CMMI Product Suite.”) The framework enables new areas of interest to be added to CMMI so that they will integrate with the existing ones.
CMMI model	A model generated from the CMMI Framework. (See also “CMMI Framework” and “CMMI Product Suite.”)
CMMI model component	Any of the main architectural elements that compose a CMMI model. Some of the main elements of a CMMI model include specific practices, generic practices, specific goals, generic goals, process areas, capability levels, and maturity levels.
CMMI Product Suite	The complete set of products developed around the CMMI concept. (See also “CMMI Framework” and “CMMI model.”) These products include the framework itself, models, appraisal methods, appraisal materials, and training materials.
commercial off-the-shelf	Items that can be purchased from a commercial supplier.
common cause of variation	The variation of a process that exists because of normal and expected interactions among components of a process. (See also “special cause of variation.”)
configuration audit	An audit conducted to verify that a configuration item or a collection of configuration items that make up a baseline conforms to a specified standard or requirement. (See also “audit” and “configuration item.”)
configuration baseline	The configuration information formally designated at a specific time during a product’s or product component’s life. (See also “product lifecycle.”) Configuration baselines plus approved changes from those baselines constitute the current configuration information.

configuration control	An element of configuration management consisting of the evaluation, coordination, approval or disapproval, and implementation of changes to configuration items after formal establishment of their configuration identification. (See also “configuration identification,” “configuration item,” and “configuration management.”)
configuration control board	A group of people responsible for evaluating and approving or disapproving proposed changes to configuration items and for ensuring implementation of approved changes. (See also “configuration item.”) Configuration control boards are also known as “change control boards.”
configuration identification	An element of configuration management consisting of selecting the configuration items for a product, assigning unique identifiers to them, and recording their functional and physical characteristics in technical documentation. (See also “configuration item,” “configuration management,” and “product.”)
configuration item	An aggregation of work products that is designated for configuration management and treated as a single entity in the configuration management process. (See also “configuration management.”)
configuration management	A discipline applying technical and administrative direction and surveillance to (1) identify and document the functional and physical characteristics of a configuration item, (2) control changes to those characteristics, (3) record and report change processing and implementation status, and (4) verify compliance with specified requirements. (See also “configuration audit,” “configuration control,” “configuration identification,” and “configuration status accounting.”)
configuration status accounting	An element of configuration management consisting of the recording and reporting of information needed to manage a configuration effectively. (See also “configuration identification” and “configuration management.”) This information includes a list of the approved configuration, the status of proposed changes to the configuration, and the implementation status of approved changes.
constellation	A collection of CMMI components that are used to construct models, training materials, and appraisal related documents for an area of interest (e.g., acquisition, development, services).

continuous representation	A capability maturity model structure wherein capability levels provide a recommended order for approaching process improvement within each specified process area. (See also “capability level,” “process area,” and “staged representation.”)
contractor	(See “supplier.”)
contractual requirements	The result of the analysis and refinement of customer requirements into a set of requirements suitable to be included in one or more solicitation packages, or supplier agreements. (See also “acquirer,” “customer requirement,” “supplier agreement,” and “solicitation package.”) Contractual requirements include both technical and nontechnical requirements necessary for the acquisition of a product or service.
corrective action	Acts or deeds used to remedy a situation or remove an error.
customer	The party responsible for accepting the product or for authorizing payment. The customer is external to the project or work group (except possibly in certain project structures in which the customer effectively is on the project team or in the work group) but not necessarily external to the organization. The customer can be a higher level project or work group. Customers are a subset of stakeholders. (See also “stakeholder.”) In most cases where this term is used, the preceding definition is intended; however, in some contexts, the term “customer” is intended to include other relevant stakeholders. (See also “customer requirement.”) End users can be distinguished from customers if the parties that directly receive the value of products and services are not the same as the parties that arrange for, pay for, or negotiate agreements. In contexts where customers and end users are essentially the same parties, the term “customer” can encompass both types. (See also “end user.”)
customer requirement	The result of eliciting, consolidating, and resolving conflicts among the needs, expectations, constraints, and interfaces of the product’s relevant stakeholders in a way that is acceptable to the customer. (See also “customer.”)
data	Recorded information. Recorded information can include technical data, computer software documents, financial information, management information, representation of facts, numbers, or datum of any nature that can be communicated, stored, and processed.

data management	The disciplined processes and systems that plan for, acquire, and provide stewardship for business and technical data, consistent with data requirements, throughout the data lifecycle.
defect density	Number of defects per unit of product size. An example is the number of problem reports per thousand lines of code.
defined process	A managed process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines; has a maintained process description; and contributes process related experiences to the organizational process assets. (See also "managed process.")
definition of required functionality and quality attributes	A characterization of required functionality and quality attributes obtained through "chunking," organizing, annotating, structuring, or formalizing the requirements (functional and non-functional) to facilitate further refinement and reasoning about the requirements as well as (possibly, initial) solution exploration, definition, and evaluation. (See also "architecture," "functional architecture," and "quality attribute.") As technical solution processes progress, this characterization can be further evolved into a description of the architecture versus simply helping scope and guide its development, depending on the engineering processes used; requirements specification and architectural languages used; and the tools and the environment used for product or service system development.
deliverable	An item to be provided to an acquirer or other designated recipient as specified in an agreement. (See also "acquirer.") This item can be a document, hardware item, software item, service, or any type of work product.

delivery environment

The complete set of circumstances and conditions under which services are delivered in accordance with service agreements. (See also “service” and “service agreement.”)

The delivery environment encompasses everything that has or can have a significant effect on service delivery, including but not limited to service system operation, natural phenomena, and the behavior of all parties, whether or not they intend to have such an effect. For example, consider the effect of weather or traffic patterns on a transportation service. (See also “service system.”)

