CMMI®-SVC, VERSION 1.3

SEI SERIES IN SOFTWARE ENGINEERING

CMMI® for Services

Guidelines for Superior Service

SECOND EDITION

Eileen C. Forrester

Brandon L. Buteau

Sandy Shrum

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CMMI® for Services

Second Edition

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PREFACE

Services make up 80 percent of the world economy and comprise more than half of U.S. Department of Defense acquisitions. The primary purpose of the CMMI for Services (CMMI-SVC) model, which is the basis of this book, is to guide service providers as they improve the way they do their work—their processes. Improved processes result in improved service performance, customer satisfaction, and profitability. When organizations using CMMI-SVC make improvements in their performance, they can ultimately contribute to the health of the world economy.

CMMI (Capability Maturity Model Integration) models are collections of effective practices that help organizations to improve their processes. The CMMI-SVC model, like all of the CMMI Product Suite,[1] was developed by a team from industry, government, and the Software Engineering Institute (SEI). Hundreds of reviewers suggest new content and changes for the model. Adopters pilot model content and give further feedback. A network of hundreds of SEI Partners and thousands of users apply the model to their work and report their experience and results, further improving model content. In this way, the CMMI-SVC model represents the ongoing consensus of thousands of practitioners about how to provide superior service.

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1. There are CMMI models that focus on the development of products and services (CMMI for Development) and on the acquisition of products and services (CMMI for Acquisition). See the CMMI website for more information about these members of the CMMI Product Suite (www.sei.cmu.edu/cmmi/).

Purpose

This book provides guidance on how all types of service provider organizations can establish, manage, and improve services that meet the needs of their customers and end users.

This guidance includes the following:

- Delivering services that meet the terms of service agreements
- Managing the organization's capacity to provide services and ensure the availability of services
- Addressing service incidents effectively
- Establishing standard services and service levels that meet the strategic needs of the organization as well as the needs of customers and end users
- Ensuring the continuity of services in the face of disaster

By integrating these and other practices, CMMI-SVC helps service providers to establish, deliver, and manage services.

Organization of This Book

This book 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 six chapters.

- Chapter 1, Introduction, offers a broad view of CMMI and the Services constellation,[2] concepts of process improvement, the history of models used for process improvement, and key concepts of CMMI for Services.
- Chapter 2, Process Area Components, describes the components of the CMMI-SVC process areas.
- Chapter 3, How to Start Using CMMI, describes the important roles needed for implementing a CMMI-based process improvement program, explains how appraisals can be used, identifies training that can help, and provides tips for getting started using CMMI.

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).

- Chapter 4, Achieving Process Improvement that Lasts, explains how selected practices in all CMMI models enable the organization to make improvement part of how it does business, including descriptions of generic goals, generic practices, maturity levels, capability levels, and equivalent staging.
- Chapter 5, Relationships Among Process Areas, describes how process areas interrelate and provides insight into the interactions among the CMMI-SVC process areas.
- Chapter 6, Essays About CMMI for Services, consists of invited essays from contributing authors. The essays cover the use of CMMI-SVC, unusual applications, and use of CMMI-SVC in new domains.

Part Two: Generic Goals and Generic Practices, and the Process Areas, contains all of the CMMI-SVC 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.[3] Process areas contain effective practices covering topics ranging from configuration management to service delivery.

To make these process areas easy to find, they are organized alphabetically by process area acronym. Most CMMI users quickly learn the process area acronyms and abandon their longer names for their shorter abbreviations. An example in which the order of the process areas by full process area title versus abbreviation is different is that Supplier Agreement Management (SAM) appears before Service Delivery (SD). Each section contains goals, practices, and examples in a format that enables you to locate information quickly.

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 for Service 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.

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3. 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.

Finally, the Book Contributors section provides information about the book's authors and those who contributed essays for Chapter 6.

Extras in This Book

Readers who are familiar with the model and with prior CMMI books will find these changes and extras in this book on CMMI-SVC.

- We extensively revised Part One to add more material on service concepts, including a discussion of lifecyles in service environments.
- We also clarified and shortened the material on generic goals and practices, and updated the material on getting started and sustaining improvement.
- In Part Two, we added margin notes to all the process areas. These notes describe why the practices in a process area are valuable and rephrase what the process area is about in plainer language than the formal model language.
- We also added author notes in Part Two to amplify service concepts or to explain how to apply core model concepts in a service context.
- Finally, we included invited essays in Chapter 6 that consist of essays from partners, experienced users, experts in service management, and new users with advice for other new adotpers.

How to Use This Book

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 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 Information Technology Infrastructure Library (ITIL) or International Organization for Standardization (ISO) 9000, you will recognize 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 might want to select which sections to read first. Read Part Two looking for practices you recognize from other models that you have used, and note variations. You might notice a different level of detail in CMMI than in the models you are accustomed to using.

Next, review the glossary to understand how some terminology can differ from that used in the process improvement models you know. Many concepts are the same, but they might 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 many of the practices presented.

Review the process areas specific to CMMI-SVC first:

- Capacity and Availability Management (CAM)
- Incident Resolution and Prevention (IRP)
- Service Continuity (SCON)
- Service Delivery (SD)
- Service System Development (SSD)
- Service System Transition (SST)
- Strategic Service Management (STSM)

Then go back and review the other process areas you are already familiar with and see the guidance for applying these practices to a service environment.

User Feedback and Questions

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

ACKNOWLEDGMENTS

This book wouldn't have been possible without the work of people from organizations dedicated to CMMI-based process improvement. The CMMI-SVC model, which was created by the CMMI Product Team, is contained in the book. Other helpful information was added by Eileen Forrester, Brandon Buteau, and Sandy Shrum.

The CMMI-SVC Model Development Team included members from different organizations and backgrounds. Ultimately, without the work of those involved in the CMMI project since it began in 1998, this book would not exist.

The CMMI-SVC Model Development Team developed what is now CMMI-SVC, V1.2, from the input of lots of users and reviewers. That team consisted of the following members: Drew Allison, Roger Bate, Rhonda Brown, Brandon Buteau, Eileen Clark, Eileen Forrester, Craig Hollenbach, Mike Konrad, Frank Niessink, Mary Lynn Penn, Roy Porter, Rich Raphael, Pamela Schoppert, Sandy Shrum, Jerry Simpson, and Jeff Zeidler. The team for CMMI-SVC V1.3 included Drew Allison, Brandon Buteau, Eileen Forrester, Christian Hertneck, and Pam Schoppert.

We would also like to acknowledge those who directly contributed to this book.

We want to thank Anita Carleton for her support and for her leadership of the Software Engineering Process Management Program (which includes CMMI) at the SEI.

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Special thanks go to Addison-Wesley Publishing Partner, Peter Gordon, for his assistance, experience, and advice. We'd also like to thank Kim Boedigheimer, Julie Nahil, Megan Guiney, Audrey Doyle, Curt Johnson, and Stephane Nakib for their help with the design, editing, and final production of this book.

From Eileen Forrester

I thank my two coauthors, Sandy and Brandon. I can't imagine doing this work without you. In addition, Craig Hollenbach, who led the volunteer industry team for the first two years of the project, is an amazing and generous collaborator. We wouldn't have this model or the book without his fine work.

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From Brandon Buteau

First, I am deeply grateful to my two coauthors, Eileen and Sandy. Besides granting me the honor of joining them in working on this book, they are both exceptional collaborators, and are some of the most productive people I've ever known. I'm also thankful to Craig Hollenbach, who invited me to work on the CMMI-SVC model team at its beginning, and to all the members of the CMMI Core Model and CMMI-SVC teams; working with all of them has greatly expanded my understanding of CMMI details and subtleties.

I would not have the skills today that made it possible for me to contribute to the CMMI-SVC model or this book without the early guidance of my parents. My father taught me the value of disciplined reasoning, and my mother taught me the value of subtleties in the meanings of words. The result has been my lifelong appreciation of good arguments and good definitions.

Finally, my wife Betsey has been a complete jewel throughout all my work on the model and the book, and has gradually progressed from being a cheerful supporter and patient sounding board to an enthusiastic advocate of CMMI-SVC practices in her own professional field. I cannot thank her enough.

From Sandy Shrum

Working simultaneously on three CMMI books has tested my limits in many ways. Those that have helped me along the journey provided both professional and personal support.

Many thanks to Rhonda Brown and Mike Konrad for their partnership during CMMI model development. They are peerless as team members and friends. Our joint management of the CMMI Core Model Team was not only effective, but enjoyable.

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Finally, thanks to the coauthors of all three CMMI books: Brandon Buteau, Mary Beth Chrissis, Eileen Forrester, Brian Gallagher, Mike Konrad, Mike Phillips, and Karen Richter. They are all terrific to work with. Without their understanding, excellent coordination, and hard work, I would never have been able to participate.

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PART ONE

About CMMI for Services

CHAPTER 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 improved performance, customer satisfaction, and profitability. The CMMI for Services (CMMI-SVC) model is designed to begin meeting that need.

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. The remaining 17 process areas focus on practices that any organization should master to meet its business objectives.

Do You Need CMMI?

CMMI is being adopted by organizations all over the world. These organizations are large and small, government and private industry, and represent industries ranging from financial to health care, manufacturing to software, education to business services. What do all of these organizations have in common?

Do You Have These Common Problems?

Many organizations accept common problems as "normal" and they don't try to address them or eliminate them. What about your organization? Are you settling for less? Take a look through the following list and see if you have accepted problems that you can solve by adopting CMMI.

- Plans are made, but not necessarily followed.
- Work is not tracked against the plan; plans are not adjusted.
- Expectations and service levels are not consistent; changes to them are not managed.
- Estimates are way off; over-commitment is common.
- When overruns become apparent, a crisis atmosphere develops.
- Most problems are discovered in operations or, worse yet, by the customer.
- Success depends on heroic efforts by competent staff members.
- Repeatability of effective behaviors is questionable.

Even if you've accepted that your organization could use something to reduce or eliminate these problems, some service providers reject the idea of using process improvement to address or resolve them. Some mythology has grown up around the idea of using process improvement. You may have heard some of these fallacies.

- I don't need process improvement; I have good people (or advanced technology, or an experienced manager).
- Process improvement interferes with creativity and introduces bureaucracy.
- Process improvement is useful only in large organizations and costs too much.
- Process improvement hinders agility in fast-moving markets.[1]

These common misconceptions serve only as excuses for organizations not willing to make the changes needed to move ahead, address their problems, and improve their bottom line.

Another way to look at whether your organization could benefit from CMMI is to think about whether it is often operating in crisis mode. Crisis mode is characterized by the following:

- Staff members working harder and longer
- Staff members moving from team to team
- Service teams lowering expectations to meet delivery deadlines
- Service teams adding more people to meet expectations or deadlines
- Everyone cutting corners
- A hero saving the day

1. See the report "CMMI or Agile: Why Not Embrace Both!" for a discussion of how CMMI and Agile can work together effectively [Anderson 2008].

How Does CMMI Help You to Solve These Problems?

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.

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

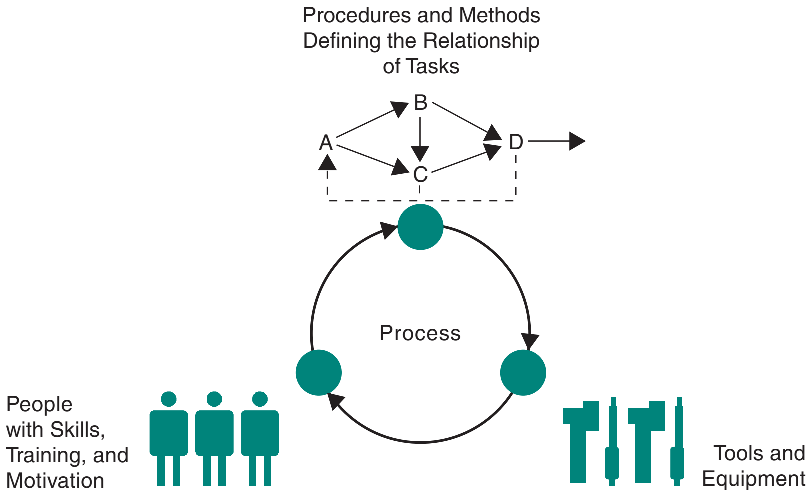

FIGURE 1.1
The Three Critical Dimensions

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.

The advantage of a process focus is that it complements the emphasis the organization places on both its people and its technology.

- A well-defined process can provide the means to work smarter, not harder. That means using the experience and training of your workforce effectively. It also means shifting the "blame" for problems from people to processes, making the problems easier to address and solve.
- An appropriate process roadmap can help your organization use technology to its best advantage. Technology alone does not guarantee its effective use.
- A disciplined process enables an organization to discover which procedures and methods are most effective and to improve them as results are measured.

CMMI is a suite of products used for process improvement. These products include models, appraisal methods, and training courses.

- The models are descriptions of best practices that can help you achieve your business goals related to cost, schedule, service levels, quality, and so forth. CMMI best practices describe what to do, but not how to do it or who should do it.
- The appraisal methods evaluate an organization's processes using a CMMI model as a yardstick. SCAMPI (Standard CMMI Appraisal Method for Process Improvement) is the group of SEI appraisal methods used with CMMI models. SCAMPI uses a formalized appraisal process, involves senior management as a sponsor, focuses the appraisal on the sponsor's business objectives, and observes strict confidentiality and nonattribution of data.
- Training courses support knowledge about the use of CMMI models and appraisal methods.

The SEI has taken the process management premise that *the quality of a product (including service) 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.

How Can CMMI Benefit You?

Today, CMMI is an application of the principles introduced almost a century ago to achieve an enduring 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].

The benefits of CMMI have been published for years and will continue to be published in the future. (See the SEI website for more information about performance results.)

The cost of CMMI adoption is highly variable depending on many factors (e.g., organization size, culture, structure, current processes). Regardless of the investment, history demonstrates a respectable return on investment (ROI).

Example returns on investment at various organizations using CMMI-DEV include those shown in Table 1.1.

Since the CMMI-SVC model was first released only two short years ago (2009), data on the results of its use are not yet available. We will be collecting ROI data as organizations adopt the CMMI-SVC model and experience the benefits.

See the CMMI website (www.sei.cmu.edu/cmmi/) for the latest information about CMMI adoption, including presentations by those who have adopted CMMI and want to share how they did it.

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].

TABLE 1.1 Benefits Resulting from the Use of CMMI-DEV

ROI	*Focus of Process Improvement Program*	*Organization*
5:1	Quality activities	Accenture
13:1	Defects avoided per hour spent in training and defect prevention	Northrop Grumman
2:1	Overall process improvement over three years	Siemens Information Systems Ltd., India

Watts Humphrey, Ron Radice, and others extended these principles further and began applying them to software in their work at IBM 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 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 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.

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.

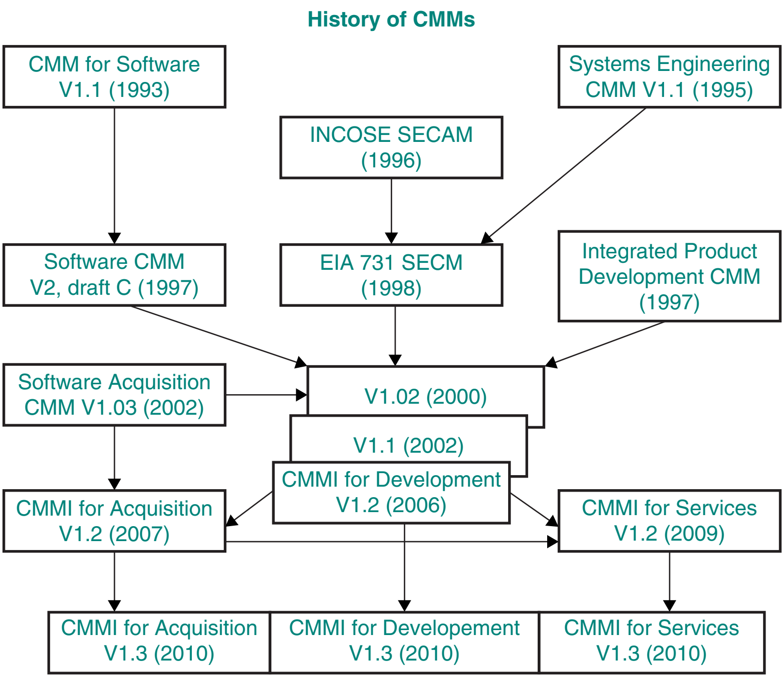

FIGURE 1.2
The History of CMMs[2]

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

By the time Version 1.2 was released, two other CMMI models were being planned. Because of this planned expansion, the name of the first 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, SEI 2010c] 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., services, development, acquisition). The model for the Services constellation 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, nonstorable 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.

Important CMMI-SVC Concepts

The following concepts are particularly significant in the CMMI-SVC model. Although all are defined in the glossary, they each employ words that can cover a range of possible meanings to those from different backgrounds, and so they merit additional discussion to ensure that model material that includes these concepts is not misinterpreted.

Service

The most important of these terms is the word *service* itself, which the glossary defines as a product that is intangible and nonstorable. 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 usage 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 nonstorable, 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 with a background in information technology, especially those familiar with disciplines such as 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 nonstorable 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* may 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 much 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. Even organizations that deliver managed IT services have service systems that encompass more than merely IT components.

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 may still have trouble with this interpretation because they may feel 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 may in some cases be true for service provider organizations with relatively immature practices, part of the difficulty may 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 may belong to customers or suppliers, and some may 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 or 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 personnel for service delivery from a broad systems perspective may 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 among 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.

SERVICES AND SERVICE SYSTEMS IN CMMI FOR SERVICES VERSUS SOA AND SAAS

If you know something about SOA or SaaS, you might be a bit nonplussed by the preceding briefly stated distinction between the various meanings of the term *service,* followed by a forward reference to a discussion of the term *service system,* where neither SOA nor SaaS is mentioned at all. Here's some additional clarification. (If you're not interested in SOA or SaaS, you can skip over this discussion.)

Although there are a variety of interpretations of SOA and SaaS, they all tend to focus on information systems of one form or another and how they are designed to deliver value. SOA emphasizes certain characteristics of the architecture of these systems (e.g., the alignment of components with business functions), whereas SaaS considers different aspects of system architecture while emphasizing the flexibility of how software capabilities are delivered to end users. Because CMMI for Services, SOA, and SaaS practitioners all use the terms *service* and *system* somewhat differently, and because it's quite possible for CMMI for Services, SOA, and SaaS to all be employed in a single context, some confusion is likely if you are not sensitive to those differences.

In the CMMI for Services perspective, a service is the result of a process, and a system (i.e., a service system) refers to all the resources required to deliver services. When done properly, the operation of a service system causes service delivery. Service systems may incorporate subsystems that are themselves information technology systems, but these IT systems might represent only a small fraction of a total service system infrastructure.

In the SOA perspective, a service is an IT system component that provides a distinct and loosely coupled function accessible through a standard, contractually governed interface. At the top level, the structure of these services is expected to correlate well with the structure of business functions that an organization performs, and SOA designs often involve analyses of one or more enterprise architectures to establish needed commonalities. No matter what level of abstraction, the term *service* in SOA is most likely to be applied to actions, methods, functions, and "things that are done" rather than to their results; and the term *system* typically refers to something that at its core is an IT system of some kind.

In the SaaS perspective, software is delivered as a service (e.g., a subscription service) without the need for the customer to pay for the full cost up front. The term *service* in SaaS therefore seems closer to the CMMI for Services usage than the SOA usage, but it's important to be clear. A SaaS service is not a software component that is made available (as in SOA), but rather is the on-demand availability of that component (and others) along with capabilities such as dynamic updates, tailorability, and load balancing. SaaS services are delivered via an IT system, but this may be only a portion of a larger service system that supplies other services such as help desk support or network management.

Service Agreement

A *service agreement* is the foundation of the joint understanding between a service provider and a 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 multipart 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 the 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 require only that the customer organization notify the service provider organization when certain services are needed. Service agreements for public services provided by governments, municipal agencies, and nonprofit organizations may 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 glossary for additional discussion of the terms *service agreement, service level agreement, customer,* and *end user.*

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 nonverbal signals (e.g., pressing a button to call a bus to a bus stop).

However 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 the request is actually within the scope of agreed services.)

Sometimes specific service requests may be incorporated directly into the 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 or a network management service that must provide 99.9 percent network availability for the life of the service agreement). Even in these situations, ad hoc service requests may 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 may occur that are unwanted. Some instances of service delivery may have lower than expected or lower than acceptable degrees of performance or quality, or may 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 may 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, personnel, 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 have to 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 with 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 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, or 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 those 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 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) may be considered a type of work group, one whose work is planned to have an intended end.

Service provider organizations may 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 may be performed by a project, whereas service delivery may be performed by a work group.

The glossary also notes that a work group may contain work groups, may span organizational boundaries, and may appear at any level of an organization. It is possible for a work group to be defined by nothing more than those in 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.

Stakeholder, Customer, and End User

In the model glossary, a *stakeholder* is defined as a group or individual who is affected by or is in some way accountable for the outcome of an undertaking. Stakeholders include any and all parties with a legitimate interest in the results of service delivery, such as service provider executives, staff members, customers, end users, suppliers, partners, and oversight groups. Remember that any given reference to stakeholders in the model covers all these types of stakeholders, and not just the ones that might be most obvious in the particular context.

The model defines a customer as the party (individual, project, or organization) responsible for accepting the product or for authorizing payment. A customer must also be external to the project that develops (delivers) a product (service), although both the customer and the project may be part of the same larger organization.

While this concept seems clear enough, the glossary includes some ambiguous language about how the term *customer* can include "other relevant stakeholders" in some contexts, such as *customer requirements*. While this caveat reflects an accepted legacy usage of the term from earlier versions of CMMI models, it could be potentially confusing in a service context, where the distinction between customers and other stakeholders (especially end users) can be especially significant.

The CMMI for Services model addresses this concern in two ways. First, it avoids the term *customer requirements* except in those contexts where it refers to the requirements of *customers* in the narrow sense (those who accept a product or authorize payment). Second, the model relies upon material in the glossary that distinguishes between customers and end users, and that defines the term *end user* itself. Specifically, the model defines an *end user* as a party (individual, project, or organization) that ultimately uses a delivered product or receives the benefit of a delivered service. While end users and customers therefore cover distinct roles in service establishment and delivery, both can often be represented by a single party.

For example, a private individual who receives financial services from a bank is probably both the customer and the end user of those services. However, in health care services, the customers often include organizations such as employers and government agencies that negotiate (or dictate) health care plan coverage for the ultimate health care beneficiaries, who are the end users of those services. (Many of these end users may be customers as well, if they have a responsibility to pay for all or part of some services.)

To summarize: It's important to keep in mind the actual scope of the terms *stakeholder, customer,* and *end user* as you review and apply the CMMI for Services model in your unique service context so that you don't overlook or confuse crucial interactions and interfaces in your service system.

CHAPTER 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.

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.)