The delivery environment is uniquely distinguished from other environments (e.g., simulation environments, testing environments). The delivery environment is the one in which services are actually delivered and count as satisfying a service agreement.

derived measure

Measure that is defined as a function of two or more values of base measures. (See also “base measure.”)

derived requirements

Requirements that are not explicitly stated in customer requirements but are inferred (1) from contextual requirements (e.g., applicable standards, laws, policies, common practices, management decisions) or (2) from requirements needed to specify a product or service component.

Derived requirements can also arise during analysis and design of components of the product or service. (See also “product requirements.”)

design review

A formal, documented, comprehensive, and systematic examination of a design to determine if the design meets the applicable requirements, to identify problems, and to propose solutions.

development

To create a product or service system by deliberate effort.

In some contexts, development can include the maintenance of the developed product.

document

A collection of data, regardless of the medium on which it is recorded, that generally has permanence and can be read by humans or machines.

Documents include both paper and electronic documents.

end user	A party that ultimately uses a delivered product or that receives the benefit of a delivered service. (See also “customer.”) End users may or may not also be customers (who can establish and accept agreements or authorize payments). In contexts where a single service agreement covers multiple service deliveries, any party that initiates a service request can be considered an end user. (See also “service agreement” and “service request.”)
enterprise	The full composition of a company. (See also “organization.”) A company can consist of many organizations in many locations with different customers.
entry criteria	States of being that must be present before an effort can begin successfully.
equivalent staging	A target staging, created using the continuous representation that is defined so that the results of using the target staging can be compared to maturity levels of the staged representation. (See also “capability level profile,” “maturity level,” “target profile,” and “target staging.”) Such staging permits benchmarking of progress among organizations, enterprises, projects, and work groups, regardless of the CMMI representation used. The organization can implement components of CMMI models beyond the ones reported as part of equivalent staging. Equivalent staging relates how the organization compares to other organizations in terms of maturity levels.
establish and maintain	Create, document, use, and revise work products as necessary to ensure they remain useful. The phrase “establish and maintain” plays a special role in communicating a deeper principle in CMMI: work products that have a central or key role in work group, project, and organizational performance should be given attention to ensure they are used and useful in that role. This phrase has particular significance in CMMI because it often appears in goal and practice statements (though in the former as “established and maintained”) and should be taken as shorthand for applying the principle to whatever work product is the object of the phrase.
example work product	An informative model component that provides sample outputs from a specific practice.
executive	(See “senior manager.”)

exit criteria	States of being that must be present before an effort can end successfully.
expected CMMI components	CMMI components that describe the activities that are important in achieving a required CMMI component. Model users can implement the expected components explicitly or implement equivalent practices to these components. Specific and generic practices are expected model components.
findings	(See “appraisal findings.”)
formal evaluation process	A structured approach to evaluating alternative solutions against established criteria to determine a recommended solution to address an issue.
framework	(See “CMMI Framework.”)
functional analysis	Examination of a defined function to identify all the subfunctions necessary to accomplish that function; identification of functional relationships and interfaces (internal and external) and capturing these relationships and interfaces in a functional architecture; and flow down of upper level requirements and assignment of these requirements to lower level subfunctions. (See also “functional architecture.”)
functional architecture	The hierarchical arrangement of functions, their internal and external (external to the aggregation itself) functional interfaces and external physical interfaces, their respective requirements, and their design constraints. (See also “architecture,” “functional analysis,” and “definition of required functionality and quality attributes.”)
generic goal	A required model component that describes characteristics that must be present to institutionalize processes that implement a process area. (See also “institutionalization.”)
generic practice	An expected model component that is considered important in achieving the associated generic goal. The generic practices associated with a generic goal describe the activities that are expected to result in achievement of the generic goal and contribute to the institutionalization of the processes associated with a process area.
generic practice elaboration	An informative model component that appears after a generic practice to provide guidance on how the generic practice could be applied uniquely to a process area. (This model component is not present in all CMMI models.)

hardware engineering

The application of a systematic, disciplined, and quantifiable approach to transforming a set of requirements that represent the collection of stakeholder needs, expectations, and constraints, using documented techniques and technology to design, implement, and maintain a tangible product. (See also “software engineering” and “systems engineering.”)

In CMMI, hardware engineering represents all technical fields (e.g., electrical, mechanical) that transform requirements and ideas into tangible products.

higher level management

The person or persons who provide the policy and overall guidance for the process but do not provide the direct day-to-day monitoring and controlling of the process. (See also “senior manager.”)

Such persons belong to a level of management in the organization above the immediate level responsible for the process and can be (but are not necessarily) senior managers.

incomplete process

A process that is not performed or is performed only partially; one or more of the specific goals of the process area are not satisfied.

An incomplete process is also known as capability level 0.

informative CMMI components

CMMI components that help model users understand the required and expected components of a model.

These components can be examples, detailed explanations, or other helpful information. Subpractices, notes, references, goal titles, practice titles, sources, example work products, and generic practice elaborations are informative model components.

institutionalization

The ingrained way of doing business that an organization follows routinely as part of its corporate culture.

interface control

In configuration management, the process of (1) identifying all functional and physical characteristics relevant to the interfacing of two or more configuration items provided by one or more organizations and (2) ensuring that proposed changes to these characteristics are evaluated and approved prior to implementation. (See also “configuration item” and “configuration management.”)

lifecycle model

A partitioning of the life of a product, service, project, work group, or set of work activities into phases.

managed process	A performed process that is planned and executed in accordance with policy; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description. (See also “performed process.”)
manager	A person who provides technical and administrative direction and control to those who perform tasks or activities within the manager’s area of responsibility. This term has a special meaning in the CMMI Product Suite besides its common standard English meaning. The traditional functions of a manager include planning, organizing, directing, and controlling work within an area of responsibility.
maturity level	Degree of process improvement across a predefined set of process areas in which all goals in the set are attained. (See also “capability level” and “process area.”)
measure (noun)	Variable to which a value is assigned as a result of measurement. (See also “base measure,” “derived measure,” and “measurement.”) The definition of this term in CMMI is consistent with the definition of this term in ISO 15939.
measurement	A set of operations to determine the value of a measure. (See also “measure.”) The definition of this term in CMMI is consistent with the definition of this term in ISO 15939.
measurement result	A value determined by performing a measurement. (See also “measurement.”)
memorandum of agreement	Binding document of understanding or agreement between two or more parties. A memorandum of agreement is also known as a “memorandum of understanding.”
natural bounds	The inherent range of variation in a process, as determined by process performance measures. Natural bounds are sometimes referred to as “voice of the process.” Techniques such as control charts, confidence intervals, and prediction intervals are used to determine whether the variation is due to common causes (i.e., the process is predictable or stable) or is due to some special cause that can and should be identified and removed. (See also “measure” and “process performance.”)

nondevelopmental item

An item that was developed prior to its current use in an acquisition or development process.

Such an item can require minor modifications to meet the requirements of its current intended use.

nontechnical requirements

Requirements affecting product and service acquisition or development that are not properties of the product or service.

Examples include numbers of products or services to be delivered, data rights for delivered COTS and nondevelopmental items, delivery dates, and milestones with exit criteria. Other nontechnical requirements include work constraints associated with training, site provisions, and deployment schedules.

objectively evaluate

To review activities and work products against criteria that minimize subjectivity and bias by the reviewer. (See also “audit.”)

An example of an objective evaluation is an audit against requirements, standards, or procedures by an independent quality assurance function.

operational concept

A general description of the way in which an entity is used or operates.

An operational concept is also known as “concept of operations.”

operational scenario

A description of an imagined sequence of events that includes the interaction of the product or service with its environment and users, as well as interaction among its product or service components.

Operational scenarios are used to evaluate the requirements and design of the system and to verify and validate the system.

organization

An administrative structure in which people collectively manage one or more projects or work groups as a whole, share a senior manager, and operate under the same policies.

However, the word “organization” as used throughout CMMI models can also apply to one person who performs a function in a small organization that might be performed by a group of people in a large organization. (See also “enterprise.”)

organizational maturity

The extent to which an organization has explicitly and consistently deployed processes that are documented, managed, measured, controlled, and continually improved.

Organizational maturity can be measured via appraisals.

organizational policy	A guiding principle typically established by senior management that is adopted by an organization to influence and determine decisions.
organizational process assets	Artifacts that relate to describing, implementing, and improving processes. Examples of these artifacts include policies, measurement descriptions, process descriptions, process implementation support tools. The term “process assets” is used to indicate that these artifacts are developed or acquired to meet the business objectives of the organization and that they represent investments by the organization that are expected to provide current and future business value. (See also “process asset library.”)
organization’s business objectives	Senior-management-developed objectives designed to ensure an organization’s continued existence and enhance its profitability, market share, and other factors influencing the organization’s success. (See also “quality and process performance objectives” and “quantitative objective.”)
organization’s measurement repository	A repository used to collect and make measurement results available on processes and work products, particularly as they relate to the organization’s set of standard processes. This repository contains or references actual measurement results and related information needed to understand and analyze measurement results.
organization’s process asset library	A library of information used to store and make process assets available that are useful to those who are defining, implementing, and managing processes in the organization. This library contains process assets that include process related documentation such as policies, defined processes, checklists, lessons learned documents, templates, standards, procedures, plans, and training materials.
organization’s set of standard processes	A collection of definitions of the processes that guide activities in an organization. These process descriptions cover the fundamental process elements (and their relationships to each other such as ordering and interfaces) that should be incorporated into the defined processes that are implemented in projects, work groups, and work across the organization. A standard process enables consistent development and maintenance activities across the organization and is essential for long-term stability and improvement. (See also “defined process” and “process element.”)

outsourcing	(See “acquisition.”)
peer review	The review of work products performed by peers during the development of work products to identify defects for removal. (See also “work product.”) The term “peer review” is used in the CMMI Product Suite instead of the term “work product inspection.”
performance parameters	The measures of effectiveness and other key measures used to guide and control progressive development.
performed process	A process that accomplishes the needed work to produce work products; the specific goals of the process area are satisfied.
planned process	A process that is documented by both a description and a plan. The description and plan should be coordinated and the plan should include standards, requirements, objectives, resources, and assignments.
policy	(See “organizational policy.”)
process	A set of interrelated activities, which transform inputs into outputs, to achieve a given purpose. (See also “process area,” “subprocess,” and “process element.”) There is a special use of the phrase “the process” in the statements and descriptions of the generic goals and generic practices. “The process,” as used in Part Two, is the process or processes that implement the process area. The terms “process,” “subprocess” and “process element” form a hierarchy with “process” as the highest, most general term, “subprocesses” below it, and “process element” as the most specific. A particular process can be called a subprocess if it is part of another larger process. It can also be called a process element if it is not decomposed into subprocesses. This definition of process is consistent with the definition of process in ISO 9000, ISO 12207, ISO 15504, and EIA 731.
process action plan	A plan, usually resulting from appraisals, that documents how specific improvements targeting the weaknesses uncovered by an appraisal will be implemented.
process action team	A team that has the responsibility to develop and implement process improvement activities for an organization as documented in a process action plan.