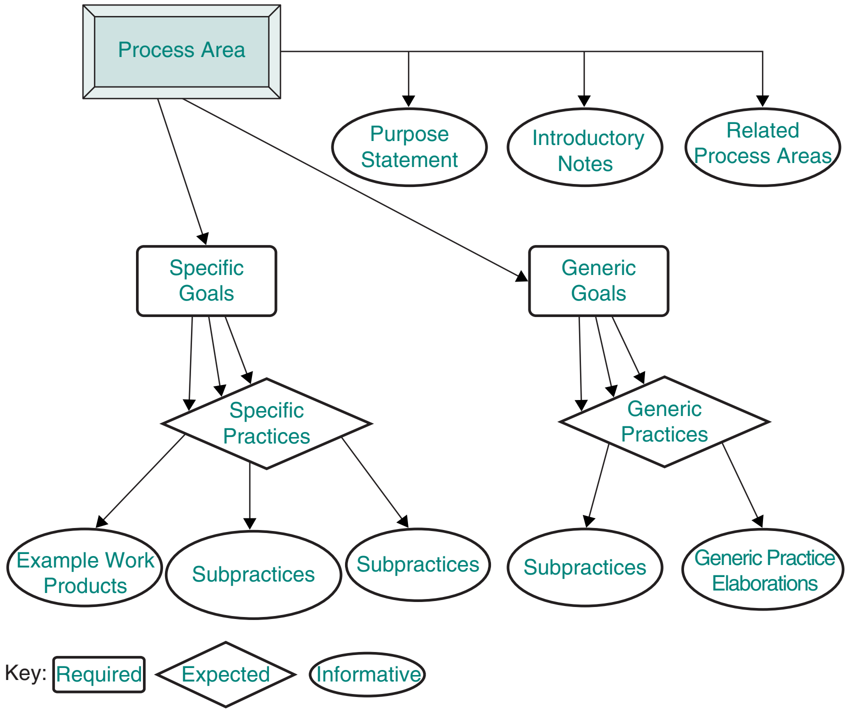

FIGURE 2.1
CMMI Model Components

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)[1]
- 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."

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."

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1. The SSD process area is an "addition."

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.

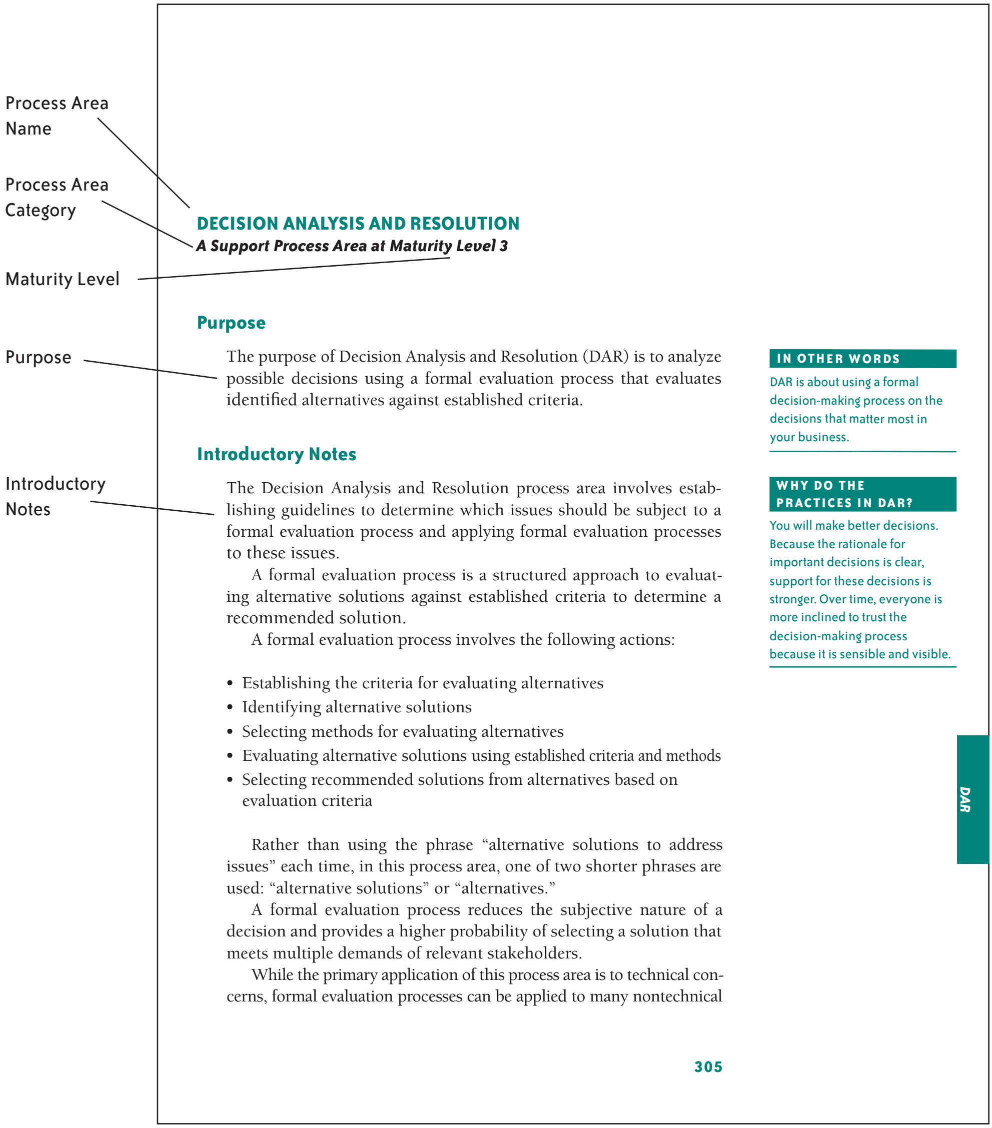
Each generic practice begins with the prefix "GP," followed by a number in the form "x.y" (e.g., GP 1.1).

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.



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.

IN OTHER WORDS

DAR is about using a formal decision-making process on the decisions that matter most in your business.

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

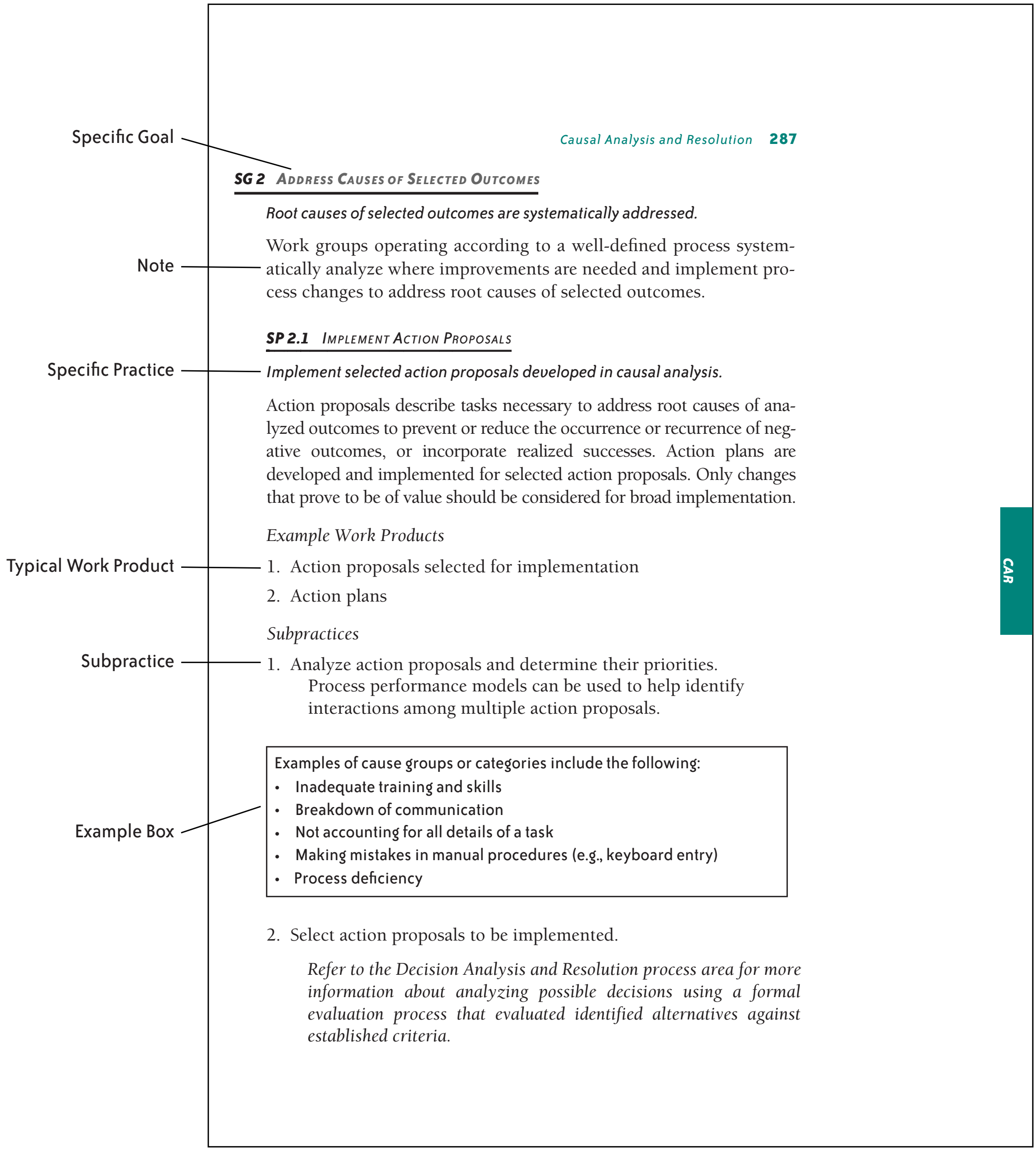
WHY DO THE PRACTICES IN DAR?

You will make better decisions. Because the rationale for important decisions is clear, support for these decisions is stronger. Over time, everyone is more inclined to trust the decision-making process because it is sensible and visible.

DAR

305

FIGURE 2.2
Sample Page from Decision Analysis and Resolution



Causal Analysis and Resolution 287

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.

   Process performance models can be used to help identify interactions among multiple action proposals.

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

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 evaluated identified alternatives against established criteria.

CAR

FIGURE 2.3
Sample Page from Causal Analysis and Resolution

Generic Goal

Generic Practice

Generic Practice Elabration

GP 2.1 Policy 191

GGS & GPS

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 ESTABLISHAN ORGANIZATIONAL POLICY

Establish and maintain an organizational policy for planning and preforming 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.

FIGURE 2.4
Sample Page from Generic Goals and Generic Practices

CHAPTER 3

HOW TO START USING CMMI

If you are new to CMMI, you may not know how to establish a process improvement program that will benefit your organization. This chapter is designed to help you learn how to get started using CMMI models, appraisal methods, and training to get you on your way to improving your organization's processes.

Important Roles in Process Improvement

Before discussing some of the actions that must be taken to establish a CMMI-based process improvement program, it is important to explain the roles involved in such a program.

These roles are critical to the success of any changes your organization wishes to make to its processes. In some organizations, one person may perform more than one role.

The Executive Sponsor

For major change to happen, you must have executive sponsorship for the change. An executive sponsor must be a top-level executive in the organization and must be committed to the process improvement program from beginning to end.

The executive sponsor helps to ensure success through the following actions:

- Uses influence and provides resources to help the organization adopt CMMI
- Chooses the best people to manage the process improvement program
- Monitors the process improvement program to ensure that it is getting the resources it needs to be successful
- Is an advocate and spokesperson for the process improvement program

As an advocate for CMMI-based process improvement, the executive sponsor must ensure that other executives fully support the process improvement program and understand these three reasons to adopt CMMI.

1. CMMI improves performance, cost, and schedule.
2. CMMI enables collaboration with external stakeholders to integrate their expectations into day-to-day activities.
3. CMMI improves the organization's ability to compete.

Executives who have successful process improvement programs typically take the following actions.

- They ask someone they trust to learn more about CMMI and report back to them.
- They speak with executives who have adopted CMMI in other organizations, participate in discussion groups and blogs, or attend a conference to learn from others who have adopted CMMI.

The Management Steering Group

Top managers form the management steering group. They oversee the improvement program and meet regularly. Their work includes reviewing progress and making decisions about what improvements should be made. This group typically is responsible for the following:

- Creating the strategic plan for the program
- Allocating resources to complete work for the program
- Providing guidance to the process group
- Removing barriers to success

The Process Group

The quality of the process group is another critical key to the success of a process improvement program. The process group is the center of all process work in the organization. It is responsible for the following:

- Being a role model for others in the organization
- Monitoring process improvement activities
- Supporting teams by providing help with chartering, training, planning, and so on
- Reporting progress and issues to the management steering group

- Being a champion for process improvement
- Teaching and encouraging others in the organization about process improvement

The Process Group Leader

The process group leader is the person who leads the process group and works with the executive sponsor to bring about change. This leader must understand quality management methods and be able to work with senior management effectively. The leader's main function is to manage the process improvement program to get results.

An effective process group leader has formally defined responsibilities, has a full-time job as the process group leader, and is a member of the management team. The process group leader should be given an adequate budget and at least two years to get the process improvement program up and running.

The Working Groups

Working groups are subgroups or extensions of the process group who implement changes assigned by the process group to a particular area of the organization. Working groups are often responsible for the following:

- Describing the organization's processes
- Comparing those processes to the CMMI model goals and practices and the organization's business objectives
- Defining new processes
- Finding ways to help the organization adopt new processes

The SCAMPI Lead Appraiser or Team Leader

When it is time to do an appraisal, the lead appraiser (for SCAMPI A appraisals) or team leader (for SCAMPI B or C appraisals) works closely with the executive sponsor to set the objectives for an appraisal. (See the section The Purpose and Function of Appraisals later in this chapter for more information about when an appraisal is appropriate.)

The lead appraiser or team leader manages, coordinates, and makes decisions during an appraisal. Another responsibility is to share progress and issues with the executive sponsor. The person in this role can be an employee of the organization or a hired consultant.

The Appraisal Team

The appraisal team performs the work of an appraisal. They gather information about the organization's processes and judge whether the processes satisfy the goals of the CMMI model the organization is using. The experience of the appraisal team affects the quality and credibility of the appraisal. Team members should have in-depth knowledge of the organization and its processes as well as a good understanding of CMMI. (All appraisal team members must receive CMMI Appraisal Team training before they can be members of an appraisal team.)

The experience of the appraisal team can supplement the knowledge of the lead appraiser or team leader to ensure the right level of knowledge and skills for the appraisal.

SCAMPI Appraisals

In general, an appraisal compares an organization's processes to descriptions of effective practices in the reference model being used—a CMMI model. The appraisal method used with CMMI is called the SCAMPI method. This method has three different classes of appraisals.

SCAMPI class A is the most rigorous method and is the only method that can result in a rating.

SCAMPI class B is a flexible, less rigorous method that uses a standard scale for evaluating processes.

SCAMPI class C is the most flexible and least rigorous method that uses a scale defined by the organization for evaluating processes.

For more information about SCAMPI training, see the SEI website at www.sei.cmu.edu/training/find/ and search by the keyword "SCAMPI."

The Purpose and Function of Appraisals

An appraisal can be used at various points in an organization's process improvement program to (1) identify weaknesses that should be addressed, (2) monitor the success of the program, and (3) prove that the program has achieved a level of success. Typically, SCAMPI B or C appraisals are used for (1) and (2) and a SCAMPI A appraisal is used for (3).

Appraisal Ratings

Many organizations conduct a SCAMPI A appraisal to achieve a maturity level rating or capability level rating. These ratings can be used to formally acknowledge the organization's successful process improvement.

Appraisal ratings can be published on the SEI website with the organization's permission. Many choose to publish their ratings so that they can refer customers and others to the site as evidence of their achievement. See the SEI website for published appraisal results at http://sas.sei.cmu.edu/pars/pars.aspx.

Finding the Right SCAMPI Lead Appraiser or Team Leader

See the Get the Right Help section later in this chapter for more information about how to find and hire the right lead appraiser or team leader for your process improvement program.

Appraisal Quality Assurance

The SEI quality assurance policy and processes ensure the high quality of appraisal results. Besides ensuring that all lead appraisers and team leaders meet stringent requirements before they can become lead appraisers or team leaders, the quality assurance team also reviews data from appraisals.

These reviews ensure that the appropriate processes were followed during appraisals and that the lead appraiser or team leader took appropriate action during the appraisal. These reviews ensure that when you hire a lead appraiser or team leader you get what you expect.

CMMI Training

Training plays an important role throughout a process improvement program. Those who are involved in the various roles necessary to improve the organization's processes must have the knowledge and skills to make it happen.

All of those involved in the process group and working groups must be trained in CMMI concepts. The executive sponsor must understand the concepts and methods of CMMI-based process improvement. Lead appraisers, team leaders, and instructors must have the appropriate training and credentials to be effective.

The SEI and its partners have many different training courses available. Some training is available only from the SEI. SEI Partners also have specialized training courses available. Your organization may also want to supplement purchased training with organization-developed training.

Some of the SEI training courses that may be useful to your organization include the following:

- CMMI-Based Process Improvement Overview
- Mastering Process Improvement
- Introduction to CMMI for Services
- Introduction to CMMI for Development
- Acquisition Supplement for CMMI for Development, Version 1.3
- Development Supplement for CMMI for Services, Version 1.3
- Services Supplement for CMMI, Version 1.3
- Defining Software Processes
- Understanding CMMI High Maturity Practices
- CMMI and Six Sigma: Strategies for Joint Implementation
- SCAMPI Lead Appraiser Training
- SCAMPI B and C Team Leader Training
- CMMI-SVC Instructor Training

For descriptions of these training courses and more information about SEI training courses, see the SEI website at www.sei.cmu.edu/training/find/ and search by selecting the "CMMI" category.

An Approach to Getting Started

Process improvement is about evaluating and possibly changing the way your organization operates. At first you don't know where this change will focus, how much will have to change, or who should be involved in making this change happen. All of this uncertainty can make process improvement seem overwhelming at first.

Collect Information

Before you begin, you must collect information about CMMI.

The SEI website contains information about CMMI at www.sei.cmu.edu/cmmi/. See www.sei.cmu.edu/cmmi/tools/svc for all the latest information on CMMI-SVC.

The latest CMMI models are available on the SEI website, as are appraisal method descriptions, presentations, and answers to frequently asked questions. The website contains CMMI related reports, articles, and links to books about CMMI. You'll also find links to early adopters of new models who can provide advice and information they have found helpful.

Information about CMMI related courses is obtainable at www.sei.cmu.edu/training/find/ by selecting the "CMMI" category. This listing contains descriptions of SEI courses and when they are offered. A three-day introductory course, called Introduction to CMMI for Services, is available for the CMMI for Services model. If you would like to know when this course is scheduled, check the Education and Training listing or contact cmmi-comments@sei.cmu.edu.

The SEI has a large number of partner organizations serving a worldwide clientele. Many of these partners are licensed to provide CMMI training and appraisal services and may also provide help for planning process improvement programs, implementing model best practices, and other related services. Some of these partner organizations have websites, publications, and tools that can help you to use CMMI for process improvement. To see a list of SEI Partners that offer CMMI related services, visit www.sei.cmu.edu/partners/directory/organization/.

Annual conferences are rich sources of information about CMMI. Conferences are great places to talk to those who have process improvement programs in their organization. Many of the presenters at these conferences recount the results of CMMI-based process improvement and the different variations of how they used the model, appraisals, and training to meet their process improvement and business objectives.

The SEPG conference series consists of four conferences: SEPG North America, SEPG Europe, SEPG Latin America, and SEPG Asia Pacific. See www.sei.cmu.edu/sepg/ for more information on these conferences.

Another annual conference is the CMMI Technology Conference and User Group. This conference is held every November in Denver, and is cosponsored by NDIA and the SEI. Check the NDIA website (www.ndia.org) and the SEI website (www.sei.cmu.edu/events/) in the summer to see more information about the upcoming conference.

A number of online groups, clubs, forums, and communities of CMMI users exchange information on a wide variety of CMMI related topics. If you belong to an online social network, find out if it already has a CMMI related group. We know of CMMI groups on Yahoo!, Facebook, and LinkedIn. A number of bloggers also write about CMMI.

Know Where You Are

Now that you are informed about CMMI, your next step is to collect information about your organization. If you already know what part of the organization should be the focus of process improvement (at least at first), then you are ahead of the game.

Collect information about your organization that will help you to build a picture of the status quo. Compare current processes to the practices in the CMMI model you plan to use. You can do this informally or you can use an established method, such as a SCAMPI appraisal, to create your picture of the status quo.

The picture that you create can take any form that you find useful. If senior management is accustomed to seeing a particular kind of representation, consider using it or something akin to it. You will have to present your analysis of the status quo to management, so it must be something that they can understand quickly and easily.

Figure 3.1 illustrates a picture of the status quo done using estimates of the percentage of process area goals already in place in the organization. Light green cells represent opportunities for improvement, dark green cells represent strengths, black cells represent areas not applicable to the organization's process improvement objectives (or not present in the model), and gray cells identify the process areas targeted for early improvement.

Figure 3.2 illustrates a picture of the status quo done using capability levels to rate the degree to which process areas are already in place in the organization. This picture is commonly called a "capability profile" and can be the output of a SCAMPI appraisal.

Gather information about your organization's culture. You may need to conduct a survey of managers, work group leaders, and staff members to gauge their resistance to change. High resistance to change will require more investment of time, money, and effort than low resistance to change. If you find one area of the organization that embraces change easily, it might be a place to start with process improvement. Success in that area will provide momentum and evidence to build support for change in other areas of the organization.

A large number of books are devoted to organizational change. If your organization is highly resistant to change, investigate ways to overcome this shortcoming to accommodate process improvement as well as other improvements (e.g., technology) that can benefit your organization.

Know Where You Are Going

Now that you have a picture of the status quo, you can create a corresponding picture of where you want to be. If the difference between where you want to be and where you are is very great, it makes sense to define incremental steps in getting from the status quo to your objective. Characterizing your objective using the same style of

	Process Management			Project and Work Management						Service Establishment and Delivery					Support				
GG3	0%	0%	0%	0%	0%	10%	14%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	GG3
GG2	0%	0%	9%	0%	13%	33%	22%	14%	31%	44%	25%	50%	27%	36%	36%	36%	0%	0%	GG2
GG1	45%	18%	18%	0%	22%	44%	90%	24%	39%	50%	57%	81%	53%	50%	44%	44%	0%	0%	GG1
SG3					56%			41%		56%	100%		88%			56%			SG3
SG2	45%	27%		100%	0%	61%	90%	65%		65%	86%	94%	53%	69%	63%	63%		31%	SG2
SG1	45%	27%	18%	0%	0%	50%	100%	24%	39%	72%	64%	94%	88%	59%	44%	63%	7%	0%	SG1
	OT	OPF	OPD	IWM	WP	WMC	SAM	RS5KM	REQM	SD	IRP	STSM	SSD	SST	PPQA	CM	DAR	MA	

Achieved goal satisfaction Did not achieve goal satisfaction Not applicable Focus of concern

FIGURE 3.1

Picture of Status Quo Using Percentage of Goal Satisfaction

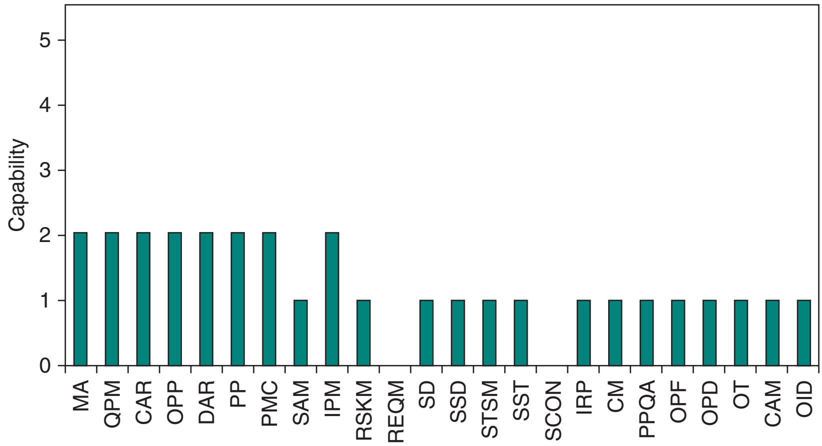


FIGURE 3.2
Picture of Status Quo Using Capability Level Ratings

picture as your status quo picture will provide a clear and concrete path to success.