process and technology improvements	Incremental and innovative improvements to processes and to process, product, or service technologies.
process architecture	(1) The ordering, interfaces, interdependencies, and other relationships among the process elements in a standard process, or (2) the interfaces, interdependencies, and other relationships between process elements and external processes.
process area	A cluster of related practices in an area that, when implemented collectively, satisfies a set of goals considered important for making improvement in that area.
process asset	Anything the organization considers useful in attaining the goals of a process area. (See also “organizational process assets.”)
process asset library	A collection of process asset holdings that can be used by an organization, project, or work group. (See also “organization’s process asset library.”)
process attribute	A measurable characteristic of process capability applicable to any process.
process capability	The range of expected results that can be achieved by following a process.
process definition	The act of defining and describing a process. The result of process definition is a process description. (See also “process description.”)
process description	A documented expression of a set of activities performed to achieve a given purpose. A process description provides an operational definition of the major components of a process. The description specifies, in a complete, precise, and verifiable manner, the requirements, design, behavior, or other characteristics of a process. It also can include procedures for determining whether these provisions have been satisfied. Process descriptions can be found at the activity, project, work group, or organizational level.

process element

The fundamental unit of a process.

A process can be defined in terms of subprocesses or process elements. A subprocess is a process element when it is not further decomposed into subprocesses or process elements. (See also “process” and “subprocess.”)

Each process element covers a closely related set of activities (e.g., estimating element, peer review element). Process elements can be portrayed using templates to be completed, abstractions to be refined, or descriptions to be modified or used. A process element can be an activity or task.

The terms “process,” “subprocess,” and “process element” form a hierarchy with “process” as the highest, most general term, “subprocesses” below it, and “process element” as the most specific.

process group

A collection of specialists who facilitate the definition, maintenance, and improvement of processes used by the organization.

process improvement

A program of activities designed to improve the process performance and maturity of the organization’s processes, and the results of such a program.

process improvement objectives

A set of target characteristics established to guide the effort to improve an existing process in a specific, measurable way either in terms of resultant product or service characteristics (e.g., quality, product performance, conformance to standards) or in the way in which the process is executed (e.g., elimination of redundant process steps, combination of process steps, improvement of cycle time). (See also “organization’s business objectives” and “quantitative objective.”)

process improvement plan

A plan for achieving organizational process improvement objectives based on a thorough understanding of current strengths and weaknesses of the organization’s processes and process assets.

process measurement

A set of operations used to determine values of measures of a process and its resulting products or services for the purpose of characterizing and understanding the process. (See also “measurement.”)

process owner	The person (or team) responsible for defining and maintaining a process. At the organizational level, the process owner is the person (or team) responsible for the description of a standard process; at the project or work group level, the process owner is the person (or team) responsible for the description of the defined process. A process can therefore have multiple owners at different levels of responsibility. (See also “defined process” and “standard process.”)
process performance	A measure of results achieved by following a process. (See also “measure.”) Process performance is characterized by both process measures (e.g., effort, cycle time, defect removal efficiency) and product or service measures (e.g., reliability, defect density, response time).
process performance baseline	A documented characterization of process performance, which can include central tendency and variation. (See also “process performance.”) A process performance baseline can be used as a benchmark for comparing actual process performance against expected process performance.
process performance model	A description of relationships among the measurable attributes of one or more processes or work products that is developed from historical process performance data and is used to predict future performance. (See also “measure.”) One or more of the measureable attributes represent controllable inputs tied to a subprocess to enable performance of “what-if” analyses for planning, dynamic re-planning, and problem resolution. Process performance models include statistical, probabilistic and simulation based models that predict interim or final results by connecting past performance with future outcomes. They model the variation of the factors, and provide insight into the expected range and variation of predicted results. A process performance model can be a collection of models that (when combined) meet the criteria of a process performance model.
process tailoring	Making, altering, or adapting a process description for a particular end. For example, a project or work group tailors its defined process from the organization’s set of standard processes to meet objectives, constraints, and the environment of the project or work group. (See also “defined process,” “organization’s set of standard processes,” and “process description.”)

product

A work product that is intended for delivery to a customer or end user.

This term has a special meaning in the CMMI Product Suite besides its common standard English meaning. The form of a product can vary in different contexts. (See also “customer,” “product component,” “service,” and “work product.”)

product baseline

The initial approved technical data package defining a configuration item during the production, operation, maintenance, and logistic support of its lifecycle. (See also “configuration item,” “configuration management,” and “technical data package.”)

This term is related to configuration management.

product component

A work product that is a lower level component of the product. (See also “product” and “work product.”)

Product components are integrated to produce the product. There can be multiple levels of product components.

Throughout the process areas, where the terms “product” and “product component” are used, their intended meanings also encompass services, service systems, and their components.

This term has a special meaning in the CMMI Product Suite besides its common standard English meaning.

product component requirements

A complete specification of a product or service component, including fit, form, function, performance, and any other requirement.

product lifecycle

The period of time, consisting of phases, that begins when a product or service is conceived and ends when the product or service is no longer available for use.

Since an organization can be producing multiple products or services for multiple customers, one description of a product lifecycle may not be adequate. Therefore, the organization can define a set of approved product lifecycle models. These models are typically found in published literature and are likely to be tailored for use in an organization.

A product lifecycle could consist of the following phases: (1) concept and vision, (2) feasibility, (3) design/development, (4) production, and (5) phase out.

product line

A group of products sharing a common, managed set of features that satisfy specific needs of a selected market or mission and that are developed from a common set of core assets in a prescribed way. (See also “service line.”)

The development or acquisition of products for the product line is based on exploiting commonality and bounding variation (i.e., restricting unnecessary product variation) across the group of products. The managed set of core assets (e.g., requirements, architectures, components, tools, testing artifacts, operating procedures, software) includes prescriptive guidance for their use in product development. Product line operations involve interlocking execution of the broad activities of core asset development, product development, and management.

Many people use “product line” just to mean the set of products produced by a particular business unit, whether they are built with shared assets or not. We call that collection a “portfolio,” and reserve “product line” to have the technical meaning given here.

product related lifecycle processes

Processes associated with a product or service throughout one or more phases of its life (e.g., from conception through disposal), such as manufacturing and support processes.

product requirements

A refinement of customer requirements into the developers’ language, making implicit requirements into explicit derived requirements. (See also “derived requirements” and “product component requirements.”)

The developer uses product requirements to guide the design and building of the product or service.

product suite

(See “CMMI Product Suite.”)

project

A managed set of interrelated activities and resources, including people, that delivers one or more products or services to a customer or end user.

A project has an intended beginning (i.e., project startup) and end. Projects typically operate according to a plan. Such a plan is frequently documented and specifies what is to be delivered or implemented, the resources and funds to be used, the work to be done, and a schedule for doing the work. A project can be composed of projects. (See also “project startup.”)

In some contexts, the term “program” is used to refer to a project.

project plan

A plan that provides the basis for performing and controlling the project's activities, which addresses the commitments to the project's customer.

Project planning includes estimating the attributes of work products and tasks, determining the resources needed, negotiating commitments, producing a schedule, and identifying and analyzing project risks. Iterating through these activities may be necessary to establish the project plan.

project progress and performance

What a project achieves with respect to implementing project plans, including effort, cost, schedule, and technical performance. (See also "technical performance.")

project startup

When a set of interrelated resources for a project are directed to develop or deliver one or more products or services for a customer or end user. (See also "project.")

prototype

A preliminary type, form, or instance of a product, service, product component, or service component that serves as a model for later stages or for the final, complete version of the product or service.

This model of the product or service (e.g., physical, electronic, digital, analytical) can be used for the following (and other) purposes:

- Assessing the feasibility of a new or unfamiliar technology
- Assessing or mitigating technical risk
- Validating requirements
- Demonstrating critical features
- Qualifying a product or service
- Qualifying a process
- Characterizing performance or features of the product or service
- Elucidating physical principles

quality

The degree to which a set of inherent characteristics fulfills requirements.

quality and process performance objectives

Quantitative objectives and requirements for product quality, service quality, and process performance.

Quantitative process performance objectives include quality; however, to emphasize the importance of quality in the CMMI Product Suite, the phrase "quality and process performance objectives" is used. "Process performance objectives" are referenced in maturity level 3; the term "quality and process performance objectives" implies the use of quantitative data and is only used in maturity levels 4 and 5.

quality assurance	A planned and systematic means for assuring management that the defined standards, practices, procedures, and methods of the process are applied.
quality attribute	A property of a product or service by which its quality will be judged by relevant stakeholders. Quality attributes are characterizable by some appropriate measure. Quality attributes are non-functional, such as timeliness, throughput, responsiveness, security, modifiability, reliability, and usability. They have a significant influence on the architecture.
quality control	The operational techniques and activities that are used to fulfill requirements for quality. (See also “quality assurance.”)
quantitative management	Managing a project or work group using statistical and other quantitative techniques to build an understanding of the performance or predicted performance of processes in comparison to the project’s or work group’s quality and process performance objectives, and identifying corrective action that may need to be taken. (See also “statistical techniques.”) Statistical techniques used in quantitative management include analysis, creation, or use of process performance models; analysis, creation, or use of process performance baselines; use of control charts; analysis of variance, regression analysis; and use of confidence intervals or prediction intervals, sensitivity analysis, simulations, and tests of hypotheses.
quantitative objective	Desired target value expressed using quantitative measures. (See also “measure,” “process improvement objectives,” and “quality and process performance objectives.”)
quantitatively managed	(See “quantitative management.”)
reference model	A model that is used as a benchmark for measuring an attribute.
relevant stakeholder	A stakeholder that is identified for involvement in specified activities and is included in a plan. (See also “stakeholder.”)
representation	The organization, use, and presentation of a CMM’s components. Overall, two types of approaches to presenting best practices are evident: the staged representation and the continuous representation.

required CMMI components

CMMI components that are essential to achieving process improvement in a given process area.

Specific goals and generic goals are required model components. Goal satisfaction is used in appraisals as the basis for deciding whether a process area has been satisfied.

requirement

(1) A condition or capability needed by a user to solve a problem or achieve an objective. (2) A condition or capability that must be met or possessed by a product, service, product component, or service component to satisfy a supplier agreement, standard, specification, or other formally imposed documents. (3) A documented representation of a condition or capability as in (1) or (2). (See also “supplier agreement.”)

requirements analysis

The determination of product or service specific functional and quality attribute characteristics based on analyses of customer needs, expectations, and constraints; operational concept; projected utilization environments for people, products, services, and processes; and measures of effectiveness. (See also “operational concept.”)

requirements elicitation

Using systematic techniques such as prototypes and structured surveys to proactively identify and document customer and end-user needs.

requirements management

The management of all requirements received by or generated by the project or work group, including both technical and nontechnical requirements as well as those requirements levied on the project or work group by the organization. (See also “nontechnical requirements.”)

requirements traceability

A discernable association between requirements and related requirements, implementations, and verifications. (See also “bidirectional traceability” and “traceability.”)

return on investment

The ratio of revenue from output (product or service) to production costs, which determines whether an organization benefits from performing an action to produce something.

risk analysis

The evaluation, classification, and prioritization of risks.

risk identification

An organized, thorough approach used to seek out probable or realistic risks in achieving objectives.

risk management

An organized, analytic process used to identify what might cause harm or loss (identify risks); to assess and quantify the identified risks; and to develop and, if needed, implement an appropriate approach to prevent or handle causes of risk that could result in significant harm or loss.