To build a picture of where you are going, gather the views of management, work group leaders, and staff members to understand their objectives for improvement. Your aim is to create a picture of success that reflects the objective of each set of stakeholders, provides a clear path to integrated improvement, and ensures the support of all stakeholders required for the process improvement program to succeed. If you cannot build a picture of success they all can support, you are not ready to begin.

Figure 3.3 illustrates a picture of the organization's process improvement objective using estimates of the percentage of process area goals desired. Dark green cells represent goals that do not need to be completely satisfied, light green cells represent goals that must be satisfied, and black cells represent areas not currently applicable to the organization's process improvement objectives (or not present in the model).

Figure 3.4 illustrates a picture of the organization's process improvement objectives using capability levels to rate the degree to which process areas will be achieved to reach process improvement objectives. This picture is commonly called a "target profile" and can be the output of a SCAMPI A appraisal.

Compare the picture of the status quo with the picture of where you are going. The difference between the two is the focus of your process improvement program. Develop a periodic (e.g., monthly,

	Process Management			Project and Work Management						Service Establishment and Delivery					Support				
GG3	0%	0%	0%	0%	100%	100%	14%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	GG3
GG2	0%	0%	9%	0%	100%	100%	22%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	GG2
GG1	45%	18%	18%	0%	100%	100%	90%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	GG1
SG3					100%			100%		100%	100%		100%			100%			SG3
SG2	45%	27%		100%	100%	61%	90%	100%		100%	100%	100%	100%	100%	100%	100%		100%	SG2
SG1	45%	27%	18%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	SG1
	OT	OPF	OPD	IWM	WP	WMC	SAM	RS5KM	REQM	SD	IRP	STSM	SSD	SST	PPQA	CM	DAR	MA	

Achieved goal satisfaction   Did not achieve goal satisfaction   Not applicable

FIGURE 3.3
Process Improvement Objective Using Percentage of Goal Satisfaction

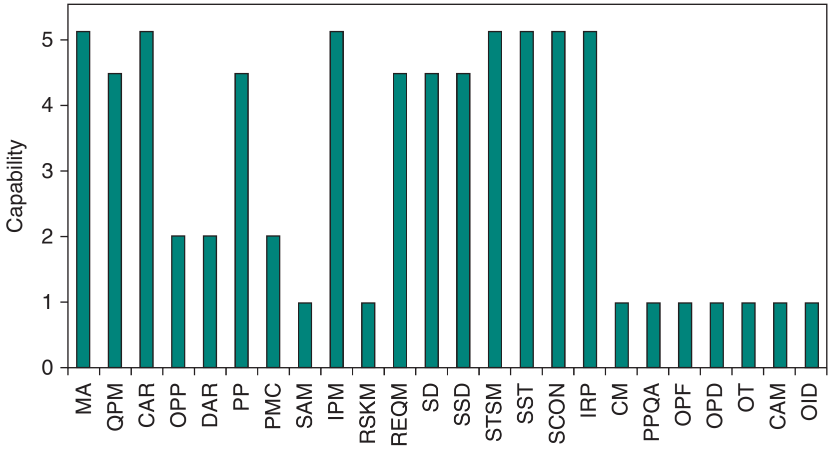


FIGURE 3.4
Process Improvement Objectives Using Capability Level Ratings

weekly) report that demonstrates your process improvement program's progress as it reaches its objectives.

Commit Resources

Remember that a process improvement program is a set of work established to focus on and achieve process improvement objectives. It must have the resources it needs to survive and succeed, including a plan, budget, and staff.

Choose the best staff members to manage the process improvement program. Ensure that they have the appropriate skills, experience, responsibility, and authority to be successful. Monitor the process improvement program over time to ensure that it is vital and strong.

Get the Right Help

If you want to hire experts to help you to achieve process improvement in your organization, consider hiring an SEI Partner organization. These organizations offer training, appraisal services, and process improvement advice.

Take these basic steps to ensure that you are selecting the right SEI Partner for your organization.

1. Check the SEI website to confirm that an SEI Partner is currently active. Only currently active partners are listed on the website. These SEI Partners receive the latest materials and information

from the SEI pertaining to the services the SEI Partner is authorized to provide.

2. Interview at least three SEI Partner organizations so that you can compare their knowledge, services, and prices.
3. Ask the SEI Partner organization for a list of the services it provides, how it recommends that your organization adopt CMMI, and how it charges for its services. If you know you need help with a particular part of CMMI, be sure to ask the partner about its experience with that specific aspect of CMMI (e.g., configuration management).
4. If you plan to have a SCAMPI appraisal as part of your relationship with the SEI Partner, ask if you will be able to interview and select your SCAMPI lead appraiser or team leader.
5. If you plan to purchase training as part of your relationship with the SEI Partner, ask if you will be able to interview and select your instructor.
6. Ask the SEI Partner organization what types of customers it has served before and how these customers differ from and resemble your organization. Ask for references. There is no better recommendation than from a satisfied customer.

Selecting a SCAMPI Lead Appraiser or Team Leader

Take these basic measures to ensure that you are selecting the right SCAMPI lead appraiser or team leader for your organization.

1. Check the SEI website to see if the SCAMPI lead appraiser or team leader is currently certified or authorized, respectively. Only currently certified SCAMPI lead appraisers and authorized SCAMPI team leaders are listed on the SEI website.
2. Ask the lead appraiser or team leader about his or her experience, including how many appraisals he or she has led and how many he or she has participated in. Find out if he or she is both a lead appraiser and a team leader.
3. Ask the lead appraiser or team leader what his or her approach is to collecting evidence, analyzing data, and presenting information that the organization can use to plan its future process improvement. Evaluate how well his or her style will fit with your organization's culture.
4. Ask the lead appraiser or team leader what types of customers he or she has served before and how these customers differ from and resemble your organization.
5. Ask the lead appraiser or team leader about his or her availability for answering questions before and after the appraisal.

Selecting a CMMI Instructor

Take these basic measures to ensure that you are selecting the right training instructor for your organization.

1. Check the SEI website to see if the instructor is authorized for the course you want. Only currently authorized or certified instructors are listed on the SEI website.
2. Ask the instructor about his or her experience, including how many courses he or she has taught and when he or she taught last.
3. Ask the instructor what his or her approach is to teaching and how he or she interprets the materials the SEI provides.
4. Ask the instructor what types of students he or she has taught before and how these students differ from and resemble the students you have in your organization.
5. Ask the instructor about his or her availability for answering questions before and after the class is held.

How to Get There

Each organization should develop an improvement strategy that meets its needs. Consequently, before you can determine the best improvement strategy, you must know the organization's business objectives. The improvement strategy, to be effective, must support and be designed to meet the organization's business objectives.

Scope of Improvement

Your process improvement strategy must target a portion of your organization, called an "organizational unit." If you have a very small organization, it may make sense to target the entire organization. However, for most organizations, a work unit, department, site, or set of projects is an appropriate beginning.

Choose the organizational unit carefully. Your first organizational unit is ideally one for which the process group can demonstrate the value of process improvement as quickly as possible. Such an approach will help to get others involved and eager to expand the process improvement into other areas.

If you hire an SEI Partner organization, its consultant may provide advice in the selection of an organizational unit for process improvement.

Reference Model Selection

Not only must you select the organizational unit you wish to improve, but you also must select the objectives for your process improvement program. Part of this selection is deciding which CMMI model to use and which process areas or capability levels (or maturity levels) to target.

Since you've selected the CMMI for Services model, you have already decided which model you want to use. If you want to achieve a particular maturity level, you have already selected the minimum set of process areas you wish to target for improvement.

However, there are other considerations. Which process areas are most critical to support the core of your business? For example, if you differentiate yourself from your competitors by your ability to make your services available under any circumstances, then the Service Continuity process area would immediately be identified as a critical process area for you.

If you are not interested in a maturity level or capability profile as part of your improvement, you are free simply to select the process areas most important to your organization.

If you hire an SEI Partner organization, its consultant may provide advice in the selection of the appropriate model scope for process improvement in your organization.

CMMI adoption is not a one-size-fits-all approach. CMMI can be used with other improvement approaches effectively. Some organizations have adopted CMMI with or in addition to other approaches such as the following:

- Agile methods
- Balanced Scorecard
- CobiT
- IEEE standards
- ISO 9000/20000
- ITIL
- People CMM
- RUP
- Six Sigma
- TSP/PSP

An Appraisal Approach

Since an appraisal measures the organization's processes against descriptions of effective practices, selecting which parts of the organization to appraise and which processes to appraise is critical. Such a selection is made based on the organization's business objectives and the process weaknesses identified by an informal mapping of CMMI goals and practices to the organization's processes.

In general, your appraisal strategy will closely follow the organizational unit and model scope selected for your process improvement program. However, that isn't required. You could select a representative subset of your process improvement program for appraisal.

As mentioned before, an appraisal can serve many purposes, including the following: (1) Identify weaknesses that should be addressed, (2) monitor the success of the program, and (3) prove that the program has achieved a level of success. Your appraisal strategy will cover when and which kind of appraisal you will use for which purpose as part of your overall process improvement program.

For example, you may begin with a SCAMPI C appraisal to identify strengths and weaknesses. Based on the information gained from this appraisal you will plan to determine the model scope and organizational units to pursue. A SCAMPI B appraisal might be scheduled a year from then to determine if the improvement project is on track. Finally, you might forecast a date when you think the process improvement program will have achieved its objectives and schedule a SCAMPI A appraisal to confirm it.

That is just one example. Your plan may be different based on your organization's needs and resources. If you hire an SEI Partner organization, its consultant may provide advice about creating an appraisal strategy.

A Training Program

If your organization is small, the best value is to purchase training from the SEI or an SEI Partner organization. If your organization is *very* large, you may want to consider becoming an SEI Partner and sending employees through training to become authorized instructors. Contact the SEI for more information and advice on the best approach for you.

A Strategy for Change

You need to make a number of decisions to establish a process improvement program. Without the right information, the risk of making mistakes or wasting time increases. That is why research and networking with others who have tried and succeeded with process improvement are invaluable in determining what is best for your organization.

Do You Want an Appraisal Rating or Not?

Appraisal ratings can be invaluable for organizations whose customers expect to see a maturity level or capability profile that will help them distinguish among providers. Sometimes an appraisal rating can be a factor that can help you differentiate yourself from the competition.

However, not all organizations need a rating. They can benefit from the process improvement benefits of CMMI, but the appraisal ratings are of little value to them. If this situation describes your organization, then you are lucky. Your CMMI-based process improvement program can be very flexible and you can select the process areas most critical to your business objectives without restriction.

Do You Want to Hire an SEI Partner or Not?

You might assume that if you don't want an appraisal rating, you don't need help from an SEI Partner, but that isn't necessarily true. If you have employees with extensive experience with CMMI and SCAMPI appraisals, you may not need to hire an SEI Partner. However, if you plan to select process areas solely on the basis of their benefit to your organization, you may need more help in selecting process areas that best answer your business needs.

Is Your Organization Ready for Change?

There are a variety of ways to determine whether your organization is ready for change. The culture of the organization must be receptive to change, and management must be willing to be consistent and support the change.

Before initiating a process improvement program, it is important to know the risks involved in undertaking such a program. Determine if your organization is ready for change by doing the following.

- Examine the history of the organization to evaluate how it has handled change in the past.
- Determine how committed each level of management is to making change happen.
- Identify areas of resistance to change from those in the organization who would be affected by the change.
- Identify areas of the organization that should not change because they are working well.

After collecting this information and analyzing it, you should be able to determine if the organization is ready for change and what the risks are for beginning a process improvement program.

These elements must be present in the organization for effective change to take place.

- A reason for change must exist. Members of the organization must be aware of organizational issues that are having an impact on the business.
- Executive management is leading the change.
- The top-level management team is committed to the change.
- A process group has valued resources assigned to it, including a process change leader who has a mandate to initiate change.
- A system of performance measures is in place that can be used to drive and track change.

If you hire an SEI Partner organization, its consultant may provide advice in determining the readiness of your organization for change and identifying the risks to making changes in your organization.

CHAPTER 4

ACHIEVING PROCESS IMPROVEMENT THAT LASTS

Overview

This chapter explains how CMMI models ensure lasting process improvement. Making improvements to achieve business objectives is only half the job. The other half is ensuring that these improvements persist over time.

Lasting Improvement

Lasting improvement requires establishing processes that are institutionalized, which means they are absorbed into the organization's standard way of doing business.

How do processes become institutionalized? Research has shown that to become institutionalized, processes must be supported by the organization. In CMMI models, this support is embodied in the generic goals and practices. That is why implementing only the specific practices of a process area is not enough; you must also implement the generic goals and practices.

Understanding Generic Practices

Generic practices ensure a degree of permanence in a variety of ways that include, but are not limited to, the following:

- Creating policies and securing sponsorship
- Ensuring that the work unit and/or organization has the resources it needs

TABLE 4.1 Model Elements Affecting Process Institutionalization

Generic Goals and Generic Practices	*Capability Levels*	*Maturity Levels*
GG 1	CL 1: Performed	(not applicable)
GG 2	CL 2: Managed	ML 2: Managed
GG 3	CL 3: Defined	ML 3: Defined
		ML 4: Quantitatively Managed
		ML 5: Optimizing

- Managing the performance of the process, managing the integrity of its work products, and involving relevant stakeholders
- Reviewing the process with higher level management and objectively evaluating its conformance to process descriptions, procedures, and standards

The generic goals and practices are listed in the first section of Part Two, including notes and subpractices that further explain them. Applied sequentially, the generic goals describe characteristics of increasingly institutionalized processes. Generic goals and their practices are designed to be applied to processes associated with each process area.

Achieving GG 1 for a process area is achieving the specific goals of a selected process area.

Achieving GG 2 for a process area is managing the performance of processes associated with the process area. This management includes a policy that indicates you will perform the process, a plan for performing the process, resources, assigned responsibilities, training, controlled work products, and so on.

Achieving GG 3 for a process area assumes that an organizational standard process exists that can be tailored to result in the process you will use.

These generic goals and generic practices are used as part of achieving capability and maturity level ratings. Table 4.1 illustrates the relationships between the generic goals and practices and the maturity and capability levels.

Understanding Capability Levels

The capability level of a process area indicates how lasting the associated processes are likely to be. A process area is given a capability level rating based on the highest generic goal satisfied.

TABLE 4.2 Capability Levels and Generic Goals

Capability Levels	*Generic Goals*
CL 1: Performed	GG 1 All SPs in the process area
CL 2: Managed	GG 1 All SPs in the process area GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10
CL 3: Defined	GG 1 All SPs in the process area GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10 GG 3 GP 3.1 and 3.2

Implementing only the specific practices of a process area will achieve capability level 1, which means that the process is performed, but it may not last.

As the organization implements the generic practices for a process, it increases the chances that the process will become part of the way the organization does business. Capability levels measure this increase in permanence for each process area by generic goal (or group of generic practices) as described in Table 4.2.

Using Capability Levels

Capability levels enable the organization to focus its process improvement efforts process area by process area. Once you select a process area, you must decide how much you want to improve the processes associated with that process area (i.e., select the appropriate capability level).

For example, an organization may wish to reach capability level 2 in one process area and capability level 3 in another. As the organization achieves 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 additional process areas relevant to its business goals.

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 used, such as 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.

The selection of a combination of process areas and capability levels is typically described in a "target profile." A target profile, as depicted in Figure 4.1, defines all of the process areas to be addressed and the targeted capability level of each. This profile governs which goals and practices the organization will address in its process improvement efforts.

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

After your organization reaches capability level 3 in the process areas it has selected for improvement, it can continue by addressing high maturity process areas (Organizational Process Performance,

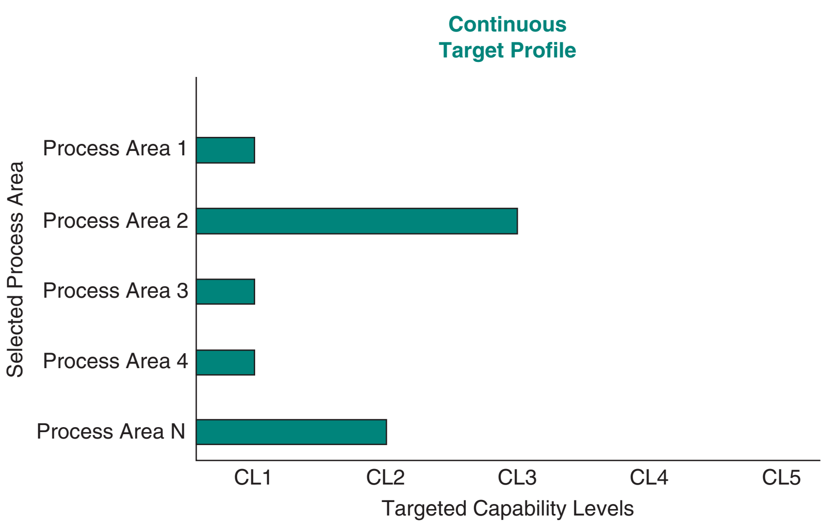


FIGURE 4.1
A Sample Target Profile

Quantitative Work Management, Causal Analysis and Resolution, and Organizational Performance Management).

The high maturity process areas focus on improving the performance of the 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 their improvement journey in this way, organizations 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. These processes enable the organization and its work groups to align the selection and analyses of processes more closely with its business objectives.

After the organization attains capability level 3 in the OPP and QWM process areas, it can continue its improvement path by selecting the CAR and OPM process areas. These processes enable the organization and its work groups to systematically identify and deploy incremental and innovative improvements that improve overall performance.

Understanding Maturity Levels

Maturity levels indicate how advanced an organization's processes are as a whole and how well the organization has achieved capability levels in a wide array of process areas. Each process area has a maturity level assigned to it; for example, the Configuration Management process area is a maturity level 2 process area. To achieve a maturity level, all of the goals of the process areas and generic goals belonging to that maturity level must be satisfied.

In other words, maturity level 2 (the lowest available maturity level) means that more than just the generic goals and practices are implemented for a single process area; it means that a whole set of process areas was implemented (including specific practices and generic practices).

An organization achieves a maturity level rating based on the highest generic goal implemented and the highest maturity level process areas satisfied. (Maturity levels are less directly related to generic practices than capability levels, but they do relate.) Maturity levels are implemented in order from 2 through 5.

As the organization achieves increasing maturity levels, it reinforces the process that will become part of the way the organization does business. Maturity levels measure this increase in permanence as described in Table 4.3.

TABLE 4.3 Maturity Levels, Process Areas, and Generic Goals

Maturity Levels	*Process Areas and Generic Goals*
ML 2: Managed	CM, MA, WMC, WP, PPQA, REQM, SAM, SD GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10
ML 3: Defined	CM, MA, WMC, WP, PPQA, REQM, SAM, SD CAM, DAR, IWM, IRP, OPD, OPF, OT, RSKM, SCON, SSD, SST, STSM GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10 GG 3 GP 3.1 and 3.2
ML 4: Quantitatively Managed	CM, MA, WMC, WP, PPQA, REQM, SAM, SD CAM, DAR, IWM, IRP, OPD, OPF, OT, RSKM, SCON, SSD, SST, STSM OPP, QWM GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10 GG 3 GP 3.1 and 3.2
ML 5: Optimizing	CM, MA, WMC, WP, PPQA, REQM, SAM, SD CAM, DAR, IWM, IRP, OPD, OPF, OT, RSKM, SCON, SSD, SST, STSM OPP, QWM CAR, OPM GG 2 GP 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, and 2.10 GG 3 GP 3.1 and 3.2

Once you reach maturity levels 4 and 5, the maturity levels no longer rely on the generic practices to increase control and permanence. These characteristics are achieved by the maturity level 4 and 5 process areas themselves.

The maturity level 4 and 5 process areas focus only on subprocesses that are indicators for the critical aspects of your business.

Measuring subprocesses, statistically managing them, and subsequently optimizing their selection and performance is a way to control a process to ensure that it continues successfully. That is the purpose and function of the process areas staged at maturity levels 4 and 5.

Using Maturity Levels

Maturity levels provide a staging of processes for improvement across the organization from maturity level 1 to maturity level 5. This improvement involves achieving the goals of the process areas at each maturity level. Process areas can be 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 could use to guide its process improvement until it satisfies 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 predetermined. Generic goal 2 applies to maturity level 2 and generic goal 3 applies to maturity levels 3 through 5.

Using Capability Levels and Maturity Levels

Capability levels support focused improvement within a single process area of the model. Maturity levels measure the overall improvement of the organization. However, both are simply different ways of viewing improvement using the same CMMI practices.

You can use capability levels to track improvement in single process areas while working toward a long-term goal of overall improvement for your organization, which can be measured by maturity levels.

Figure 4.2 demonstrates how capability levels and maturity levels work together to help you achieve improvement.

Figure 4.2 illustrates how organizations can focus on capability levels of a process area to ensure improvement of those processes while having a plan for the overall improvement of the organization's processes in the framework of maturity levels. In this way, you can use capability levels and maturity levels to reach your process improvement objectives.

Table 4.4 provides a list of CMMI-SVC process areas and their associated categories and maturity levels.

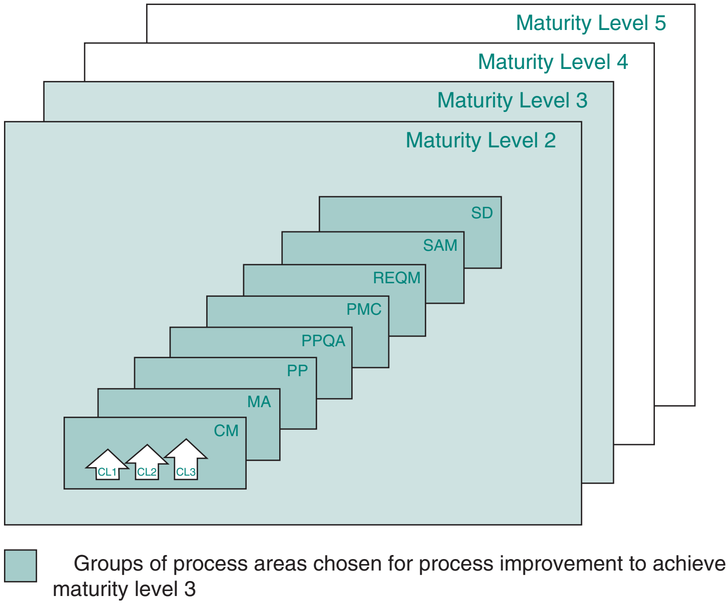


FIGURE 4.2
Process Areas in Continuous and Staged Representations

TABLE 4.4 Process Areas and Their Associated 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

TABLE 4.4 Process Areas and Their Associated Categories and Maturity Levels *(Continued)*

Process Area	*Category*	*Maturity Level*
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)[1]	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

Up to this point, we have not discussed process appraisals in much detail. The SCAMPI method[2] 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

1. The SSD process area is an "addition," which means that it is optional when selecting process areas to implement.

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

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

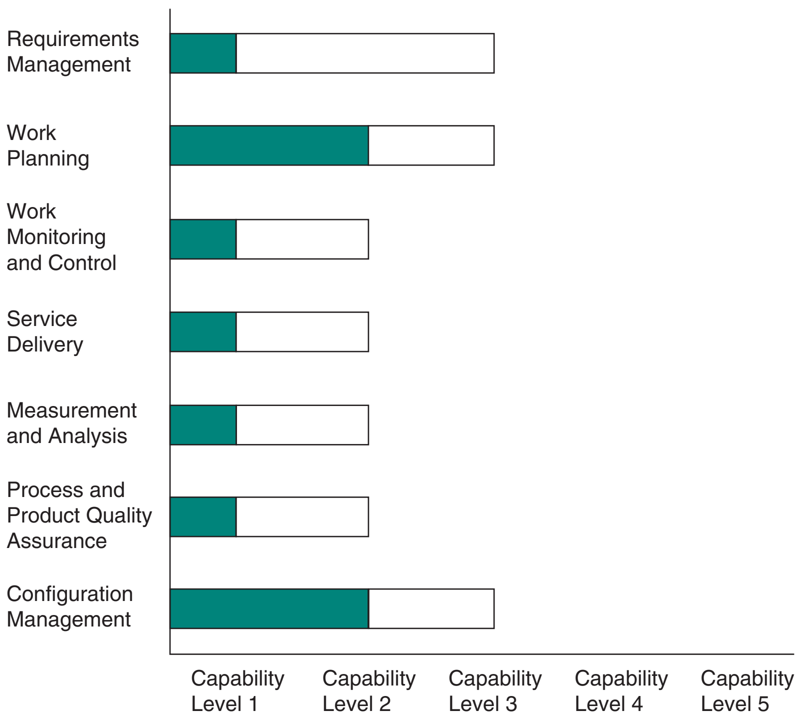


FIGURE 4.3
An Example of a Target and Achievement Profile

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.[3]

Although the reasons to use the continuous representation are many, ratings consisting of capability level profiles are limited in their ability to 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 4.4 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.

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.

3. See Table 7.1 in the Generic Goals and Generic Practices section of Part Two for more information about the dependencies between generic practices and process areas.

Name	Abbr.	ML	CL1	CL2	CL3
Configuration Management	CM	2			
Measurement and Analysis	MA	2			
Process and Product Quality Assurance	PPQA	2			
Requirements Management	REQM	2			
Supplier Agreement Management	SAM	2		Target Profile 2	
Service Delivery	SD	2			
Work Monitoring and Control	WMC	2			
Work Planning	WP	2			
Capacity and Availability Management	CAM	3			
Decision Analysis and Resolution	DAR	3		Target Profile 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[4]	SSD	3			
Service System Transition	SST	3			
Strategic Service Management	STSM	3			
Organizational Process Performance	OPP	4			
Quantitative Work Management	QWM	4		Target Profile 4	
Causal Analysis and Resolution	CAR	5			
Organizational Performance Management	OPM	5		Target Profile 5	

FIGURE 4.4
Target Profiles and Equivalent Staging

4. This process area is an "SSD addition."

Achieving High Maturity

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

When using capability levels, 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 and Causal Analysis and Resolution. 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.

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CHAPTER 5

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 Project and Work Management 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 5.1 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.

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.

Service establishment and delivery process areas represent the “core” of the CMMI for Services model in a longitudinal sense; all of the relationships can be laid out over time in the form of interchanges that span a service lifecycle. Working through these relationships for each process area is one way to lay the groundwork for a discussion of service lifecycles, which is at the end of this chapter.

Although this is a useful way to describe the process areas and their relationships, there is no order of implementation implied in this discussion. The activities that support each of these process areas are often iterative in nature and affect the other process areas and their associated activities.

The Strategic Service Management (STSM) process area stands at the beginning of the metaphorical timeline. STSM practices cover

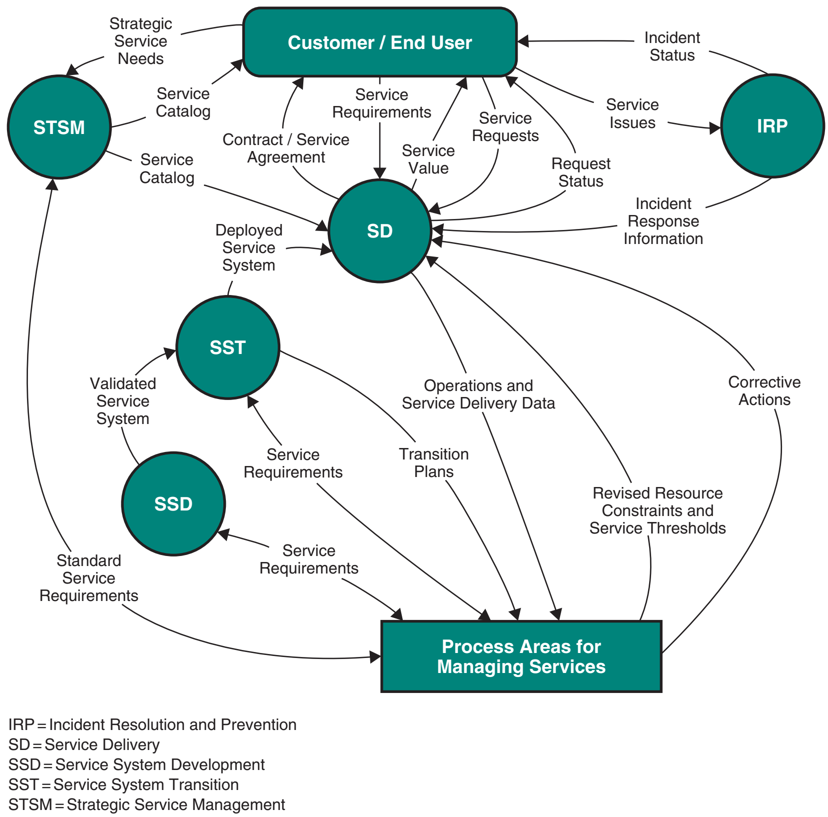

FIGURE 5.1
Key Process Area Relationships for Establishing and Delivering Services

collecting and analyzing information about customers' and end users' strategic service needs, and using this (and other) information to identify and define the requirements for standard services.

These requirements, their derived requirements, and requirements for nonstandard services are all handled by the Requirements Management (REQM) process area (which appears and is discussed in Relationships that Drive Service Management).

STSM practices also cover producing a service catalog that is used by customers and end users to select and request services, and is used by the organization to help regulate what services actually are delivered (covered by the Service Delivery process area).

Next in line is the Service System Development (SSD) process area. SSD practices start with service requirements and transform them via requirements development, design, implementation, integration, verification, and validation into a new service system (or into significant changes to an existing service system). This transformation often yields derived requirements that should be managed as well (by REQM).

The Service System Transition (SST) process area covers the deployment of the validated service system produced by SSD. SST practices move the service system into operational use while minimizing impacts on concurrent service delivery. During the preparations for this deployment as well as during the deployment itself, SST practices are guided by previously established requirements, and may generate additional derived requirements of their own.

Everything comes together in the Service Delivery (SD) process area. SD practices include working with customers to identify their specific service requirements and establish service agreements. Service catalogs established by STSM may make this easier. The deployed service system is then operated (also covered by SD) to produce service value (i.e., delivered services) in response to specific service requests that are covered by the established agreements. SD practices include providing status information on these requests back to the originating customers, as well as providing overall operations and service delivery measures to other service management process areas. Feedback from service management practices then regulates ongoing service delivery. Finally, information about how incidents are being handled enables an effective operational integration of incident and service request responses.

To handle actual or possible interference with the delivery of services, the Incident Resolution and Prevention (IRP) process area practices include receiving information about such incidents from customers and end users (as well as from internal sources). IRP practices cover determining how best to respond to each incident, doing whatever is needed to enable incident closure, keeping the customers and end users updated with incident status, and addressing incident causes to reduce the impact or occurrence of future incidents.

The depiction of these process areas and relationships in Figure 5.1 should be interpreted with caution. They are not the only important ones for effective service establishment and delivery. A few other significant process areas and relationships include the following.

- The Configuration Management (CM) process area covers keeping configurations and configuration items of service system components produced by SSD under control.
- The Organizational Process Definition (OPD) process area covers creating the standard processes needed to deliver the standard services

defined in STSM processes. OPD also covers providing these processes and related service lifecycles to SSD processes to guide the design of service system development.

- The Organizational Training (OT) process area covers implementing the training strategy created by SST processes to prepare staff members for the rollout of a new or changed service system.
- The Causal Analysis and Resolution (CAR) process area covers identifying and addressing the root causes of problems identified during IRP processes.

Relationships that Drive Service Management

Figure 5.2 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

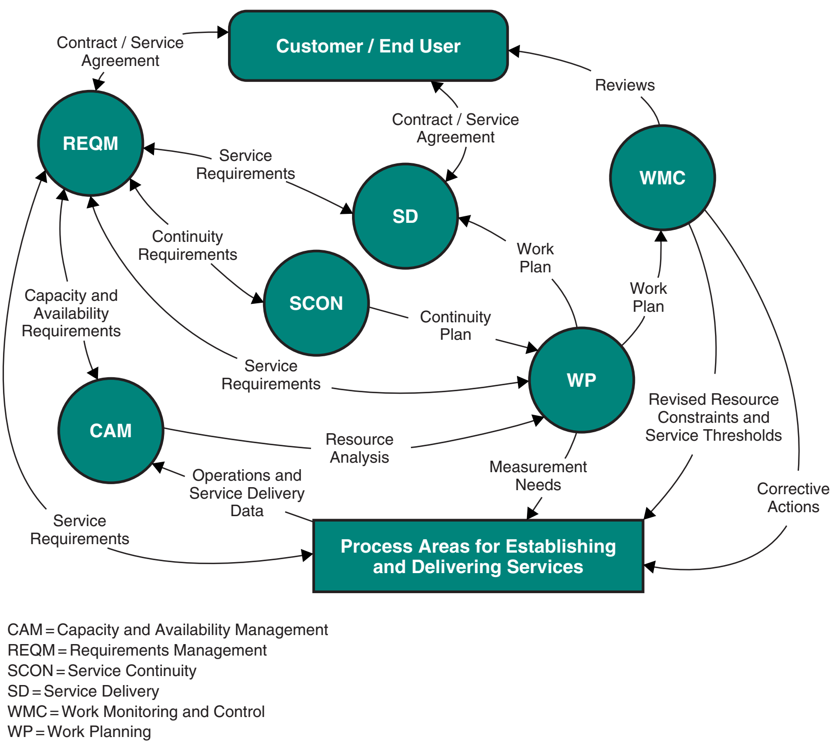

FIGURE 5.2
Key Process Area Relationships for Service Management

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 process areas that are most central to the management of services have their own critical relationships, many of which are illustrated in Figure 5.2. Because they cover activities that are performed more or less throughout the entire service lifecycle, there's no particularly obvious order for considering them, so an alphabetical sorting is used.

The Capacity and Availability Management (CAM) process area receives information about capacity and availability requirements, service system operations, and other service delivery data. CAM practices are used to analyze this information to produce estimates of the types and quantities of resources needed over time to deliver services, based on the use of service system representations. These analyses may also yield modifications to previously established requirements.

The Work Monitoring and Control (WMC) process area is driven by work plans, as well as by operational-level plans (not shown in Figure 5.2) created on the fly during service delivery, and by service system operations and service delivery data (also not shown in Figure 5.2). WMC practices determine whether current and anticipated service system operations are consistent with overall work plans, and establish corrective actions or needed revisions to resource constraints or service thresholds. In addition, customers and end users are kept informed about overall operations.

The Work Planning (WP) process area represents the logical foundation of work management in a services context. WP practices develop and maintain a work plan that builds on resource analyses performed by CAM and covers all the service system resources. WP also establishes commitments to the plan from necessary stakeholders. This plan is constrained by the overall service requirements established for the work from one or more service agreements with actual or anticipated customers. As other work related plans are developed (e.g., a service continuity plan), WP practices ensure that they are harmonized and consistent with the overall work plan. Finally, WP establishes the data measurement needs of the work group that determine what data should be collected during service system operations.

The Requirements Management (REQM) process area is the focal point for tracking requirements for any aspect of the work. REQM practices both collect requirements from and distribute requirements to many other process areas, including those originating in service agreements with customers. This coordination facilitates requirements change management, bidirectional traceability, and the detection of inconsistencies between requirements and the full range of work products created or used by the work group.

To provide assurance that critical services can be delivered no matter what happens, the Service Continuity (SCON) process area implements a specialized form of risk management. This work is often performed across an organization rather than in any single work group, because the risks created by major disasters frequently have an organization-wide scope. SCON practices are used to identify essential service resources and functions based on priority service requirements, and then to prepare, verify, and validate plans to ensure that catastrophic events will not completely wipe out a service provider's ability to deliver all services.

The Service Delivery (SD) process area appears in the discussions of both types of process areas and relationships (service delivery and service management), because SD includes both types of activities. From a service management perspective, SD practices include the creation of service agreements with customers. The service requirements from those agreements, plus the resource constraints and schedules identified in the work plan, allow SD to establish a targeted service delivery approach that will satisfy all stakeholders. This approach guides the operational-level responses to service requests during ongoing service delivery.

As with the process areas and relationships that drive service establishment and delivery, the service management process areas and relationships that appear in Figure 5.2 are not the only ones relevant to effective service management. The CMMI for Services model contains cross-references between these and many other process areas that identify these types of relationships. As you learn and understand the distribution of goals and practices across the entire model, you will probably realize the existence of other relationships that are not explicitly identified.

Lifecycles

Anyone who has managed or worked in a service business knows that work activities change over time in a way that reflects the dependencies among those activities as well as their dependence on the activities of other relevant stakeholders. For example, from a high-level perspective, you need a service agreement in place before you begin delivering services; you have to create a service system of some kind before you roll it out into operational use; and so on. These types of time-phased relationships can be organized and abstracted into groups of activities called "phases," and the phases can be structured and ordered into patterns called "lifecycles."

Although the concept of a lifecycle is fairly commonly used and understood in the context of domains such as manufacturing and product development, it is less often considered in the context of service delivery. Because the CMMI for Services model makes a variety of references to lifecycles, and because a proper understanding of them is helpful for achieving higher levels of process maturity, service lifecycles and ways of modeling them are worth an extended discussion.

The Importance of Lifecycles

Lifecycles are valuable because they provide a consistent and improvable basis of planning for any repeatable pattern of work activities over time. They provide a common framework within which business processes can be ordered. Organizations that don't use lifecycles may have to create from scratch the plans needed to accomplish new work each time, without the benefit of prior experience and the knowledge of a normal order of events. This type of approach to work planning over time can lead to wasted effort, lower-quality plans, and higher risks.

Rather than describing every last detail of a set of related work activities and events over time, lifecycles usually abstract the most significant information into a manageable number of chunks or phases. For different types of lifecycles, these phases can cover different degrees of scope ranging from single tasks to entire lines of business. Lifecycle phases can also have a varying granularity ranging from minutes to years in length, depending on the scope of the phase and nature of the service domain. For example, contrast the likely phases of a service request lifecycle in a service domain that emphasizes speedy response (e.g., fast food restaurants) with those in a service domain that emphasizes extreme caution (e.g., historical artifact conservation).

Effective and balanced abstraction of information is what determines the value of lifecycles. Too much detail and a lifecycle will likely require too much modification to be used repeatedly. Too little detail and a lifecycle may be missing important guidance. To be valuable, a lifecycle must have the necessary reusable information for *your* organization. With the right balance of information, good lifecycles allow you to more effectively plan for needed changes, smoothly transition from one phase of activity to another, and consistently control the pace of your work over time.

Lifecycles in CMMI for Services

The CMMI for Services model mentions a number of different types of lifecycles, including those for products, projects, services, incidents, and service systems. (Sometimes these are referred to as "lifecycle models," which indicate the existence of a relatively small set of standardized lifecycles created, selected, or adapted by an organization.) However, little guidance is provided on how these and other lifecycles might be defined in a services context, or how they may interrelate, so it may be difficult to know where to begin.

This discussion outlines some examples to help you get started with your lifecycle definitions, but caution is warranted: These are only *examples* of what is possible. Some of these examples may be more broadly useful than others, but it is important for you to tailor them to meet the needs of your organization, or create other lifecycles that may be specifically relevant to your situation. The Organizational Process Definition process area contains a practice that specifically focuses on the creation of effective lifecycle models by your organization.

Service Lifecycles

Because the primary focus of CMMI for Services is on services rather than on products in general, we can use the concept of a *service* as the entry point into the discussion of lifecycles. The lifecycle of a service might best be interpreted as lasting the entire period of time that a particular service is actually available plus the additional time needed to make that service available and remove it from availability. A service lifecycle covers the fullest possible extent of events and activities related over time in any way to the actual delivery of a service, and might therefore include the following phases:

1. Conceptualization: determining what services must be provided for different types of customers
2. Development: determining how services will be provided and establishing the resources needed to do so
3. Actualization: establishing agreements to deliver services and actually delivering services to satisfy those agreements
4. Retirement: removing a service that is no longer needed

Since a service lifecycle encompasses the complete scope of all activities related to service delivery, it's quite reasonable to expect that all the different process areas of the CMMI for Services model are potentially applicable in one or more of these phases. However, one process area stands out as being of interest *primarily* in service lifecycles and less so in other lifecycles: Strategic Service Management. This process area focuses on the conceptualization of services in ways that are independent of service agreements with individual customers. Strategic Service Management practices help you to define a standard foundation of services for all of your customers.

Project Lifecycles

The CMMI for Services model handles the concept of a project in a flexible way. Some organizations have a single ongoing project that operates a service system for different customers through different service agreements over time. Other organizations might have a separate project for each major service agreement with a different customer. Still other organizations may consider their service related work to take the form of ongoing operations rather than one or more projects. Even for these organizations, however, some major types of work have a specific beginning and end, and can be managed as projects (such as the creation of a new service system).

Service provider organizations follow so many different business models that it's impossible to establish a meaningful single project lifecycle to cover them all. The project lifecycles you define should reflect your own project and related work management needs. For example, if your organization treats each service agreement as a separate project, your project lifecycle might include the following phases:

1. Agreement: negotiating with your customer and establishing your service agreement
2. Preparation: planning, organizing, and allocating your resources, as well as establishing your service delivery approach and your service system (if needed)
3. Delivery: providing services to your customers in response to service requests, handling incidents, and managing and maintaining your service system
4. Termination: completing your service agreements, disposing of service system resources, and archiving project data

These same phases might occur in a different order if your organization has projects that cover multiple service agreements; preparation might precede agreement, and you might have multiple agreement phases.

Like a service lifecycle, a project lifecycle is broad in scope, and most process areas of the CMMI for Services model have practices that are applicable to project lifecycles. However, several service specific process areas stand out as being particularly relevant to most project lifecycles:

- Service Delivery, which covers responding to service requests and maintaining your service system, as well as the establishment of service agreements and your service delivery approach
- Capacity and Availability Management, which monitors, analyzes, and reports on the capacity and availability of your service system
- Incident Resolution and Prevention, which resolves service incidents and helps to keep your service operation running smoothly

Service System Lifecycles

The lifecycle of a service system may fall completely within a single project lifecycle, it may span several project lifecycles, or it may be more sensibly related to an overall service lifecycle. Alternatively, a single service or project lifecycle might span several service system lifecycles. However your service system lifecycles are aligned, you should define their phases to comprehensively cover all the necessary processes. For example, a "waterfall" type of service system lifecycle might have the following phases:

1. Analysis: determining what your service system will do by developing and refining the requirements for services to a sufficient level of detail
2. Design: identifying the types of service system components, functions, and interfaces needed to address identified requirements, and allocating those requirements to appropriate components
3. Implementation: assembling, building, and integrating components into a working service system
4. Transition: placing a new or changed service system into operational use
5. Operation: delivering services, handling incidents, and maintaining the service system
6. Retirement: removing service system components or the entire service system from active use

Other service system lifecycles can be similarly adapted from other product development lifecycle models such as incremental or evolutionary models. You should also consider that different service and work contexts may require very different emphases and time scales for the various phases. For example, an organization providing professional services with a simple service system might have the operation phase occupying the bulk of the service system lifecycle. Another organization might build custom complex service systems under contract for each customer, in which case the analysis, design, and implementation phases might be more significant.

Two service specific process areas stand out as being particularly relevant to most service system lifecycles:

- Service System Development: analyzing, designing, developing, integrating, verifying, and validating your service system
- Service System Transition: preparing to deploy your service system into operational use, and actually deploying it

In addition, the Service Delivery, Capacity and Availability Management, and Incident Resolution and Prevention process areas all contribute useful practices to the operational phase of a service system's lifecycle.

Service Request Lifecycles

Depending on the length and complexity of the service requests your organization handles, the lifecycle of a single service request may be so simple that you might choose to describe it as a single process rather than as a lifecycle with multiple phases and processes. Either way, your service requests are likely to include at least the following steps or phases:

1. Initiation: receiving and recording a communication from a customer of a particular need for a service
2. Analysis: determining an initial appropriate method for responding to the request, and identifying and assigning resources sufficient to execute the response
3. Resolution: providing the requested service
4. Closure: confirming that the customer received the anticipated service, and recording appropriate service information, including customer satisfaction data

Some service requests may involve lifecycles with the possibility of iterations of analysis and response, or the response phase may itself be divisible into further phases. In any case, the Service Delivery process area is the one process area of the CMMI for Services model that is most relevant to service requests and their lifecycles.

Incident Lifecycles

For some organizations, the lifecycle of an incident may often be similar in outline to a service request lifecycle, with the exception that incidents are not usually "initiated" intentionally. And some incident lifecycles may also be so short as to be best addressed through a single process. The necessary activities will probably include the following steps or phases:

1. Detection: identifying and recording the existence of a possible interference with service delivery
2. Analysis: determining an initial appropriate method for responding to the incident, and identifying and assigning resources sufficient to execute the response
3. Resolution: performing the identified method for correcting or mitigating the incident
4. Closure: confirming that the incident has been resolved and recording appropriate incident information

In many incident management contexts, the initial response may be inadequate to bring the incident to closure, and cycles of analysis and response may be necessary (including escalation that identifies and assigns additional resources). The Incident Resolution and Prevention process area is the one process area of the CMMI for Services model that is most relevant to service incidents and their lifecycles.

Putting Lifecycles Together

With so many different types of lifecycles to consider, you may have some difficulty imagining how they are interrelated. A lifecycle diagram is useful for this purpose, and it can serve as the starting point for defining your own lifecycles. Figure 5.3 provides an example of one way that these service related lifecycles can be integrated and aligned.