Typically, risk management is performed for the activities of a project, a work group, an organization, or other organizational units that are developing or delivering products or services.

senior manager

A management role at a high enough level in an organization that the primary focus of the person filling the role is the long-term vitality of the organization rather than short-term concerns and pressures. (See also “higher level management.”)

A senior manager has authority to direct the allocation or reallocation of resources in support of organizational process improvement effectiveness.

A senior manager can be any manager who satisfies this description, including the head of the organization. Synonyms for senior manager include “executive” and “top-level manager.” However, to ensure consistency and usability, these synonyms are not used in CMMI models.

This term has a special meaning in the CMMI Product Suite besides its common standard English meaning.

service

A product that is intangible and non-storable. (See also “product,” “customer,” and “work product.”)

Services are delivered through the use of service systems that have been designed to satisfy service requirements. (See also “service system.”)

Many service providers deliver combinations of services and goods. A single service system can deliver both types of products. For example, a training organization can deliver training materials along with its training services.

Services may be delivered through combinations of manual and automated processes.

This term has a special meaning in the CMMI Product Suite besides its common standard English meaning.

service agreement

A binding, written record of a promised exchange of value between a service provider and a customer. (See also “customer.”)

Service agreements can be fully negotiable, partially negotiable, or non-negotiable, and they can be drafted either by the service provider, the customer, or both, depending on the situation.

A “promised exchange of value” means a joint recognition and acceptance of what each party will provide to the other to satisfy the agreement. Typically, the customer provides payment in return for delivered services, but other arrangements are possible.

A “written” record need not be contained in a single document or other artifact. Alternatively, it may be extremely brief for some types of services (e.g., a receipt that identifies a service, its price, its recipient).

service catalog

A list or repository of standardized service definitions.

Service catalogs can include varying degrees of detail about available service levels, quality, prices, negotiable/tailorable items, and terms and conditions.

A service catalog need not be contained in a single document or other artifact, and can be a combination of items that provide equivalent information (such as web pages linked to a database.) Alternatively, for some services an effective catalog can be a simple printed menu of available services and their prices.

Service catalog information can be partitioned into distinct subsets to support different types of stakeholders (e.g., customers, end users, provider staff, suppliers).

service incident

An indication of an actual or potential interference with a service.

Service incidents can occur in any service domain because customer and end-user complaints are types of incidents and even the simplest of services can generate complaints.

The word “incident” can be used in place of “service incident” for brevity when the context makes the meaning clear.

service level

A defined magnitude, degree, or quality of service delivery performance. (See also “service” and “service level measure.”)

service level agreement

A service agreement that specifies delivered services; service measures; levels of acceptable and unacceptable services; and expected responsibilities, liabilities, and actions of both the provider and customer in anticipated situations. (See also “measure,” “service,” and “service agreement.”)

A service level agreement is a kind of service agreement that documents the details indicated in the definition.

The use of the term “service agreement” always includes “service level agreement” as a subcategory and the former may be used in place of the latter for brevity. However, “service level agreement” is the preferred term when it is desired to emphasize situations in which distinct levels of acceptable services exist, or other details of a service level agreement are likely to be important to the discussion.

service level measure

A measure of service delivery performance associated with a service level. (See also “measure” and “service level.”)

service line

A consolidated and standardized set of services and service levels that satisfy specific needs of a selected market or mission area. (See also “product line” and “service level.”)

service request

A communication from a customer or end user that one or more specific instances of service delivery are desired. (See also “service agreement.”)

These requests are made within the context of a service agreement.

In cases where services are to be delivered continuously or periodically, some service requests may be explicitly identified in the service agreement itself.

In other cases, service requests that fall within the scope of a previously established service agreement are generated over time by customers or end users as their needs develop.

service requirements

The complete set of requirements that affect service delivery and service system development. (See also “service system.”)

Service requirements include both technical and nontechnical requirements. Technical requirements are properties of the service to be delivered and the service system needed to enable delivery. Nontechnical requirements may include additional conditions, provisions, commitments, and terms identified by agreements, and regulations, as well as needed capabilities and conditions derived from business objectives.

service system

An integrated and interdependent combination of component resources that satisfies service requirements. (See also “service system component” and “service requirements.”)

A service system encompasses *everything* required for service delivery, including work products, processes, facilities, tools, consumables, and human resources.

Note that a service system includes the people necessary to perform the service system’s processes. In contexts where end users perform some processes for service delivery to be accomplished, those end users are also part of the service system (at least for the duration of those interactions).

A complex service system may be divisible into multiple distinct delivery and support systems or subsystems. While these divisions and distinctions may be significant to the service provider organization, they may not be as meaningful to other stakeholders.

service system component

A resource required for a service system to successfully deliver services.

Some components can remain owned by a customer, end user, or third party before service delivery begins and after service delivery ends. (See also “customer” and “end user.”)

Some components can be transient resources that are part of the service system for a limited time (e.g., items that are under repair in a maintenance shop).

Components can include processes and people.

The word “component” can be used in place of “service system component” for brevity when the context makes the meaning clear.

The word “infrastructure” can be used to refer collectively to service system components that are tangible and essentially permanent. Depending on the context and type of service, infrastructure can include human resources.

service system consumable

A service system component that ceases to be available or becomes permanently changed by its use during the delivery of a service.

Fuel, office supplies, and disposable containers are examples of commonly used consumables. Particular types of services can have their own specialized consumables (e.g., a health care service may require medications or blood supplies).

People are not consumables, but their labor time is a consumable.

shared vision	A common understanding of guiding principles, including mission, objectives, expected behavior, values, and final outcomes, which are developed and used by a project or work group.
software engineering	(1) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software. (2) The study of approaches as in (1). (See also “hardware engineering,” and “systems engineering.”)
solicitation	The process of preparing a package to be used in selecting a supplier. (See also “solicitation package.”)
solicitation package	A collection of formal documents that includes a description of the desired form of response from a potential supplier, the relevant statement of work for the supplier, and required provisions in the supplier agreement.
special cause of variation	A cause of a defect that is specific to some transient circumstance and is not an inherent part of a process. (See also “common cause of variation.”)
specific goal	A required model component that describes the unique characteristics that must be present to satisfy the process area. (See also “capability level,” “generic goal,” “organization’s business objectives,” and “process area.”)
specific practice	An expected model component that is considered important in achieving the associated specific goal. (See also “process area” and “specific goal.”) The specific practices describe the activities expected to result in achievement of the specific goals of a process area.
stable process	The state in which special causes of process variation have been removed and prevented from recurring so that only common causes of process variation of the process remain. (See also “capable process,” “common cause of variation,” “special cause of variation,” and “standard process.”)
staged representation	A model structure wherein attaining the goals of a set of process areas establishes a maturity level; each level builds a foundation for subsequent levels. (See also “maturity level” and “process area.”)

stakeholder

A group or individual that is affected by or is in some way accountable for the outcome of an undertaking. (See also “customer” and “relevant stakeholder.”)

Stakeholders may include project or work group members, suppliers, customers, end users, and others.

This term has a special meaning in the CMMI Product Suite besides its common standard English meaning.

standard (noun)

Formal requirements developed and used to prescribe consistent approaches to acquisition, development, or service.

Examples of standards include ISO/IEC standards, IEEE standards, and organizational standards.

standard process

An operational definition of the basic process that guides the establishment of a common process in an organization.

A standard process describes the fundamental process elements that are expected to be incorporated into any defined process. It also describes relationships (e.g., ordering, interfaces) among these process elements. (See also “defined process.”)

statement of work

A description of work to be performed.

statistical and other quantitative techniques

Analytic techniques that enable accomplishing an activity by quantifying parameters of the task (e.g., inputs, size, effort, and performance). (See also “statistical techniques” and “quantitative management.”)

This term is used in the high maturity process areas where the use of statistical and other quantitative techniques to improve understanding of project, work, and organizational processes is described.

Examples of non-statistical quantitative techniques include trend analysis, run charts, Pareto analysis, bar charts, radar charts, and data averaging.

The reason for using the compound term “statistical and other quantitative techniques” in CMMI is to acknowledge that while statistical techniques are expected, other quantitative techniques can also be used effectively.

statistical process control

Statistically based analysis of a process and measures of process performance, which identify common and special causes of variation in process performance and maintain process performance within limits. (See also “common cause of variation,” “special cause of variation,” and “statistical techniques.”)

statistical techniques	Techniques adapted from the field of mathematical statistics used for activities such as characterizing process performance, understanding process variation, and predicting outcomes. Examples of statistical techniques include sampling techniques, analysis of variance, chi-squared tests, and process control charts.
subpractice	An informative model component that provides guidance for interpreting and implementing specific or generic practices. Subpractices may be worded as if prescriptive, but they are actually meant only to provide ideas that can be useful for process improvement.
subprocess	A process that is part of a larger process. (See also “process,” “process description,” and “process element.”) A subprocess may or may not be further decomposed into more granular subprocesses or process elements. The terms “process,” “subprocess,” and “process element” form a hierarchy with “process” as the highest, most general term, “subprocesses” below it, and “process element” as the most specific. A subprocess can also be called a process element if it is not decomposed into further subprocesses.
supplier	(1) An entity delivering products or performing services being acquired. (2) An individual, partnership, company, corporation, association, or other entity having an agreement with an acquirer for the design, development, manufacture, maintenance, modification, or supply of items under the terms of an agreement. (See also “acquirer.”)
supplier agreement	A documented agreement between the acquirer and supplier. (See also “supplier.”) Supplier agreements are also known as contracts, licenses, and memoranda of agreement.
sustainment	The processes used to ensure that a product or service remains operational.
system of systems	A set or arrangement of systems that results when independent and useful systems are integrated into a large system that delivers unique capabilities.

systems engineering

The interdisciplinary approach governing the total technical and managerial effort required to transform a set of customer needs, expectations, and constraints into a solution and to support that solution throughout its life. (See also “hardware engineering” and “software engineering.”)

This approach includes the definition of technical performance measures, the integration of engineering specialties toward the establishment of an architecture, and the definition of supporting lifecycle processes that balance cost, schedule, and performance objectives.

tailoring

The act of making, altering, or adapting something for a particular end.

For example, a project or work group establishes its defined process by tailoring from the organization’s set of standard processes to meet its objectives, constraints, and environment. Likewise, a service provider tailors standard services for a particular service agreement.

tailoring guidelines

Organizational guidelines that enable projects, work groups, and organizational functions to appropriately adapt standard processes for their use.

The organization’s set of standard processes is described at a general level that may not be directly usable to perform a process.

Tailoring guidelines aid those who establish the defined processes for project or work groups. Tailoring guidelines cover (1) selecting a standard process, (2) selecting an approved lifecycle model, and (3) tailoring the selected standard process and lifecycle model to fit project or work group needs. Tailoring guidelines describe what can and cannot be modified and identify process components that are candidates for modification.

target profile

A list of process areas and their corresponding capability levels that represent an objective for process improvement. (See also “achievement profile” and “capability level profile.”)

Target profiles are only available when using the continuous representation.

target staging

A sequence of target profiles that describes the path of process improvement to be followed by the organization. (See also “achievement profile,” “capability level profile,” and “target profile.”)

Target staging is only available when using the continuous representation.

team

A group of people with complementary skills and expertise who work together to accomplish specified objectives.