In this hypothetical example, the service provider organization provides a separate set of services independently to each major customer based on a separately negotiated service agreement. Each service agreement defines the scope of a separate project. A separate service system is developed for each project, and that system is ready for use by the time the service agreement is finalized. Service delivery then occurs whenever the provider organization handles customer-generated

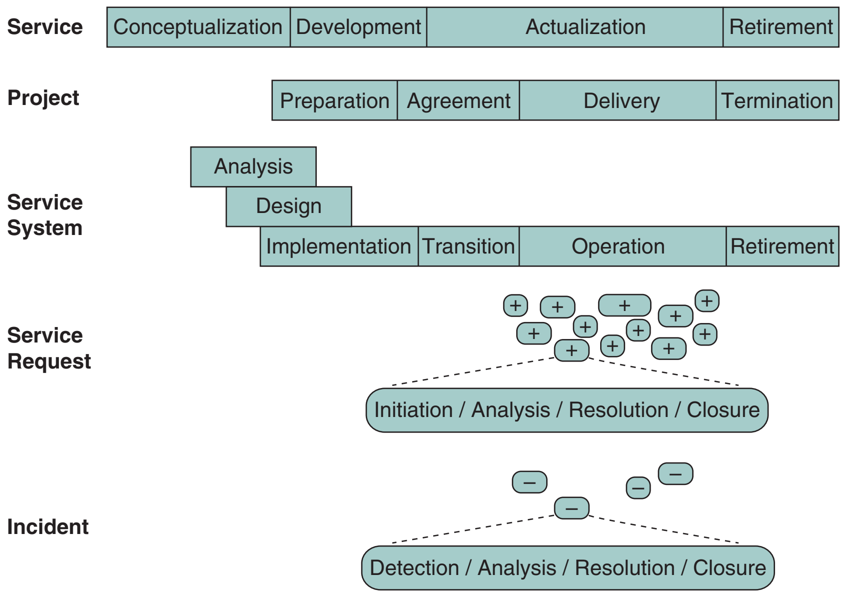

FIGURE 5.3
An Example of Service Related Lifecycle Alignment

service requests; different requests take different amounts of time and resources to handle (see the "+" bars in the diagram). Sometimes service delivery is incomplete or inadequate, and there are incidents that need to be handled as well (see the "-" bars in the diagram); these also can require different amounts of time and resources to achieve closure.

Of course, your own organization may have one or more ways of integrating these and other lifecycles that are quite different from this example. A service system lifecycle might span multiple projects with the same customer or with different customers. A single long-running project might span multiple service system lifecycles, or might need to include a product development lifecycle for tangible items that are delivered to customers along with services. Some types of service requests might be resolved across the entire duration of a service agreement, and some might be resolved through automated processes. Your organization may not consider a project lifecycle to be important at all; instead, an additional separate lifecycle for pursuing major business opportunities may be appropriate. In the end, your own business structure and work patterns are the primary drivers that determine what lifecycles are needed, how they should be defined, and how they should be tied together.

CHAPTER 6

ESSAYS ABOUT CMMI FOR SERVICES

This chapter consists of essays written by invited contributing authors. All of these essays are related to CMMI for Services. Some of them are straightforward applications of CMMI-SVC to a particular field; for example, reporting a pilot use of the model in an IT organization or in education. In addition, we sought some unusual treatments of CMMI-SVC: How can CMMI-SVC be used in development contexts? Can CMMI-SVC be used with Agile methods—or are services already agile? Finally, several essayists describe how to approach known challenges using CMMI-SVC: adding security concerns to an appraisal, using the practices of CMMI-SVC to capitalize on what existing research tells us about superior IT service, and reminding those who buy services to be responsible consumers, even when buying from users of CMMI-SVC.

In this way, we have sought to introduce ideas about using CMMI-SVC both for those who are new to CMMI and for those who are very experienced with prior CMMI models. These essays demonstrate the promise, applicability, and versatility of CMMI for Services.

A Changing Landscape

By Peter Flower

Book authors' comments: During the past three years, Trinity, where Peter Flower is a founder and managing director, has been working with a major aerospace and defense contractor that is transforming its business from one that develops and sells products to one that provides the services necessary to keep the products operational and to ensure that they are available when and where customers want them. This new form of "availability contracting" supports the company's strategic move to grow its readiness and sustainment capabilities and support its customers through partnering agreements.

During Peter's work to help make this transformation happen, he has become aware that this is not just a strategic change in direction by one organization, but is part of a global phenomenon that is becoming known as the "servitization" of products. With this realization, Peter sets the larger stage, or rather, paints the landscape, in which process improvement for service fits.

> *"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change."*
>
> *— Charles Darwin*

Changing Paradigms

Services are becoming increasingly important in the global economy; indeed, the majority of current business activity is in the service sector. Services constitute more than 50 percent of the GDP in low-income countries, and as the economies of these countries continue to develop, the importance of services continues to grow. In the United States, the current list of Fortune 500 companies contains more service companies and fewer manufacturers than in previous decades.

At the same time, many products are being transformed into services, with today's products containing a higher service component than in previous decades. In management literature, this is referred to as the "servitization" of products. Virtually every product today has a service component to it; the old dichotomy between product and service has been replaced with a service-product continuum.

For limited rates of change in the past, it has been sufficient for management to seek incremental improvements in performance for existing products and processes. This is generally the domain in which benchmarking has been most effective. However, change in the business, social, and natural environments has been accelerating. A major concern for top management, especially in large and established companies, is the need to expand the company's scope, not only to ensure survival and success in the present competitive arena, but also to make an effective transition to a turbulent future environment. The transition of an established organization from the present to the future competitive environment is often described in terms of a "paradigm shift." Think of a paradigm shift as a change from one way of thinking to another. It's a revolution, a transformation, a sort of metamorphosis. It does not just happen, but rather is driven by agents of change. To adopt a new paradigm, management needs to start thinking differently, to start thinking "outside the box."

Throughout history, significant paradigm shifts have almost always been led by those at the fringes of a paradigm, not those with a vested interest (intellectual, financial, or otherwise) in maintaining the current paradigm, regardless of its obvious shortcomings. Paradigm shifts do not involve simply slight modifications to the existing model. They instead replace and render the old model obsolete.

The current change that is engulfing every industry is unprecedented, and many organizations, even in the Fortune 500, may not survive the next five years. This shift is not to be mistaken as a passing storm, but rather is a permanent change in the weather. Understanding the reasons behind this change and managing them has become one of the primary tasks of management if a business is to survive.

The Principal Agents of Change

Globalization or global sourcing is an irreversible trend in delivery models, not a cyclical shift. Its potential benefits and risks require enterprise leaders to examine what roles and functions in a given business model can be delivered or distributed remotely, whether from nearby or from across the globe. The political, economic, and social ramifications of increased global sourcing are enormous. With China and India taking a much larger slice of the world economy, and with labor-intensive production processes continuing to shift to lower-cost economies, traditional professional IT services jobs are now being delivered by people based in emerging markets. India continues to play a leading role in this regard, but significant additional labor is now being provided by China and Russia, among other countries.

IP telephony and VoIP communications technologies, made possible by the Internet, are driving voice and data convergence activity in most major companies. In turn, this is leading to a demand for new classes of business applications. Developers are finally shifting their focus toward business processes and away from software functionality. In turn, software has become a facilitator of rapid business change, not an inhibitor. The value creation in software has shifted toward subscription services and composite applications, and away from monolithic suites of packaged software. With increased globalization and continued improvements in networking technologies, enterprises will be able to use the world as their supply base for talent and materials. The distinction among different functions, organizations, software integrators and vendors, and even industries will be increasingly blurred as packaged applications are deconstructed and delivered as service-oriented business applications.

Open source software (OSS) and service-oriented architecture (SOA) are revolutionizing software markets by moving revenue streams from license fees to services and support. In doing so, they are a catalyst for restructuring the IT industry. OSS refers to software whose code is open and can be extended and freely distributed. In contrast to proprietary software, OSS allows for collaborative development and a continuous cycle of development, review, and testing. Most global organizations now have formal open source acquisition and management strategies, and OSS applications are directly competing with closed-source products in every software infrastructure market. The SOA mode of computing, based on real-time infrastructure (RTI) architecture, enables companies to increase their flexibility in delivering IT business services. Instead of having to dedicate resources to specific roles and processes, companies can rely more on pools of multifaceted resources. These improvements in efficiency have enabled large organizations to reduce their IT hardware costs by 10 percent to 30 percent and their labor costs by 30 percent to 60 percent as service quality improves and agility increases. Large companies are now looking to fulfill their application demands through shared, rather than dedicated, sources, and to deliver their software by external pay-as-you-go providers. For example, Amazon.com now sells its back-office functions to other online businesses, allowing its IT processes to be made available to other companies at a price, as a separate business from that of selling goods to consumers.

A problem for those moving from one paradigm to another is their inability to see what is before them. The current, but altering, paradigm consists of rules and expectations, many of which have been in place for decades. Any new data or phenomena that fail to fit those assumptions and expectations are often rejected as errors or impossibilities. Therefore, the focus of management's attention must shift to innovation and customer service, where personal chemistry or creative insight matters more than rules and processes. Improving the productivity of knowledge workers through technology, training, and organizational change needs to be at the top of the agenda in most boardrooms in the forthcoming years. Indeed, a large percentage of senior executives think that knowledge management will offer the greatest potential for productivity gains in the next 15 years and that knowledge workers will be their most valuable source of competitive advantage. We are experiencing a transition from an era of competitive advantage gained through information to one gained from knowledge creation. Investment in information technology may yield information, but the interpretation of the information and the value added to it by the human mind is knowledge. Knowledge is the prerogative of the human mind, and not of the machines.

Unlike the quality of a tangible product, which can be measured in many ways, the quality of a service is only apparent at the point of delivery and is dependent on the customer's point of view. There is no absolute measure of quality. Quality of service is mostly intangible, and may be perceived from differing viewpoints as the timely delivery of a service, delivery of the right service, convenient ordering and receipt of the service, and providing value for money. This intangibility requires organizations to adopt a new level of communication with their customers about the services they can order, ensuring that customers know how to request services and report incidents and that they are able to do so. They need to define and formally agree on the exact service parameters, ensure that their customers understand the pricing of the service, ensure the security and integrity of their customers' data, and provide agreed-upon information regarding service performance in a timely and meaningful manner. Information, therefore, is not only a key input in services production, but also a key output as well.

In addition, an organization's "online customers" are literally invisible, and this lack of visual and tactile presence makes it even more crucial to create a sense of personal, human-to-human connection in the online arena. While price and quality will continue to matter, personalization will increasingly play a role in how people buy products and services, and many executives believe that customer service and support will offer the greatest potential for competitive advantage in the new economy.

Management's Challenge

As a result of this paradigm shift, a number of key challenges face many of today's senior business managers. The major challenges include management's visibility of actual performance and control of the activities that deliver the service, to ensure that customers get what they want. Controlling costs by utilizing the opportunities presented by the globalization of IT resources; compliance with internal processes and rules, applicable standards, regulatory requirements, and local laws; and continuous service improvement must become the order of the day.

Operational processes need to be managed in a way that provides transparency of performance, issues, and risks. Strategic plans must integrate and align IT and business goals while allowing for constant business and IT change. Business and IT partnerships and relationships must be developed that demonstrate appropriate IT governance and deliver the required, business-justified IT services (i.e., what is required, when required, and at an agreed cost). Service processes must work smoothly together to meet the business requirements and must provide for the optimization of costs and total cost of ownership (TCO) while achieving and demonstrating an appropriate return on investment (ROI). A balance must be established between outsourcing, insourcing, and smart sourcing.

Following the economic crisis, the social environment is considerably less trusting and less secure, and the public is wary of cascading risks and seems to be supportive of legislation and litigation aimed at reducing those risks, including those posed by IT. As a result, it is very likely that IT products and services will soon be subject to regulation, and organizations must be prepared to meet the requirements that regulated IT will impose on their processes, procedures, and performance.

Organizations will need to measure their effectiveness and efficiency, and demonstrate to senior management that they are improving delivery success, the business value of IT, and how they are using IT to gain a competitive advantage. Finally, organizations must understand how they are performing in comparison to a meaningful peer group, and why.

Benchmarking: A Management Tool for Change

Benchmarking is the continuous search for, and adaptation of, significantly better practices that leads to superior performance by investigating the performance and practices of other organizations (benchmark partners). In addition, benchmarking can create a crisis to facilitate the change process.

The term *benchmark* refers to the reference point against which performance is measured. It is the indicator of what can and is being achieved. The term *benchmarking* refers to the actual activity of establishing benchmarks.

Most of the early work in the area of benchmarking was done in manufacturing. However, benchmarking is now a management tool that is being applied almost everywhere. Benefits of benchmarking include providing realistic and achievable targets, preventing companies from being industry-led, challenging operational complacency, creating an atmosphere conducive to continuous improvement, allowing employees to visualize the improvement (which can, in itself, be a strong motivator for change), creating a sense of urgency for improvement, confirming the belief that there is a need for change, and helping to identify weak areas and indicating what needs to be done to improve. As an example, quality performance in the 96 percent to 98 percent range was considered excellent in the early 1980s. However, Japanese companies, in the meantime, were measuring quality by a few hundred parts per million, by focusing on process control to ensure quality consistency. Thus, benchmarking is the only real way to assess industrial competitiveness and to determine how one company's process performance compares to that of other companies.

Benchmarking goes beyond comparisons with competitors to understanding the practices that lie behind performance gaps. It is not a method for copying the practices of competitors, but a way of seeking superior process performance by looking outside the industry. Benchmarking makes it possible to gain competitive superiority rather than competitive parity.

With the CMMI for Services reference model, the SCAMPI appraisal method, and the Partner Network of certified individuals such as instructors, appraisers, and evaluators, the Software Engineering Institute (SEI) provides a set of tools and a cadre of appropriately experienced and qualified people that organizations can use to benchmark their own business processes against widely established best practices. It must be noted, however, that there will undoubtedly be difficulties encountered when benchmarking. Significant effort and attention to detail is required to ensure that problems are minimized.

The SEI has developed a document to assist in identifying or developing appraisal methods that are compatible with the CMMI Product Suite. This document is the Appraisal Requirements for CMMI (ARC). The ARC describes a full benchmarking class of appraisals as class A. However, other CMMI-based appraisal methods might be more appropriate for a given set of needs, including self-assessments, initial appraisals, quick-look or mini-appraisals, incremental appraisals, and external appraisals. Of course, this has always been true, but the ARC formalizes these appraisals into three classes by mapping requirements to them, providing a consistency and standardization rarely seen in other appraisal methods. This is important because it recognizes that an organization can get benefits from internal appraisals with various levels of effort.

A CMMI appraisal is the process of obtaining, analyzing, evaluating, and recording information about the strengths and weaknesses of an organization's processes and the successes and failures of its delivery. The objective is to define the problems, find solutions that offer the best value for the money, and produce a formal recommendation for action. A CMMI appraisal breaks the organization down into discrete areas that are the targets for benchmarking, and it is therefore a more focused study than other benchmarking methods as it attempts to benchmark not only business processes but also the management practices behind them. Some business processes are the same, regardless of the type of industry.

The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) is the official SEI method to provide a benchmarking appraisal. Its objectives are to understand the implemented processes, identify process weaknesses (called "findings"), determine the level of satisfaction against the CMMI model ("gap analysis"), reveal development, acquisition, and service risks, and (if requested) assign ratings. Ratings are the extent to which the corresponding practices are present in the planned and implemented processes of the organization and are made based on the aggregate of evidence available to the appraisal team.

SCAMPI appraisals help in prioritizing areas of improvement and facilitate the development of a strategy for consolidating process improvements on a sustainable basis; hence SCAMPI appraisals are predominantly used as part of a process improvement program. Unless an organization measures its process strengths and weaknesses, it will not know where to focus its process improvement efforts. By knowing its actual strengths and weaknesses, it is easier for an organization to establish an effective and more focused action plan.

Summary

Driven by unprecedented technological and economic change, a paradigm shift is underway in the servitization of products. The greatest barrier in some cases is an inability or refusal to see beyond the current models of thinking; however, for enterprises to survive this shift, they must be at the forefront of change and understand how they perform within the new paradigm.

Benchmarking is the process of determining who is the very best, who sets the standard, and what that standard is. If an organization doesn't know what the standard is, how can it compare itself against it?

One way to achieve this knowledge and to establish the necessary continuous improvement that is becoming a prerequisite for survival is to adopt CMMI for Services.

"To change is difficult. Not to change is fatal."

— Ed Allen

Expanding Capabilities across the "Constellations"

By Mike Phillips

Book authors' comments: We frequently hear from users who are concerned about the three separate CMMI models and looking for advice on which is the best for them to use and how to use them together. In this essay, Mike Phillips, who is the program manager for CMMI, considers the myriad ways to get value from the multiple constellations.

As we are finishing the details of the current collection of process areas that span three CMMI constellations, this essay is my opportunity to encourage "continuous thinking." My esteemed mentor as we began and then evolved the CMMI Product Suite was our chief architect, Dr. Roger Bate. Roger left us with an amazing legacy. He imagined that organizations could look at a collection of "process areas" and choose ones they might wish to use to facilitate their process improvement journey.

Maturity levels for organizations were all right, but not as interesting to him as being able to focus attention on a collection of process areas for business benefit. Small businesses have been the first to see the advantage of this approach, as they often find the full collection of process areas in any constellation daunting. An SEI report, "CMMI Roadmaps," describes some ways to construct thematic approaches to effective use of process areas from the CMMI for Development constellation. This report can be found on the SEI website at www.sei.cmu.edu/library/abstracts/reports/08tn010.cfm.

As we created the two new constellations, we took care to refer back to the predecessor collection of process areas in CMMI for Development. For example, in CMMI for Acquisition, we note that some acquisition organizations might need more technical detail in the requirements development effort than what we provided in Acquisition Requirements Development (ARD), and to "reach back" to CMMI-DEV's Requirements Development (RD) process area for more assistance.

In CMMI for Services, we suggest that the Service System Development (SSD) process area is useful when the development efforts are appropriately scoped, but the full Engineering process area category in CMMI-DEV may be useful if sufficiently complex service systems are being created and delivered.

Now, with three full constellations to consider when addressing the complex organizations many of you have as your process improvement opportunities, many additional "refer to" possibilities exist. With the release of the V1.3 Product Suite, we will offer the option to declare satisfaction of process areas from any of the process areas in the CMMI portfolio. What are some of the more obvious expansions?

We have already mentioned two expansions—ARD using RD, and SSD expanded to capture RD, TS, PI, VER, and VAL. What about situations in which most of the development is done outside the organization, but final responsibility for effective systems integration remains with your organization? Perhaps a few of the acquisition process areas would be useful beyond SAM. A simple start would be to investigate using SSAD and AM as a replacement for SAM to get the additional detailed help. And ATM might give some good technical assistance in monitoring the technical progress of the elements being developed by specific partners.

As we add the contributions of CMMI-SVC to the mix, several process areas offer more ways to expand. In V1.2 of CMMI-DEV, for example, we added informative material in Risk Management to begin to address beforehand concerns about continuity of operations after some significant disruption occurs. Now, with CMMI-SVC, we have a full process area, Service Continuity (SCON), to provide robust coverage of continuity concerns. (And for those who need even more coverage, the SEI now has the Resilience Management Model [RMM] to give the greater attention that some financial institutions and similar organizations have expressed as necessary for their process improvement endeavors. For more, see www.cert.org/resilience/rmm.html.)

Another expansion worthy of consideration is to include the Service System Transition (SST) process area. Organizations that are responsible for development of new systems—and maintenance of existing systems until the new system can be brought to full capability—may find the practices contained in SST to be a useful expansion since the transition part of the lifecycle has limited coverage in CMMI-DEV. (See the essay by Lynn Penn and Suzanne Garcia Miller for more information on this approach.) In addition, CMMI-ACQ added two practices to PP and PMC to address planning for and monitoring transition into use, so the CMMI-ACQ versions of these two core process areas might couple nicely with SST.

A topic that challenged the development team for V1.3 was improved coverage of "strategy." Those of us with acquisition experience knew the criticality of an effective acquisition strategy to program success, so the practice was added to the CMMI-ACQ version of PP. In the CMMI-SVC constellation, Strategic Service Management (STSM) has as its objective "to get the information needed to make effective strategic decisions about the set of standard services the organization maintains." With minor interpretation, this process area could assist a development organization in determining what types of development projects should be in its product development line. The SVC constellation authors also added a robust strategy establishment practice in the CMMI-SVC version of PP (Work Planning) to "provide the business framework for planning and managing the work."

Two process areas essential for service work were seriously considered for insertion into CMMI-DEV, V1.3: Capacity and Availability

Management (CAM) and Incident Resolution and Prevention (IRP). In the end, expansion of the CMMI-DEV constellation from 22 to 24 process areas was determined to be less valuable than continuing our efforts to streamline coverage. In any case, these two process areas offer another opportunity for the type of expansion I am exploring in this essay.

Those of you who have experienced appraisals have likely seen the use of target profiles that gather the collection of process areas to be examined. Often these profiles specifically address the necessary collections of process areas associated with maturity levels, but this need not be the case. With the release of V1.3, we have ensured that the reporting system (SCAMPI Appraisal System or SAS) is robust enough to allow depiction of process areas from multiple CMMI constellations. As use of other architecturally similar SEI models, such as the RMM mentioned earlier as well as the People CMM, grows, we will be able to depict profiles using mixtures of process areas or even practices from multiple models, giving greater value to the process improvement efforts of a growing range of complex organizations.

CMMI for Services, with a Dash of CMMI for Development

By Maggie Pabustan and Mary Jenifer

Book authors' comments: Maggie Pabustan and Mary Jenifer implement process improvements at a Washington-area organization, AEM, that many would consider a development house, given that its mission is applied engineering. They have been strong users of the CMMI-DEV model, yet they have found that CMMI-SVC works admirably in their setting for some contracts. Here they provide an early-adopter account of how to use both models and how to switch from one to the other to best advantage.

How do you apply CMMI best practices to a call center that provides a variety of services and develops software? This essay describes the adaptation of the CMMI for Services model to a call center that exists within a larger organization having extensive experience in using the CMMI for Development model. The call center provides a mix of services, from more traditional software support services to more technical software development expertise. Since software development is not the primary work of the call center, however, applying the CMMI for Development model to its processes was insufficient. The CMMI for Services framework helped to provide all of the elements needed for standardized service delivery and software development processes.

The Development Environment

Applied Engineering Management (AEM) Corporation is a 100 percent woman-owned company, founded by Sharon deMonsabert, Ph.D, in 1986. It is located in the Washington Metropolitan Area and historically has focused on engineering, business, and software solutions. Over the years, AEM has contributed significant effort toward implementing processes based on the CMMI for Development model. Its corporate culture of process improvement is one that values the CMMI model and the benefits of using it. Two of AEM's federal contracts have been appraised and rated as maturity level 3 using the CMMI for Development model. Both of these contracts focus on software development and maintenance. When considering the feasibility of an appraisal for a third federal contract that focuses on customer support, AEM management determined that the nature of the work was a closer match to the CMMI for Services model, so it proceeded with plans for a CMMI for Services appraisal. After considerable preparation, the organization participated in a Standard CMMI Appraisal Method for Process Improvement (SCAMPI) appraisal in 2010.

The Services Environment

This third contract provides 24/7 customer support to the worldwide users of a software application for a federal client. The customer support team, known as the Support Office, is a staff of 16 people who are tasked with six main areas of customer support.

- Site visits: These site visits are in the form of site surveys, software installation and training, and revisits/refresher training. Tasks may include user training, data analysis, data migration preparation and verification, report creation, and bar coding equipment setup.
- Support requests: Requests for assistance are received from users primarily via e-mail and telephone.
- Data analysis: Data analysis occurs in relation to the conduct of site visits and in the resolution of requests. Support Office team members provide data migration assistance and verification during site visits and identify and correct the source of data problems received via requests.
- Reporting: The Support Office creates and maintains custom reports for each site. In addition, the Support Office provides software development expertise for the more robust reporting features in the application, including universe creation and ad hoc functionality.
- Configuration Change Board (CCB) participation: Team members participate in CCB meetings. Tasks associated with these meetings

include clarifying requirements with users and supporting change request analysis.

- Testing: As new versions of the software are released, the Support Office provides testing expertise to ensure correct implementation of functionality.

The Support Office has been in existence in various forms for more than 20 years. It has been a mainstay of customer service and product support for both AEM and its federal clients, and has been recognized for its dedication. The work has expanded in the past several years to include two more federal clients, and is set to expand to include additional federal clients in the coming months.

Implementing CMMI for Services

The CMMI for Services model has proven to be an excellent choice of a process framework for the Support Office. Its inclusion of core CMMI process areas and its emphasis on product and service delivery allows the Support Office to focus on its standard operating procedures, project management efforts, product development, product quality, and customer satisfaction.

Work Management Processes

Since the services provided by the Support Office are so varied, the project planning and management efforts have had to mature to cover all of these services in detail. Even though the Work Planning and Work Monitoring and Control process areas exist in both the CMMI for Development and CMMI for Services models, the maintenance of project or work strategy continues to be a key practice for Support Office management. Support Office management continuously identifies constraints and approaches to handling them, plans for resources and changes to resource allocation, and manages all associated risks. The project or work strategy drives the day-to-day management activities. Work activities within the CMMI for Services realm typically do not have fixed end dates. This is very much the case with the work performed by the Support Office. When the process implementers were reviewing the Support Office processes, much thought was given to the nature and workflow of the services they provide. As a result, the group's processes support the continuous occurrence of work management tasks and resource scheduling. Additionally, Support Office management not only answers to multiple federal clients, but in this capacity also has to manage the site visits, support operations, data tasks, product development, and product testing for these clients. As such, the planning and monitoring of these efforts are performed with active client involvement, usually on a daily basis.

During the SCAMPI appraisal, Project Planning (in CMMI-SVC, V1.3, this becomes Work Planning) was rated at capability level 3, which was higher than the capability levels achieved by the organization for any of the other process areas in the appraisal scope. In addition, the extensive involvement of the clients was noted as a significant strength for the group.

Measurement and Analysis Processes

Over the years, the measurements collected by Support Office management have evolved significantly—in both quantity and quality. These measures contribute to the business decisions made by AEM and its clients. Measures are tracked for all of the customer support areas. Examples include travel costs, user training evaluation results, request volume, request completion rate, request type, application memory usage, application availability, change request volume, and defects from testing. Although the Measurement and Analysis process area exists in both the CMMI for Development and CMMI for Services models, of particular use to the Support Office is the relationship between Measurement and Analysis and Capacity and Availability Management in the CMMI for Services model. As they provide 24/7 customer support, both capacity and availability are highly important. The measures selected and tracked enable Support Office management and its clients to monitor status and proactively address potential incidents.

Quality Assurance Processes

Quality assurance checkpoints are found throughout the processes used by the Support Office. Each type of service includes internal review and approval, at both a process level and a work product level. Process implementers found that in the CMMI for Services environment, as in the CMMI for Development environment, the quality of the work products is highly visible to clients and users. They implemented processes to ensure high-quality work products. For example, the successful completion of site visits is of high importance to clients, in terms of both cost and customer satisfaction. Because of this, the work involved with planning for site visits is meticulously tracked. The processes for planning site visits are based on a 16-week cycle and occur in phases, with each phase having a formal checkpoint. At any point in any phase, if the plans and preparations have encountered obstacles and the checkpoint cannot be completed, then management works with the client to make a "go/no-go" decision. As another quality assurance task, process reviews are conducted by members of AEM's corporate-level Process Improvement Team. Members of this team are external to the Support Office and conduct the reviews using their knowledge and experience with CMMI for Development process reviews and SCAMPI appraisals. They review the work products and discuss processes with members of the Support Office regularly.

Software Development Processes

A benefit of using the CMMI for Services model is that even though the model focuses on service establishment and delivery, it is still broad enough to apply to the software development work performed by the Support Office. The model allowed the Support Office to ensure that they have managed and controlled processes in place to successfully and consistently develop quality software that meets their clients' needs. Using the CMMI for Development model, AEM has been able to address software development activities in a very detailed manner for its other contracts. In applying the CMMI for Services model to the Support Office contract, AEM's process implementers found that the essential elements of software development still existed in the Services model. They found that these elements, including Configuration Management, Requirements Management and Development, Technical Solution, Product Integration, Verification, and Validation are addressed sufficiently in the Services model, though not necessarily as separate process areas. Given that the scope of the Support Office's SCAMPI appraisal was focused on maturity level 2 process areas, Service System Development was not included. As the Support Office improves its processes and strives to achieve higher maturity, Service System Development will come into play.

Organizational Processes

In the past, one of the Support Office's weaknesses arguably could have been its employee training processes. An individual team member's knowledge was gained primarily through his or her experiences with handling user requests and working on-site with users. The experiences and relationships built with other team members in the office were also a great source of knowledge. This caused some problems for newer team members who did not have the same exposure and learning experiences as the other team members. The process of applying the CMMI for Services model helped the Support Office focus on documenting standard processes and making them available to all team members. All team members have access to the same repository of information. Lessons learned from site visits are now shared with all members of the team, and lessons learned by one team member more quickly and systematically become lessons learned by all team members. This focus has allowed the Support Office to turn a weakness into a strength. This strength was noted during the SCAMPI appraisal.

Implementation Results

Using continuous representation, the Support Office received a maturity level 2 rating with the CMMI for Services model. One of the greatest challenges the Support Office faces in its attempt to achieve advanced process improvement and higher capability and maturity ratings is an organizational issue. While the nature of the Support Office work is services rather than development, the team must integrate itself with AEM's overall process improvement efforts, which are more in line with development. The Support Office, AEM's CMMI for Development groups, and its Process Improvement Team will have to work together to achieve greater cohesiveness and synergy. Interestingly, the Support Office may become the first AEM group to measure its processes against higher maturity levels. Its processes as a service organization, rather than as a development organization, lead it closer to achieving quantitative management and optimization of its processes.

In summary, the CMMI for Services model was an excellent fit for the Support Office. It provides a framework for work management, including capacity and availability management, as well as measurement and analysis opportunities. Its emphasis on service delivery matches the customer support services provided by the group, and helps the group to provide higher-quality and more consistent customer service. The CMMI for Services model is flexible enough to encompass the work involved with developing software products, and also ensures that the processes to produce software and services sufficiently correspond to those used by AEM's software development contracts.

Enhancing Advanced Use of CMMI-DEV with CMMI-SVC Process Areas for SoS

By Suzanne Miller and Lynn Penn

Book authors' comments: Suzanne Miller has been working for several years with process improvement and governance for systems of systems. Lynn Penn works at Lockheed Martin, where she leads the process improvement work in a setting with a long history of successful improvement for its development work.

Suzanne posited in the last edition of this book that systems engineering can be usefully conceived of as a service. Lynn most recently led a team to improve service processes at Lockheed Martin. Once her team had learned about the CMMI-SVC model, they recognized that service process areas could also provide a next level of capability to already high-performing development teams. In other words, Lynn proved in the field what Suzanne had conceptualized.

The term *system of systems* (SoS) has long been a privileged term to define development programs that are a collection of task-oriented systems that, when combined, produce a system whose functionality surpasses the sum of its constituent systems. The developers of these "mega-systems" require discipline beyond the engineering development cycle, extending throughout the production and operations lifecycles. In the U.S. Department of Defense context, many programs like these were the early adopters of CMMI-DEV. The engineering process areas found within the CMMI-DEV model reflect a consistently useful roadmap for developing the independent "subsystems." Given a shared understanding of the larger vision, CMMI-DEV can also help to maintain a focus on the ultimate functionality and quality attributes of the larger system of systems.

However, the operators of these complex systems of systems are more likely to see the deployment and evolution of these SoS as a service that includes products, people to train them on the use of the SoS components, procedures for technology refresh, and other elements of a typical service system. From their viewpoint, an engineering organization that doesn't have a service mindset is only giving them one component of the service system they need. From the development organization's viewpoint, participating in a system of systems context also feels more like providing a service that contains a product more than the single product developments of the past. They are expected to provide much more skill and knowledge about their product to other constituents in the system of systems; they have much more responsibility for coordinating updates and upgrades than was typical in single product deliveries; and they are expected to understand the operational context deeply enough to help their customers make best use of their products within the end-user context, including adapting their product to changing needs. Changing the organizational mindset to include a services perspective can make it easier for a traditional development organization to transition to being an effective system of systems service provider.

With the introduction of CMMI-SVC, development programs involved in the system of systems effort are able to further enhance their product development discipline even within the context of their existing engineering lifecycle. As an example, the engineering process area of Product Integration (PI) has always been a cornerstone in effecting the combination of subsystems and the production of the final system. However, as the understanding of the operational context of a system of systems matures, it is also necessary to have the ability to add, modify, or delete subsystems while maintaining the enhanced functionality of the larger system. The Service System Transition (SST) process area provides a useful answer to this need. This CMMI-SVC process area now gives the system of systems developer guidance on methodically improving the product with new or improved functionality, while considering and managing the impact. Impact awareness is important internally to management, test and integration organization, configuration management, and quality, as well as externally to the ultimate users. All stakeholders share in the benefits of effective transition of new capabilities into the operational context. The planning of the transition coupled with product integration engineering provides both the producer and the ultimate customer with the confidence that a trusted system will continue to operate effectively as the context changes.

Another obvious gap in the development of these systems of systems is the absence of a system continuity plan. At Lockheed Martin, we have found that the CMMI-SVC process area of Service Continuity (SCON) can be effectively translated to "System" Continuity. The practices remain the same, but the object of continuity is the system or subsystem as well as the services that are typical in a sustainment activity. The ability of the producer to plan for subsystem failure, while maintaining the critical functions of the ultimate system, is a focus that can easily be missed during the SoS lifecycle. The prioritization of critical functionality (a practice within SCON) emphasizes the need for the customer and users to focus on the requirements that must not fail even under critical circumstances. Test engineers have always identified and run scenarios to ensure that the system can continue to function under adverse conditions. However, the Service Continuity guidance looks at the entire operations context, which focuses test engineering on the larger system of systems context and the potential for failure there, rather than just the adverse conditions of a particular subsystem.

Capacity and Availability Management (CAM) provides guidance to ensure that all subsystems, as well as deployment and sustainment services, meet their expected functionality and usage. When we use CAM and translate resources called for into subsystems and functionality, it becomes a valuable tool in system development. Management can use CAM practices to make sure costs that are associated with subsystem development and maintenance are within budget. Developers can use CAM practices to monitor whether the required subsystems are sufficient and available when needed. Risk Management (RSKM), a core process area, can be used to build on CAM to ensure that subsystem failures are minimized. Understanding capacity and availability is critical during SoS stress and endurance testing, since this kind of testing requires an accurate representation of the system within its intended operational environment, as called for in CAM.

Although these examples of translating CMMI-SVC process areas into the engineering context are specific to large systems of systems, they can be adapted to any development environment. Looking at the CMMI-SVC process areas as an extension to CMMI-DEV should be encouraged, especially for organizations whose product commitments extend into the sustainment and operations portions of the lifecycle. The ability of the one constellation to enhance the guidance from other constellations makes CMMI even more versatile as a process improvement tool than when it is operating as a single constellation. Proactively selecting process areas to meet a specific customer need—for either a product or service, or both—demonstrates both internally and externally a true understanding of the processes necessary to solve customer problems, not just provide a product customers have to adapt to obtain optimal performance. Shifting our mental model from pure product development to product development within the service of supporting an operational need demonstrates a multidimensional commitment to quality throughout the development and operations lifecycle that end users particularly value.

Multiple Paths to Service Maturity

By Gary Coleman

Book authors' comments: Gary Coleman provides insight from CACI, an organization that has faced a challenge shared by many: which of the CMMI models to use, and also, whether CMMI and other frameworks, such as ISO, be used together, or whether an organization must choose one framework and adapt it to all circumstances. Gary demonstrates how CACI has adapted to using the various models and frameworks based on the context of the line of business, following multiple paths to maturity.

CACI is a 13,000-person company that provides professional services and IT solutions in the defense, intelligence, homeland security, and federal civilian government arenas. One of our greatest distinctions is the process improvement program we began more than 15 years ago to achieve industry-recognized credentials that will bring the greatest value and innovation to our clients. This has resulted in CACI earning CMM-SW, CMMI-DEV, ISO-9001, and ISO-20000 qualifications. Across the company, CACI has executed a multiyear push to implement the best practices of the ITIL framework, and the Project Management Institute's PMBOK. Most recently, CACI achieved an enterprise-wide maturity level 3 rating against CMMI-DEV.

One aspect of the multimodel environment in which we operate is the competing nature of these models. We are becoming adept at dealing with this competition, and being able to select the bits and pieces of each model that will support the needs of a given program. Our organizational Process Asset Library contains process assets that support all of these models, as well as best practice examples that we collect and evaluate as we proceed through our project work.

This essay presents three cases of groups within CACI that have pursued credentials supporting their service related business. None of these teams were starting from scratch, and each of them had different starting points based on prior process work, customer interest, and management vision. They arrived at different end points as well.

- Case 1: adapted CMMI-DEV to its service areas
- Case 2: uses ISO-9001 to cover services, and may move to ISO-20000
- Case 3: has made the choice to move to CMMI-SVC

All three cases exist in the multimodel world, and have had to make their choices based on a variety of factors, under a range of competitive, technical, and customer pressures.

Case 1: CMMI-DEV Maturity Level to CMMI-DEV Maturity Level 3 Adapted for Services, 2004–2007

CACI's first move into model-based services took place in a group that was developing products and delivering services. In most cases, the services were not related to the developed product, and while the distinct product and service teams shared a management team and some organizational functions, they had little need to organize between teams or to coordinate joint activities.

The drive to pursue a credential came about as management anticipated their customers' interest in CMMI credentials. They had already installed an ISO-9001 quality management system to cover their management practices, and that had been a foundation for the first CMMI-DEV effort covering their engineering projects at maturity level 2, which they achieved in 2005.

As the service content of their business grew, it became clear to management that they could incorporate some of their lessons learned in the engineering areas, and the discipline of the CMMI, to their service activities. In fact, they came to realize that it would be easier to include these service functions in their process activities than it would be to work them by exception or exclusion. This insight led them to apply the CMMI-DEV model across the board.

There were challenges, of course, especially where the development of common standard processes was concerned. It was not always easy to see how some of the development engineering practices could be applied to services, and there was not much prior industry experience to rely upon. Attempts to write processes that could be applied in both development and service settings sometimes resulted in processes that were so generic in nature that significant interpretational guidance, and complex tailoring guidance, would be needed to support them. A large but very helpful effort went into building this guidance so that the project teams would know what was expected of them in their contexts of either products or services. This guidance was also very useful in the effort to put together the practice implementation indicators for the appraisal, and as supporting materials for the appraisal team members during the appraisal to remind them of the interpretations that were being relied upon.

In spite of the challenges, there were areas that were easily shared, and their experience showed that many of the project management areas and organizational functions could be defined in a way that allowed for their use in both engineering and service related projects. They defined methods and tools for the management of requirements and risks, for example, that could be easily visualized, taught, and executed in both domains. These successes have encouraged them to continue to look for other areas where their process efforts can be shared, and to concentrate on improvements that can be leveraged across both their services and their product development programs.

Case 2: CMM-SW to CMMI-DEV and ISO 9001

This group consisted of two main organizations: one that developed and maintained a suite of software products, and another that supported the customer's use of those products in the field (installation, training, help desk, etc.). These two programs shared a common senior management function and an overarching quality assurance support function, but little else. In fact, initially the two programs were under different contracts and interacted with very different client communities.

The drive to CMM for their engineering side began as a result of the customer's interest, and the CACI team worked closely with the customer teams so that both CACI and the customer achieved separate CMM ratings, and eventually CMMI ratings, at nearly the same time. Successes with the results of CMM-based process improvement led enlightened management to recognize the potential benefit of applying process improvement techniques on the service side. ISO-9001 was chosen at that time because the company had a considerable experience base in implementing ISO-9001-based Quality Management Systems in other areas, and no other suitable frameworks could be found at that time.

As both the ISO-9001 and CMMI systems developed in isolation at first, senior management noticed that similar processes, tools, reporting methods, and training existed in both areas. This revelation was the drive that started an effort to consolidate similar approaches for economies of scale. Even though the types of work being done in each area were quite different, there were many areas of commonality. This was especially true in the management and support processes, where the common process improvement team could define single approaches. A side benefit of this effort was that a new mindset that emphasized the potential for common processes overcame an older mindset that focused on the differences between the development and service teams.

When the customer proposed that the two contracts be brought together under a single umbrella contract, CACI was ready to propose a unified approach that not only included shared processes in areas that made sense, but also showed how the customer would benefit from the increased interconnectedness of the programs under CACI's management. Tighter connection between the service-side help desk staff and the development-side requirements analysts would improve the refinement of existing requirements and uncover new requirements that would enhance both the products and their support. That same connection improved the testing capabilities because the early interactions of the development and service sides ensured better understanding of customers' needs. The help desk and other customer-facing services could be more responsive to customers through improved communications with developers, and much of this would be due to the synergy of a common language of process and product.

This group has watched other groups within CACI that have implemented ISO-20000 on their service activities, and has also begun to evaluate whether the CMMI-SVC model offers benefits to them and their customer. They wonder if they have already achieved many of the benefits of the common set of foundation processes that the CMMI constellations share. They appreciate the flexibility of the ISO-20000 standard, and its relative clarity of interpretation. In addition, the sustainment aspects of the ISO-20000 external surveillance audits (missing in the CMMI world) appeal to the people who have relied on this in the ISO-9001 world. In the end, the decision of which way to go next will be heavily influenced by the customer's direction.

Case 3: CMM-SW to CMMI-DEV Maturity Level 3 and Maturity Level 5 to CMMI-SVC

This is another group with a long history of process improvement within CACI, dating back to the days of CMM for Software. Their engineering and development efforts cover a range of maintenance of legacy software applications, re-platforming of some of those legacy programs, and development of new programs. In addition, this same group provides a variety of specialty services to their customers that include consulting in Six Sigma, and range to the installation and maintenance of servers and data centers.

The drive to CMM, and subsequently to CMMI-DEV, came initially from the customer, but was fueled by CACI management's recognition that a credential would represent a "stake in the ground," establishing their capability. At the same time, it would also be support for improvement and growth of their capability to satisfy their customer's growing needs for higher-quality deliverables. When the customer raised the bar and identified a requirement for maturity level 4, this team had already begun their move to high maturity, targeting maturity level 5. They achieved level 5 and continue to grow their quantitative skills to this day.

This foundation in process improvement, and a culture of always looking to get better, was the basis for new inquiries into where they could apply their skills, and the obvious candidates were the services areas of their business. By now, the company had achieved several ISO-20000 credentials in a number of other IT groups, and there was certainly a motivation to take advantage of these prior successes. However, the strong CMMI awareness of this group inclined them to consider the CMMI-SVC model. The fact that the CMMI-SVC model covered a broader range of service types was important to the team in their decision, and the fact that it was organized in a way that allowed them to "reuse" and "retool" existing process assets and tools for the shared process areas is what forced the decision to go with CMMI-SVC.

A formal analysis was done and the results were shared with both CACI management and with the customer in a kickoff meeting where the plan to move forward with CMMI-SVC was presented. They anticipate that other customers will eventually see the value of the credential. They expect that CMMI-SVC will help them to grow their process excellence into the services areas, giving them the benefits that they have had for so long in their engineering and development areas.

With these three cases, all within one company, it's clear that the claims of the CMMI product team at the SEI have merit. Adopters can use CMMI-DEV in service domains and CMMI-SVC in development, as well as in their primary intended discipline. In addition, CMMI models coexist in a compatible fashion in organizations using ISO, PMBOK, and other frameworks.

Using CMMI-DEV and ISO 20000 Assets in Adopting CMMI-SVC

By Alison Darken and Pam Schoppert

Book authors' comments: SAIC has been a participant on both versions of the CMMI for Services model teams, and Alison Darken and Pam Schoppert worked on the initiative to adopt CMMI-SVC at SAIC. Like the prior essay authors, they found that it is feasible. They also found that it required care, even with their deep knowledge of a new model. They offer some detailed experience on what kinds of services seem to suit CMMI-SVC content best and what terminology differences among the models may call for additional understanding and adaptation of even a robust process asset set.

Upon release of Version 1.2 of the CMMI-SVC model, SAIC began developing a corporate-level CMMI-SVC compliant set of process documents, templates, and training as part of SAIC's EngineeringEdge assets. The objective was to develop a CMMI-SVC compliant asset set consistent with existing process assets without exceeding CMMI-SVC requirements. The expected relationship between CMMI-SVC and the other models and standards already implemented in corporate asset collections was key to planning this development effort. At the time development began, SAIC had asset sets compliant with CMMI for Development (V1.2), ISO 20000, and ISO 9001:2001 (see Figure 6.1).

SAIC's earlier work in organizational process development and adoption provided the CMMI-SVC initiative with the following:

- An understanding of the overall CMMI architecture and approach
- ITIL expertise
- Expectations of reuse of assets in existing "views" (e.g., asset collections)

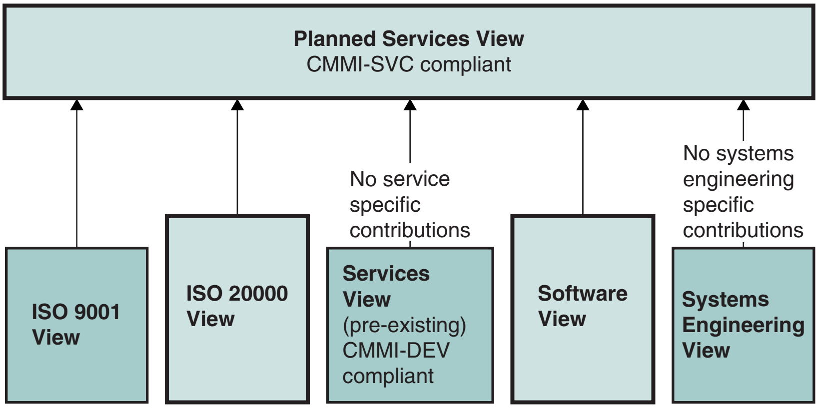

FIGURE 6.1
Preexisting SAIC Asset Sources

Nine months after the project started, the CMMI-SVC compliant view was released, on time and within budget, using a part-time development team of four process engineers and managers. We learned that our existing understanding and resources, based on CMMI-DEV and ISO 20000, while helpful overall, were also the source of many unexpected challenges. Following are some of the key lessons we learned from our effort.