A team establishes and maintains a process that identifies roles, responsibilities, and interfaces; is sufficiently precise to enable the team to measure, manage, and improve their work performance; and enables the team to make and defend their commitments.

Collectively, team members provide skills and advocacy appropriate to all aspects of their work (e.g., for the different phases of a work product's life) and are responsible for accomplishing the specified objectives.

Not every project or work group member must belong to a team (e.g., a person staffed to accomplish a task that is largely self-contained). Thus, a large project or work group can consist of many teams as well as project staff not belonging to any team. A smaller project or work group can consist of only a single team (or a single individual).

technical data package

A collection of items that can include the following if such information is appropriate to the type of product and product component (e.g., material and manufacturing requirements may not be useful for product components associated with software services or processes):

- Product architecture description
- Allocated requirements
- Product component descriptions
- Product related lifecycle process descriptions if not described as separate product components
- Key product characteristics
- Required physical characteristics and constraints
- Interface requirements
- Materials requirements (bills of material and material characteristics)
- Fabrication and manufacturing requirements (for both the original equipment manufacturer and field support)
- Verification criteria used to ensure requirements have been achieved
- Conditions of use (environments) and operating/usage scenarios, modes and states for operations, support, training, manufacturing, disposal, and verifications throughout the life of the product
- Rationale for decisions and characteristics (e.g., requirements, requirement allocations, design choices)

technical performance	Characteristic of a process, product, or service, generally defined by a functional or technical requirement. Examples of technical performance types include estimating accuracy, end-user functions, security functions, response time, component accuracy, maximum weight, minimum throughput, allowable range.
technical performance measure	Precisely defined technical measure of a requirement, capability, or some combination of requirements and capabilities. (See also “measure.”)
technical requirements	Properties (i.e., attributes) of products or services to be acquired or developed.
traceability	A discernable association among two or more logical entities such as requirements, system elements, verifications, or tasks. (See also “bidirectional traceability” and “requirements traceability.”)
trade study	An evaluation of alternatives, based on criteria and systematic analysis, to select the best alternative for attaining determined objectives.
training	Formal and informal learning options. These learning options can include classroom training, informal mentoring, web-based training, guided self study, and formalized on-the-job training programs. The learning options selected for each situation are based on an assessment of the need for training and the performance gap to be addressed.
unit testing	Testing of individual hardware or software units or groups of related units. (See also “acceptance testing.”)
validation	Confirmation that the product or service, as provided (or as it will be provided), will fulfill its intended use. In other words, validation ensures that “you built the right thing.” (See also “verification.”)
verification	Confirmation that work products properly reflect the requirements specified for them. In other words, verification ensures that “you built it right.” (See also “validation.”)

version control	The establishment and maintenance of baselines and the identification of changes to baselines that make it possible to return to the previous baseline. In some contexts, an individual work product may have its own baseline and a level of control less than formal configuration control may be sufficient.
work breakdown structure (WBS)	An arrangement of work elements and their relationship to each other and to the end product or service.
work group	A managed set of people and other assigned resources that delivers one or more products or services to a customer or end user. (See also “project.”) A work group can be any organizational entity with a defined purpose, whether or not that entity appears on an organization chart. Work groups can appear at any level of an organization, can contain other work groups, and can span organizational boundaries. A work group together with its work can be considered the same as a project if it has an intentionally limited lifetime.
work plan	A plan of activities and related resource allocations for a work group. Work planning includes estimating the attributes of work products and tasks, determining the resources needed, negotiating commitments, producing a schedule, and identifying and analyzing risks. Iterating through these activities can be necessary to establish the work plan.
work product	A useful result of a process. This result can include files, documents, products, parts of a product, services, process descriptions, specifications, and invoices. A key distinction between a work product and a product component is that a work product is not necessarily part of the end product. (See also “product” and “product component.”) In CMMI models, the definition of “work product” includes services, however, the phrase “work products and services” is sometimes used to emphasize the inclusion of services in the discussion.
work product and task attributes	Characteristics of products, services, and tasks used to help in estimating work. These characteristics include items such as size, complexity, weight, form, fit, and function. They are typically used as one input to deriving other resource estimates (e.g., effort, cost, schedule).

work startup

When a set of interrelated resources for a work group is directed to develop or deliver one or more products or services for a customer or end user. (See also “work group.”)

REPORT DOCUMENTATION PAGE			<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave Blank)		2. REPORT DATE November 2010		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE CMMI® for Services, Version 1.3			5. FUNDING NUMBERS FA8721-05-C-0003	
6. AUTHOR(S) CMMI Product Development Team				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213			8. PERFORMING ORGANIZATION REPORT NUMBER CMU/SEI-2010-TR-034	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) HQ ESC/XPK 5 Eglin Street Hanscom AFB, MA 01731-2116			10. SPONSORING/MONITORING AGENCY REPORT NUMBER ESC-TR-2010-034	
11. SUPPLEMENTARY NOTES				
12A DISTRIBUTION/AVAILABILITY STATEMENT Unclassified/Unlimited, DTIC, NTIS			12B DISTRIBUTION CODE	
13. ABSTRACT (MAXIMUM 200 WORDS) CMMI® (Capability Maturity Model® Integration) models are collections of best practices that help organizations to improve their processes. These models are developed by product teams with members from industry, government, and the Carnegie Mellon® Software Engineering Institute (SEI). This model, called CMMI for Services (CMMI-SVC), provides a comprehensive integrated set of guidelines for providing superior services.				
14. SUBJECT TERMS CMMI, Services, CMMI for Services, Version 1.3, process improvement, reference model, service model, service delivery			15. NUMBER OF PAGES 506	
16. PRICE CODE				
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. Z39-18
298-102