Understanding the Service Spectrum

It became apparent very early on that CMMI-SVC was not a standard, cookie-cutter fit for the myriad service types performed by SAIC and other companies. Some services better match the CMMI-SVC definition in that they are simultaneously produced and consumed (e.g., help desk and technical support services). On the other side of the spectrum of service types are those that are more developmental in nature, but do not involve software or system engineering full-lifecycle development. Examples include training development, engineering studies, and independent verification and validation (IV&V).

Organizations need to understand their particular service types and realize that service type can affect application of the CMMI-SVC model (see Figure 6.2). We found that the model's *service specific* process areas were easiest to apply on the right side of the spectrum where service delivery was immediate upon request. Process areas such as Service Delivery (SD) and Incident Resolution and Prevention (IRP) were a natural fit; core process areas in the area of project management required more manipulation. In contrast, services to the left of the spectrum required up-front development before a service request

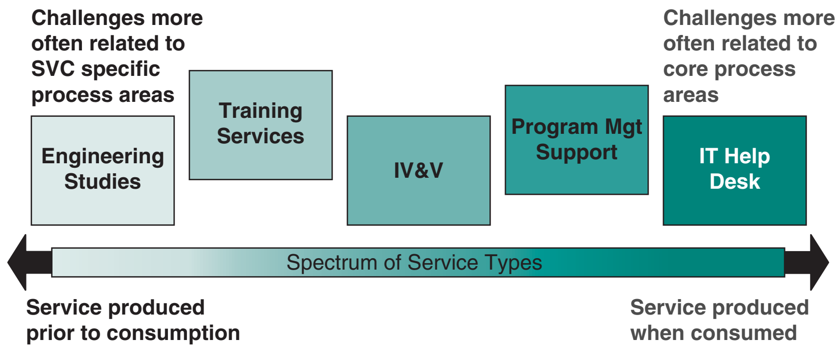

FIGURE 6.2
Applying CMMI-SVC to the Service Spectrum

could be satisfied. Often, considerable design, development, and verification were necessary to deliver just a single instance of a service, such as the development and delivery of a training class. We also had to address development of tangible products often accompanying these services and requiring the same level of rigor as products produced under CMMI-DEV. The model assumes such products are part of the service system, but in some cases they are unique to that one service request and, at SAIC, are not properly treated as part of the service system (e.g., an engineering study). Because of the developmental feel and reduced volume of service instances, service specific process areas such as Service System Development (SSD) and Capacity and Availability Management (CAM) required more massaging. Understanding the service spectrum and the specific service catalog of an organization can ease adoption and implementation of CMMI-SVC.

Rethinking the Core Process Areas

Understanding the CMMI model required a paradigm shift. Prior knowledge of CMMI can be both an asset and a handicap in dealing with CMMI-SVC. To avoid going down the wrong path, we had to make a very conscious effort to avoid over-generalizing from past experience to CMMI-SVC. For instance, for some core process areas (Process Management process areas, Measurement and Analysis [MA], and Configuration Management [CM]), while the practices were the same, they needed to be viewed from a different perspective. The following are the areas in which we encountered a particular challenge.

- It was necessary to move from the project-centric view of CMMI-DEV and shift to a "program"-oriented process where a program was an ongoing activity that accommodated many specific projects, tasks, or individual service requests. ISO 20000 reflects this perspective, but with CMMI-SVC we were fighting the slant of the core process areas and our own past history with CMMI.

- An appreciation of the two-phase nature of a program was key. During establishment, the program matches well with a project and with the practices in CMMI-DEV. This phase produces an actual product, the service system, at its conclusion. After service delivery begins, the picture shifts away from development.
- A centralized notion of metrics as applied to software projects required rethinking as a distributed activity in terms of collection, analysis, and use. Metrics also refocused from measuring the progress of a project, applicable during service system development, to measuring performance, once delivery began.
- The CM process area in CMMI provided too little guidance and asked too little to responsibly serve an IT service project. We struggled with the tension between maintaining our goal of not exceeding the expectations of the standard and the knowledge that an IT services program would get in a lot of trouble with only that minimal level of rigor.
- It took some retraining to avoid conflating defects with incidents.
- As explained in the next section, we adopted the term *problem* to refer to underlying causes. The goal in IRP related to this activity did not require the full application of Causal Analysis and Resolution (CAR), even CAR without a quantitative management component. We had to make a particular effort not to require more in this area than CMMI-SVC required.
- CMMI-SVC required more-detailed, lower level assets for IT services. We had to find a solution for this while still maintaining a flexible, generic, corporate-level set. We adopted a template for manuals that contains shells for the needed detailed work instructions.

Understanding Customer Relationships

SAIC works through contracts with government and commercial customers. In a company such as SAIC, two situations need to be addressed: SAIC provides a standard set of services for many customers (see Figure 6.3), and SAIC performs a dedicated service(s) under contract for a particular customer (see Figure 6.4). Our approach to establishing the service system and on-boarding customers varied based on for whom and how the service was provisioned. This led to distinct service lifecycles.

The lifecycles shown in Figure 6.3 and Figure 6.4 represent a unique paradigm related to our services business.

- An organization may use the "field of dreams" approach of "If you build it, they will come." In this paradigm, the organization has a vision for a service *before* obtaining customer commitments.

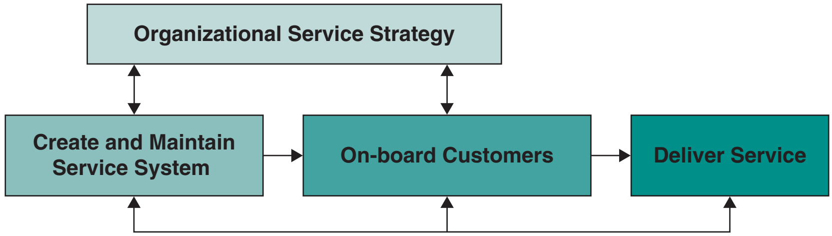

FIGURE 6.3
Service Provider Paradigm

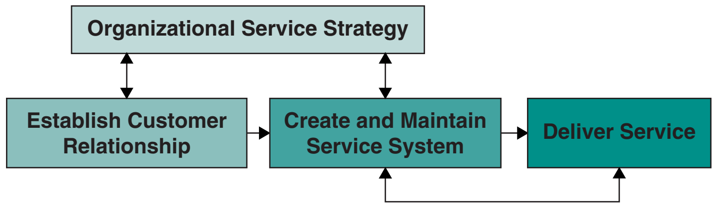

FIGURE 6.4
Contract-Based Paradigm

The activities related to on-boarding customers come after the service catalog in STSM is developed and after the service system is established in SSD. This situation was addressed by a service provider lifecycle.

- Organizations may provision services in response to a defined service agreement. This flow begins with identification and contractual negotiation with a customer, followed by establishment of the service system and service delivery. In this situation, the contract-based lifecycle is employed. It still mandates alignment to strategic organizational service management.

Both lifecycle models have the same key elements, but the order of activities varies.

To better understand the decisions made, it helps to be aware that, overall, our service asset view, as well as our other asset views, have the following features.

- They are primarily intended for work efforts that support external customers.
- They must comply with internal SAIC corporate policies including program management, contract management, and pre-award policies. Some of these fall outside of CMMI, but are essential to the way SAIC does business.

Some work efforts or contracts are equivalent to fulfilling a single service request (e.g., one engineering study, one training course). This presents some challenges since some process areas such as STSM, SSD, and IRP are not cost-effective or practical for a single request. Our solution was to develop an organization approach for these efforts to avoid over-burdening such small contracts with the requirements of these process areas and to shift the overhead to the organization owning the contract.

Understanding the New Terminology

We found that some terminology used in CMMI was not in sync with ISO 20000 and ITIL as already implemented in our environment. Sometimes the ITIL and ISO terminology was a better fit on its own merits. There weren't many instances, but they were pervasive.

- "Service request" has a very specific meaning in the ITIL and ISO 20000 world, and it is not the same as the way it is defined in CMMI. An ITIL service request is a preapproved, standard request (e.g., change out a printer ribbon), as opposed to the use in CMMI to encompass not just preapproved, standard requests, but all customer requests. Because ISO 20000 and ITIL were already present in the organization, we were concerned about confusion. We also thought it was very useful to have a specific term for preapproved, standard requests since their handling differs from nonstandard requests.
- A term was needed to easily refer to the pursuit and management of addressing underlying causes. The term *problem* is used in ITIL and works well to make it easier to talk about the subject.
- As discussed earlier, management needed to be addressed in terms of programs, not just projects. With CMMI-SVC, Version 1.3, the term *work* is introduced in place of *project*. While this is helpful in avoiding some of the assumptions associated with *project,* in the SAIC environment, we see a need to address both program type management and project management in a service context. The ongoing service effort is managed as a program and larger individual service requests or service system modifications are managed as projects.

Understanding How to Reuse Existing CMMI Process Assets

At the time we developed our CMMI-SVC compliant set SAIC had three existing CMMI-DEV compliant asset views from which to draw: Software, Systems Engineering, and Services. The latter attempted to fit services to the CMMI-DEV model. None of the assets unique to the preexisting Services View were reused nor were any unique to the Systems Engineering View. All CMMI-DEV view assets that proved useful for CMMI-SVC were found in the Software View or were standard assets shared across multiple views. The exact relationship with the Software View is as follows.

- Sixteen percent of the Service View assets, mostly organizational assets, could be shared between views without modification.
- Twenty-seven percent, mostly from PM, QA, CM, and peer review, could be shared with relatively minor modification.
- Twenty-seven percent, unique to the Services View, were developed from a Software View source.
- The Software View was indicated in the Services View as an optional source for assets to support service system development (i.e., the Software Test Specification Template).

The types of modifications required to share were almost exclusively due to the following.

- Creation of assets unique to the Services View: References were now needed to cite both the Software View version and the Services View (e.g., citations might be required to both the Configuration Management Plan Template used in Software and Systems Engineering and the Service Configuration Management Plan Template used only in Services).
- Differences in terminology: Even in describing core process area activities, the same terminology would not always work for both software and services. For instance, using *problem* to describe underlying causes overloaded a term that had always been used as a synonym for *defect* in SAIC CMMI-DEV views. This meant we could not share our change tracking form between views.

There were some cases, such as metrics, that differed enough to require a unique asset with a different approach. In a significant number of cases, however, we didn't feel that an asset could be shared despite often directing virtually the same activities and corresponding to the same practices. The motive for not sharing, in the majority of cases, was to increase user convenience. Our philosophy is that ease of use is more important than reducing complexity from the organization's perspective. User push back is much more difficult to address than finding ways around maintaining multiple versions of the same thing, each suited to a different user community. We wanted to spare users from plowing through too many references to alternative versions of specific documents and so forth. This was the main reason, for instance, for developing a configuration management plan template for services distinct from that used for software and systems engineering.

We were also able to share or use as a source several of the customized training classes supporting the Software View process. Twenty-nine percent of the classes for the Services View had sources in the Software View. Forty-three percent were shared with the Software View after some modification.

Understanding How to Use and Reuse ISO 20000 Assets

Five percent of the assets unique to the Services View, all related to CMMI-SVC specific process areas, were developed from an ISO 20000 source. The small number of ISO 20000 sources is misleading. The assets developed from them were among the most significant in the revised Services View and would have required a great deal of effort to create without a source. They included plan templates for capacity and availability management, continuity management, and service transition, and a request, incident, and problem manual.

We were surprised that we couldn't share service specific assets and had to do so much work to create the revised Services View version from the ISO 20000 source. This was due to the following factors.

- Terminology differences. This was not as serious as it might have been, because in many cases, we adopted the ISO 20000 or ITIL terminology (e.g., *service request, problem management*).
- References to other ISO 20000 assets not included in the Services View.
- Lack of overlap between CMMI and ISO 20000 as to what functions received more detail, rigor, or elaboration. This was a serious issue. Some examples include the following.
    - QA: ISO 20000 appears to leave the definition of QA as understood in CMMI to the ISO 9001 standard. The only auditing discussed in the ISO 20000 standard refers to auditing against the ISO 20000 standard itself. Our ISO 9001 View did not contribute to our CMMI-SVC effort. Where the ISO 9001 scope overlapped with CMMI-SVC, we had better-matching CMMI-DEV resources available.
    - CM: ISO 20000, as an IT standard, focuses on some recordkeeping issues that are essential to IT services (e.g., a configuration management database [CMDB]), but wouldn't necessarily be

needed in all services. It also delves more deeply into change management. Document management is specifically addressed.

  - PM: ISO 20000 frequently focuses on different aspects of project management than CMMI, such as the customer complaint process and financial management.
  - Organizational process: In ISO 20000, the organization and the service program are essentially identical; therefore, OPF, OPD, and OT occur within the service program.
- Structural differences as to how activities were grouped. Although this might not seem to make any difference—a practice is a practice no matter how you organize the discussion—it does result in certain natural groupings of responsibilities and practitioner ways of thinking. The main examples are inter-workings of availability, continuity, and capacity, and the definition of CM.
  - In ISO 20000, availability and *continuity* are paired whereas CMMI joins availability and *capacity*. Furthermore, the expectations for what would be discussed within each differed in some aspects. We had created separate ISO 20000 plan templates for each of these three areas as well as a manual template for capacity management—four documents in all. For the Services View, a Capacity and Availability Plan Template and a Continuity Plan Template were sufficient to address the practices. The requirement for model representations of the service isn't included in ISO 20000.
  - In ISO 20000, the CMMI CM practices are distributed among three functional areas: Release, Change Management, and Configuration Management. Configuration Management is confined to the recordkeeping and repository maintenance function. Attention is also given to document management. These factors introduce a larger number of practices that need to be met and a multiplicity of roles that in the CMMI-SVC View would be assigned to the CM manager and maybe to the CM team.

Specialized ISO 20000 process training courses were heavily used as sources for 29 percent of the CMMI-SVC process classes.

Conclusion

Going into the development effort, we had initially expected a relatively painless exercise in which we would be able to reuse our CMMI-DEV assets for CMMI-SVC core process areas with relatively little modification, and base our assets associated with service specific activities directly on ISO 20000. We discovered that these transitions were not as effortless as we had hoped, and that, in fact, without exercising some care, prior knowledge of CMMI-DEV and ISO 20000 could take us down the wrong paths. On balance, it was very valuable to have a foundation in CMMI-DEV before attempting to take on CMMI-SVC, but implementers should exercise caution about applying what they know, and approach process adoption for services from a fresh perspective.

Experience-Based Expectations for CMMI-SVC

By Takeshige Miyoshi

Book authors' comments: Takeshige Miyoshi has had a rich and varied career in engineering and process improvement in Japan. Many development organizations realize that CMMI-SVC may be particularly amenable to the service arms of an organization that has enjoyed success with Software CMM or CMMI-DEV. This eminent engineer traces the history of the earlier models and affirms how CMMI-SVC fits into that lineage. Then he goes further, and notes that CMMI-SVC content has something to offer for development environments as well.

One of the impressions that struck me most when I first read through the CMMI-SVC model was that it promises to be a widely useful process model. This impression is based on my ten years of field experience maintaining part of a mainframe operating system, and my experiences observing the implementation status of SW-CMM and CMMI in a variety of real-world situations through performing a number of assessments and appraisals. Also, its thoughtful model structure could provide benefits to many users of CMMI-DEV. Since 1994, I have been heavily involved in assessments and appraisals using the SPICE framework and the CMM (SW-CMM and CMMI) models at many companies in Japanese industries.

Expectations for CMMI-SVC to Be a Promising Model

The most prominent feature of the CMMI-SVC model is its applicability to a variety of business fields. This feature comes from its thoughtful model structure: corresponding to the Engineering category in CMMI-DEV, CMMI-SVC has the Service Establishment and Delivery category, which includes five process areas: Strategic Service Management (STSM), Service System Development (SSD), Service System Transition (SST), Service Delivery (SD), and Incident Resolution and Prevention (IRP).

In this category, the most appropriate service system, in terms of an individual business context for a wide range of service organizations, is developed by SSD according to the strategic needs and plans for the organization's standard services defined in STSM. After deploying the service system to the service delivery environment by SST, actual services are delivered to customers using practices in SD by operating the service system. During service delivery, if service incidents occur, they are handled and resolved by practices in IRP. The series of service delivery activities are managed and supported by the CMMI model's common Project and Work Management and Support categories. Furthermore, CMMI-SVC, like other CMMI models, provides a clear improvement path. Namely, the performance and quality of these service activities are improved, step by step, primarily by functions covered by process areas in the Process Management category.

In CMMI-DEV, software, hardware, or system products that are to be delivered to customers are developed using the process areas in the Engineering category. On the other hand, in CMMI-SVC, the SSD (Service System Development) process area, which is analogous to the Engineering process areas of CMMI-DEV, develops the organization's service system to be used for delivering services. Actual services are provided to customers by operating this service system.

In CMMI-SVC, to develop an organization's service system using SSD and to clearly define how to operate the service system, the organization must understand the real status of its working service sites. In what working environments, and using what kinds of tasks, are the workers providing daily services? Therefore, you must inevitably take the policy of following the "site-first" principle, namely, to attach importance to what is happening and what is being done at the service site or on the shop floor. By doing so, "process descriptions are consistent with the way work actually gets done," as you can see on the first paragraph on slide 8 of Module 2 of the Introduction to the CMMI-DEV, V1.2 material. Having the "site-first" principle, and following the best practices of SSD, an excellent service system can be developed and will become the basis for providing superior services.

My experience-based intuition tells me that the principle of "providing intangible and non-storable service products by operating an organization's specific service system" could be thoughtfully applied to a variety of organizations that find that implementing all of the CMMI-DEV practices is a heavy burden on them. In addition, it could provide an opportunity for those organizations that want to improve performance and product quality to thoughtfully interpret the model's practices considering the organization's own business objectives.

A Prelude

Back in the early 1960s, I started my career as an electrical engineer at an electric company that produced various kinds of broadcasting machines, including large-console-type videotape recorders. I often recall those old days with strong feelings. Having several production divisions with an independent quality assurance group, the company was rapidly growing in the field. However, labor union movements were prospering at that time in the electric industry, and we had several weeks of labor strikes every six months in the factory. Even in this unstable working environment, if we had process definitions of the production cycle, and if management really understood what was happening at the production site, it was much easier to produce high-quality products on schedule. Here, I learned that the "site-first" principle is most important for producing high-quality products. After examining CMMI-SVC, I see that the Service Continuity process area has practices that could have helped us to deal with these disruptions.

After joining a pioneering independent software house in Japan, Software Research Associates, Inc. (SRA), in 1970, I had experienced a number of application and basic software development projects and a variety of maintenance projects as well as a national R&D project. Especially from the early 1970s, I was fortunate to participate on the team that developed and maintained the IOCS (Input and Output Control System) of Operating Systems for UNIVAC 1100 series large-scale computers. This was in the golden days of UNIVAC Japan, one of the leading mainframers in Japan. UNIVAC's large-scale computers were installed one after another at a number of organizations in various fields. Since IOCS is a necessary piece of software for inputting users' data to the computer and to see the processing results, it was installed and used in more than 100 sites on this island, and accordingly, I experienced various kinds of trouble.

I often visited users' sites from northern areas to southern regions of the island. In this maintenance service environment, service requests came from users of the UNIVAC 1100 Series via Field Support Groups, using User Service Request sheets. In light of CMMI-SVC, this would correspond to the request management practice in the Service Delivery process area. One time, we received an urgent request about serious trouble from one of the remote site users. Quickly, I jumped to the remote site by taking the Shinkansen and local trains. At midnight, I tried every possible method to reproduce the phenomenon, did huge tracing memory dumps, analyzed them, and found system bugs that could occur in very rare cases in conjunction with hardware functions. When I organized a brief report about my troubleshooting, the bright sun rose from the eastern sky. All of this is a dear memory of the old days.

Although we didn't have a clearly defined maintenance process, we had a structured flowchart of the IOCS functions. This chart could be the service system representation called for in the Capacity and Availability Management process area or one of the important service system components that is developed using the Service System Development process area and is used in the Service Delivery process area of CMMI-SVC. In this case, instead of waiting for the user's information from the remote site, I quickly visited the user site by myself and took a series of speedy actions: doing tracing memory dumps, analyzing them, and quickly developing a trouble report to explain it to the real user. In addition, we prevented similar future troubles by updating the IOCS software. Experienced service providers also recognize this activity as incident handling, as expressed in the Incident Resolution and Prevention process area of CMMI-SVC. Through these ten years of service tasks at UNIVAC Japan, by actively dedicating myself to tackling various kinds of troubleshooting, I had an opportunity to learn how software engineering theory works in real-world situations, and also that the "site-first" principle is most important. Those are my favorite memories of the old days.

My CMM Experience

In 1996, I joined the SEPG at Fuji-Xerox Corp. to promote the first formal CMM-based SPI project in Japan. After more than two years of effort, the organization achieved maturity level 2 for the first time in Japan, which had a good effect on many companies in Japan, drawing attention to their processes as a way to keep to their schedules and produce quality products. During my three years of experience on this project, I learned what could lead to a successful SPI project and what could lead to an unsuccessful one. In addition to my experiences in my early days, I had a belief again that the "site-first" principle would work here, too!

Soon after becoming a CBA-IPI lead assessor in 1999, I started supporting CMM training courses and formal assessments at various companies in Japan, including the forerunners of SW-CMM, such as Toden Software Inc. (currently called "TEPSYS") and SRA. This professional support for many companies has continued to the present, using CMMI-DEV, and will continue with CMMI-SVC in the very near future.

From Compliance-Driven Improvement to Performance-Driven Improvement

As we can see in one of the three major drivers of revisions to CMMI, "Increasing confidence in and usefulness of SCAMPI appraisal results," there is no denying the fact that until several years ago, many CMM(I) users were apt to rush to achieving a maturity level by conducting "compliance-driven improvement." Times have changed, however, and we must promote SPI activities seriously under the motto of "performance-driven improvement" considering the severe economic situation we have experienced in recent years.

To promote performance improvement, it is most important to think about how to make good use of the process assets sharing framework in a way that functions most appropriately in the organization's business environment. To create organizational business effects, CMM(I)'s traditional "conceptual software process framework" depicted in Figure 4.1 of the classic book, *Software CMM,* is still vividly alive in CMMI-SVC. This is, so to speak, the "Process Assets Sharing" framework, namely, the organization's best practices, lessons learned, and data about its processes. This information is systematically collected, disseminated, and shared throughout the organization. This is one of the most important concepts, and has been consistently used throughout the model's evolution, from SW-CMM to CMMI-DEV and CMMI-SVC.

In most large organizations in which large- and mid-size development projects are running, the six process areas in the Engineering category of CMMI-DEV are considered to have reasonable best practices. However, many organizations that have smaller projects or service functions have found that those Engineering best practices have been a heavy load to implement. Until a few years ago, some service organizations used CMMI-DEV practices, although they were not fully aligned with service activities. Using CMMI-SVC, they will be relieved from the restraint of implementing all of the practices of the Engineering category of CMMI-DEV.

Several years ago, I participated in SPI activities at a service organization that provided software support for open source customers. At that time, I had a hard time flexibly interpreting the practices of the Engineering process areas to map them to small span engineering tasks in the organization's specific situations, although I seriously referred to the SEI's technical note on interpreting CMMI-DEV for service, *Interpreting CMMI for Service Organizations – a System Engineering and Integration Service Example* [SEI 2003].

But now, fortunately, we have the promising process model, CMMI-SVC! This model addresses the needs of a wide range of service types by flexibly and effectively using every past experience of CMM(I) models, and provides a clear improvement path. As I have shown, even in development organizations, some of the practices of the CMMI-SVC process areas are helpful. And I believe that the aforementioned principle of "providing service products by operating an organization's specific service system" could be thoughtfully applied not only to a variety of organizations that feel that implementing all of the CMMI-DEV practices is a little heavy, but also to many of the potential new CMMI users in a wide range of service types. In addition, by disseminating the usability of this principle, I would like to help produce an atmosphere of "performance-driven improvement" in the real world so that many CMMI-DEV users can really improve their performance and quality by deeply and thoughtfully interpreting the model practices in light of their organization's business context and objectives.

An IT Services Scenario Applying CMMI for Services: The Story of How HeRus Improved Its IT Services

By Drew Allison of SSCI

Book authors' comments: In this essay, Drew Allison, a Certified ITIL V3 Expert and Certified Lead Appraiser and Instructor for CMMI-DEV and CMMI-SVC from the Systems and Software Consortium, draws on her experiences bringing CMMI to IT service organizations to provide some observations and a scenario that reflects an amalgam of those experiences. These experiences indicate that some of the challenges that IT service organizations face in implementing CMMI-SVC are similar to those that were faced by development organizations in the early days of adopting SW-CMM and CMMI. However, some challenges are due to the unique characteristics of services discussed earlier in this book. At least for organizations like the one in the scenario, unique challenges are caused by the business and service delivery environments they face as external IT service providers. The good news is that ITIL and CMMI play very well together. Many of the assets developed in the last years of ITIL and CMMI implementation can be leveraged to speed up and strengthen the adoption of good IT service management and delivery practice, resulting in improved IT service performance and quality (and eventually, reduced cost).

Observations

Organizations like the one in the scenario I've provided are external IT service providers and they have internal IT departments. One of the great challenges they all face as IT contractors is managing the variety of services they provide to many different customers in a competitive environment in which periods for transitioning in a complex service system, operating the service system at required service levels, and transitioning out may by force happen within very short time periods and while operating "to the bone." Customers do not understand enough about CMMI or ITIL to understand their critical role in the successful implementation of both frameworks. Therefore, customer participation in fulfilling the true intent of CMMI-SVC and ITIL may be lacking. The customer may not allow adequate time for contractors to institutionalize good practices and experience performance results, which can result in frequent contractor turnover. Poor acquisition practice can further aggravate these issues.

Other challenges relate to who is responsible for implementing CMMI-SVC (often legacy CMMI-DEV process groups with little understanding of services). These issues could be categorized as knowledge management and organizational issues. There isn't much IT service contractors can do about the competition and customer maturity. However, the following observations will concentrate on knowledge management and organizational issues that companies can influence.

All of the companies that inspired the scenario implemented CMMI-DEV and achieved maturity level 3. This means they had a functioning process infrastructure, which included process and training groups with CMMI-DEV expertise and assets such as standard processes, training, and measurement data collected from development projects and other groups (but not service groups). All of the companies had active IT service improvement groups focused on the ITIL (which stands for Information Technology Infrastructure Library) framework separate from the CMMI process groups. The core members of the CMMI process groups had many challenges to work through, which included these:

- Mastering an understanding of what services are about, including where and how CMMI-DEV assets can and cannot be leveraged
- Being able to communicate with the ITIL group despite different terminology, framework purposes, structures, and levels of abstraction
- Working through the political and organizational challenges (which included obtaining charge codes for the time and resources necessary to coordinate between the two groups)
- Identifying assets developed by the ITIL groups that could be leveraged for the CMMI-SVC effort

Of course, the "elephant in the room" was how or whether these two groups' paths would cross organizationally. As happens with so many organizations, true coordination between process and performance improvement initiatives for compliance with various standards and frameworks is rarely achieved because they have separate and sometimes competing reporting chains, budgets, incentives, and domain expertise. These differences result in language, cultural, and knowledge barriers. It will take time for the CMMI process groups to either learn about services or recruit members who do understand services and can communicate comfortably with the rest of the CMMI group. Organizational and knowledge management barriers are substantial.

The good news is that if the CMMI process group is operating at maturity level 3, it will have a good training infrastructure in place to bring the new service members of the group "up to speed" quickly on topics they will need to be effective members of the CMMI process group. Topics commonly include the scope of CMMI, process management, measurement, and process and product quality assurance. An active, functional process management infrastructure also serves as an example. Unfortunately, such a functioning infrastructure is not the case in all CMMI maturity level 3 organizations. Some have little or no process maturity in the area of process management and training despite having achieved maturity level 3. For example, no process descriptions for process management activities may be available, or process management may be simply inactive and dysfunctional. (Such dysfunction is often due to a lack of ongoing and consistent senior management support or constant organizational upheaval, including frequent changes in leadership or changes in customer direction regarding the importance of CMMI. Under such circumstances, it is difficult for new process group members to "hit the ground running.")

Old habits die hard when a process professional has spent years growing and perfecting his or her knowledge in a particular framework. It was difficult for CMMI-DEV groups to stop focusing on schedules, effort, size, and tangible deliverables in favor of capacity, availability, performance, and other aspects of operating, monitoring, and managing the service system. What made understanding these aspects of services even harder is the state of practice in the service industry, which is nowhere near the ideal represented in ITIL and CMMI-SVC.

Most IT service organizations have not yet developed service catalogs (or if they have, the catalogs do not provide great value), are not planning strategically for their service, are not performing capacity and availability management beyond basic monitoring, and are not meeting the intent of service level management (often because they do not have customers mature enough to give them the opportunity to meet the intent). In other words, the processes in a service organization may not “live up to” SVC process area specific goals as well as a development organization might “live up to” DEV Engineering process area specific goals. Therefore, defining processes to satisfy the SVC process area specific goals may require more than discussions with subject matter experts (SMEs) to document how work is currently being done.

Process management, Process and Product Quality Assurance (PPQA), Measurement and Analysis (MA), and training processes plague many service organizations, just as they do many development organizations. Just as MA was the “long pole in the tent” for most organizations implementing CMMI-DEV, so it appears to be for SVC. However, the pole may be even longer given the state of the service industry. Not only are processes not documented, but the practices are neither performed nor managed. There is little focus on measurement objectives, process measurement, or measurement beyond what is currently provided by their tools automatically.

The situation faced by these implementers of CMMI-SVC was different from their experience with CMMI-DEV in many ways, including the following.

- They didn’t have a background in the services sold by their organization. (Although, of course, they were themselves providers of process improvement services.) For example, CMMI process group members lacked knowledge about how services were managed (e.g., day to day, week to week) and where and how interactions with customers occurred. Attempting to understand and document service activities and mapping the activities to CMMI-SVC practices is more difficult because roles and processes are not documented and GP 2.4, Assign Responsibility, is lacking.
- Some learning curves were misperceptions carried over from the use of CMMI-DEV such as “Configuration Management (CM) doesn’t exist in services because it’s only for software,” or “there’s no place for Decision Analysis and Resolution (DAR) in service operations because that’s about making design decisions during development.” Knowledge of how or even *whether* services did configuration management was lacking. In one case, the communication barrier between a legacy CMMI-DEV person discussing CM with a services person was so bad that the DEV person walked away with the impression that there was no CM on the services side.

- The gaps between the specific practices of CMMI-SVC and the activities of the organization were larger than they had been with CMMI-DEV due to the state of the industry described earlier. Most shortcomings using CMMI-DEV had been to process maturity and institutionalization practices (e.g., generic goals, process management, training, support) more so than the Engineering practices. This difference left the process team with not only a learning curve to understand services but, for at least some of the specific practices, no SMEs to consult in the organization who could tell them how the practices were performed (because they weren't). In other words, there was a learning curve for potential SMEs as well as process group members.
- As always, scheduling time with SMEs was a challenge. However, given the dynamic and often unpredictable nature of the services (i.e., amount and frequency of ad hoc, firefighting activity) and the business pressure to operate "at the bone," it was more difficult than ever. This shortage of SME availability affected process development and appraisal activities. One appraisal was affected by a major incident that made most interviewees unavailable.

Despite these challenges, there were many bright spots when the "light went on" either for the ITIL group or for the CMMI group. Each realized that an asset existed that one or the other needed. A barrier in communication dropped and they enjoyed an "aha" moment together. Or an organizational barrier showed signs of weakening, such as the CMMI group telling the ITIL group who they needed to contact in the training group to get training defined and coordinated for service roles. Rather than trying to co-opt the ITIL group's efforts, the CMMI group proved they could be an asset because they had worked through many of the questions and challenges the ITIL group faced. Trust and sharing issues existed between some groups when they feared that their territory was being invaded or co-opted or that their processes would be thrown away or replaced with less useful ones.

Once the CMMI process groups had access to an expert that was fluent in both ITIL and CMMI and who could help them with mapping and other resources, the translation and learning process went considerably faster.

Another bright spot was that existing CMMI-DEV processes for Process Management, Support, and Project and Work Management process areas were leveraged for CMMI-SVC. However, no "plug and play" or "silver bullet" solutions were available and the definition of processes was in various stages of completion. The effort required to construct a process solution that works well for both development and service groups should not be underestimated.

ITIL provides insight into how some development processes may be made more useful for IT services. For example, ITIL has excellent IT service processes for CM (see ITIL's Service Asset and Configuration Management and Change Management processes in the *Service Transition* book) and Supplier Agreement Management or SAM (see ITIL's Supplier Management process in the *Service Design* book). Additional IT service insights for Organizational Process Focus (OPF), Organizational Process Definition (OPD), and MA can be extracted from ITIL's *Continual Service Improvement* book and Knowledge Management process in the *Service Transition* book.

Of course, ITIL provides detailed processes for many of the SVC process areas of CMMI-SVC, such as these:

- Strategic Service Management or STSM (see ITIL's Service Catalog Management process in the *Service Design* book and strategic service planning information in the *Service Strategy* book)
- Service Delivery or SD (see ITIL's Service Level Management process in the *Service Design* book and Service Request Fulfillment process and service operation functions in the *Service Operation* book)
- Capacity and Availability Management or CAM (see ITIL's Capacity Management and Availability Management processes in the *Service Design* book)
- Service Continuity or SCON (see ITIL's IT Service Continuity Management process in the *Service Design* book)
- Service System Transition or SST (see ITIL's Release and Deployment Management process in the *Service Transition* book)
- Incident Resolution and Prevention or IRP (see ITIL's Incident Management and Problem Management processes in the *Service Operation* book)

Additional IT service insights may be gained for the Service System Development (SSD) and Project and Work Management process areas by reviewing the *Service Design* and *Service Transition* books, though these process areas are more difficult to map into specific ITIL processes because the related content is distributed.

Decades of ITIL use has resulted in additional literature that provides measurement examples for IT services, publicly available service catalog examples, user groups for IT service management (itSMF), and many other resources that will speed the implementation of CMMI-SVC in an IT services organization. Conversely, decades of CMMI use has resulted in powerful resources for implementing effective Process Management (e.g., OPF, OPD, Organizational Training or OT), Project and Work Management (e.g., Work Planning or WP, Work Monitoring and Control or WMC, Integrated Work Management or IWM, SAM, Requirements Management or REQM), and Support (CM, MA, PPQA, DAR, Causal Analysis and Resolution or CAR) so critical to institutionalizing good IT service management practice.

What It Looks Like in Practice

With challenges and opportunities for joint ITIL and CMMI-SVC use, let's look at a scenario that is fictionalized but drawn from several real-world experiences to demonstrate how ITIL and CMMI-SVC work together in practice. The following scenario describes how a fictional IT service organization called Heroes Are Us (HeRus) applied the CMMI-SVC model to improve its service performance, reduce cost, and increase customer satisfaction. The scenario focuses on four Service process areas in the CMMI-SVC model. Mappings between the scenario and goals in CMMI-SVC are provided to help you make the connection between the scenarios and the model and to increase your depth of knowledge about CMMI-SVC. For help with terms, please refer to the glossary.

Introduction to the HeRus Scenario

Ms. Shandra Takie manages the IT department for HeRus, a mid-size (approximately 900 employees), privately held (family-owned), government contractor providing database management, application development, service desk, and data center services primarily to the Department of Defense (DoD). The IT department has 50 employees who support the work of HeRus. Like the employees they support, their motto is to be "Johnny on the spot" (i.e., available and willing to do whatever is needed).

HeRus has aggressive growth plans for the next five years and would like to "go public." To realize its growth plans, HeRus must justify and control costs, increase performance, improve quality, and showcase the value its services provide. HeRus is under pressure from competitors, particularly in the area of cost. To realize its growth plans, HeRus must adopt industry best practices. Instead of relying on heroes and rewarding "end justifies the means" behavior, HeRus wants to rely on standard procedures and processes across the company that can be adapted to the requirements of each contract.

The business development office scans for requests for proposals (RFPs) from federal and state civil agencies and the DoD for IT services. Bidding on, ramping up for, and shutting down contracts consume a great deal of time and effort at HeRus. The business development office is often far along in developing a proposal before the right technical stakeholders in the company are identified and brought in to provide advice. Sometimes the advice of technical experts is too late and commitments are made to provide services that are not in the best interests of HeRus's future. The current services and service levels offered are not documented in any centralized fashion. What little information exists on current services is documented in various contracts and service level agreements (SLAs) without a basis in standard services.

Shandra has been assigned the role of IT Service Process Czar with the goal of piloting new IT service processes with the internal IT staff before deploying them to contracts. Shandra attended a recent SEI Software Engineering Process Group (SEPG) conference and learned the importance of aligning services with business goals. Shandra has her own motives for moving forward with the process improvement initiative.

Budget cuts in recent years have reduced support for existing systems and applications as well as delayed the purchasing of new capacity. Shandra wants to show the value to HeRus's bottom line of the IT services her department is providing. She knows that to support corporate growth plans, an upgrade to IT systems is needed, but in the current climate, strong rationale backed by data would have to be provided.

Shandra also understands that with better data and the means to estimate required capacity and availability to support HeRus's growth plans, she can justify needed upgrades and increased automation of processes. Currently, HeRus relies on primarily manual processes that hinder the IT department's ability to provide quality services at required service levels. She wants to justify greater investment in tools and automation of processes.

Shandra believes that the more closely IT services and service processes are aligned to business objectives and business processes, the more successful she will be. To achieve success, she must provide greater visibility into the achievements, challenges, performance, quality, costs, and contributions IT makes to HeRus. She must move the IT department from being focused on technology and infrastructure to being focused on service, with business objectives and processes driving IT service plans and processes.

Service Delivery (SD)

Shandra has had no SLA for IT operations, but the number and frequency of complaints indicate that IT is not meeting expectations. A service-level management process owner is appointed to address how HeRus plans, coordinates, agrees (Service Delivery process area), monitors, and reports on SLAs (Work Monitoring and Control process area), and maintains the SLAs (Service Delivery process area). The process owner will provide templates of SLAs for use by HeRus's service-level managers.

The service-level management process owner decides that, as a first step, service-level managers should base their SLAs on the service catalog and analyze existing SLAs and data. These data include input from the capacity management process, availability of management process, incident management process, problem management process, service continuity process, information security process, and various IT functions. With this input, the SLA will then be defined, negotiated, and agreed. Quality Assurance (QA) will check whether the SLA is available to service providers, customers, and end users as planned. QA will also check whether the SLAs are periodically updated (SD SG 1).

Up until this time, no documentation existed to describe how to prepare for service delivery and how to deliver service. HeRus had relied on the knowledge of its experienced IT staff. Shandra knows that 50 percent of IT knowledge is in people's heads, and 45 percent of IT will retire within five years. Because of this, and to increase consistency and quality, Shandra decides it's time to document how HeRus prepares for and delivers its services. Standard processes and process assets will be stored in a Process Asset Library (PAL) available to the organization and used by QA in its compliance activities. QA is thrilled that it will have better information on what to check, but given the increased awareness of what actually needs QA's involvement they're lobbying for more resources (SG 2).

Shandra's IT service process improvement steering committee decides to use the service desk as a pilot for its processes for SD preparation and fulfillment. The service-desk manager will document the approach used for SD, including how service requests are handled and required resources. What the service-desk manager documents will likely be elevated to a standard service-desk process for use on future contracts. Service-desk staff members will confirm readiness to deliver services according to procedures, and evidence of having followed readiness check procedures will be documented. Shandra has read the latest literature on the importance of checklists for improving service quality, so she encourages the use of checklists in the new processes (SG 2).

Service requests currently are processed and tracked in the same system as incidents, and there have been problems with the volume of service requests bogging down the incident management staff. Shandra decides that separate processes for service requests are needed. Service requests will be distinguished clearly from incidents, and procedures and mechanisms for storing, accessing, updating, tracking, and reporting service request records will be defined. Shandra will argue for investment in more self-help and self-service mechanisms to free the service-desk staff to work on incidents (SG 2).

The service-desk staff reports that they are receiving and processing service requests according to the SLA and meeting their targets consistently. The incident management staff reports that their performance has improved as a result of having clearer service request processes, including clear assignment of responsibility and authority (GP 2.4). Now that the service-request staff consistently review service-request status and resolution and confirm results with relevant stakeholders, customer satisfaction is way up. The service logs, performance reports, customer satisfaction data, and request management system records all show that the service system is being operated to deliver services according to SLAs and in compliance with processes (QA has confirmed this!). It is clear from looking at maintenance notifications, logs, and schedules that the service system is being maintained to ensure the continuation of service delivery (SG 3).

Capacity and Availability Management (CAM)

The IT department has been achieving a decent 99.9 percent uptime, but the downtime occurs at the worst times, and with the cutbacks in purchasing, increased demand, and lack of demand management, Shandra anticipates that she will not be able to maintain this uptime rate. To support HeRus's long-term growth plans, a strategic approach to capacity and availability management is needed that considers future capacity and availability requirements.

She knows that these requirements are influenced by the other processes being defined, including the service continuity process and future innovations and emerging technologies process. Other influencers are patterns of business activity, demand, and how HeRus can affect them. Up until now, capacity and availability management has had an operational perspective focused on monitoring the performance, utilization, and throughput of the IT infrastructure and some aspects of IT services, such as response to incidents. HeRus has also monitored availability and reliability to a certain extent, forecasting whether agreed targets will be met.

Little analysis is going on and HeRus relies on the expert knowledge of its IT staff for many of the activities in CAM. HeRus has little documentation about what thresholds are set and why and what action should take place when certain conditions are met. Shandra knows that when the economy improves, some of her expert staff members will leave for "greener pastures." The reliance on expert judgment and ad hoc practices has led to inconsistent performance and quality and represents a risk for HeRus.

When SLAs are documented, CAM data are rarely consulted, which is due in part to the overall lack of data. When decisions are made about changes to the service system, CAM data are rarely consulted. IT service continuity plans at HeRus do not have a firm foundation on data from other processes, such as capacity management or availability management. Shandra would like that to change because she knows the performance of the new processes relies in part on the availability and use of good data.

Shandra judges that IT service quality and performance at HeRus will improve with more analysis, a proactive approach to CAM, more reporting to relevant stakeholders, and more input from CAM to other processes, such as these:

- Service-level management (to enable better decisions about what targets are agreed in SLAs)
- Change management (to enable better decisions about change)
- IT service continuity management (to enable better continuity planning and reduce the risk of not being able to meet IT service continuity requirements)

The approach to CAM has been largely reactive at HeRus. Shandra decides that the approach has to change. She understands that with the budget constraints and competition in the marketplace, including vendors who represent possible IT outsourcing opportunities for HeRus, she must implement more sophisticated CAM practices and tools that will support a more proactive, data-based approach. She wants HeRus to reduce costs and increase performance by using tuning and exploring demand management.

Shandra establishes a process owner for capacity management and another process owner for availability management and reminds them that they need to get started right away on defining measures and analytic techniques to support the analysis she hopes to put into place. Shandra would like to see baseline models of current performance and resource utilization as a start. She knows these baseline models must be established before more predictive models can be established to help answer "what if" questions about changes, workload allocation and volume, SLAs, application sizing, and other questions from the design team, problem management group, and service continuity planning group.

Service Continuity (SCON)

HeRus has weak business continuity plans and policies, which only mention the importance of ensuring that there are contingency plans in place for “computer systems” and IT. Shandra knows this is a woefully inadequate treatment of IT service continuity. She knows that detailed plans must be put into place, personnel need training on the plans, and the plans should be validated to ensure that IT services can be resumed within required, agreed-to time frames (SG 2).

Shandra helps the IT service continuity process owner to begin planning by identifying and prioritizing the essential functions that must be performed and the essential resources to ensure service continuity (SG 1). They do this in close coordination with HeRus’s business process owners knowing that their ultimate goal is to support business continuity. To understand the essential resources, they need input from CM and other HeRus IT service processes.

Having a good start on the service catalog provides valuable input to their planning efforts. To maintain their IT service continuity plan adequately, they must receive inputs from HeRus’s change management process (to assess the potential impact of changes on their plans); CM (to understand the relationships between services, technology, and business processes); and other processes.

Having finished the HeRus IT service continuity plan, they establish training to ensure that the plans can be successfully executed. Having conducted the training, they analyze the evaluations and determine that some improvements are needed to both the training and their plans before they will be ready to verify and validate the plans. Once the improvements are made and preparations for verification and validation of the IT service continuity plan are made, they conduct the verification and validation activities as planned and analyze the results, making additional improvements where necessary (SG 3).

Incident Resolution and Prevention (IRP)

HeRus’s internal IT department has only been able to meet the target response time (35 minutes) for incidents about 30 percent of the time. They have no single repository for incidents, their underlying causes, and approaches to addressing them. Partly because of this lack of information, communication has been poor between the service desk and the rest of the IT department, particularly about known errors, incidents, and their underlying causes. Causes of incidents were not tracked sufficiently, and in fact, no effort was being made to discover the underlying causes of incidents and prevent their recurrence.

Shandra decided to define an incident management process focused on handling interruptions to normal service and returning normal service as quickly as possible. She also defined a process for preventing incidents, developing workarounds, and addressing underlying causes of selected incidents. She decided to clearly assign responsibility and authority (GP 2.4) for incident management, preventing incidents, developing workarounds, and developing action plans for underlying causes when documented criteria were met (SG 3).

Staff members were trained on the processes (GP 2.5). Responsibilities included identifying, controlling, and addressing incidents (SG 2). Using the new processes, staff members now responded in specific ways to specific incidents. They consulted the incident management system to know whether there were workarounds. Information recorded in the incident management system and other sources was used as input to help prevent incidents (e.g., through trend analysis). Information about incidents was recorded and could be grouped and linked to support analysis of trends and underlying causes.

Monitoring the status of incidents and communicating with stakeholders throughout incident handling (SP 2.5, SP 2.6) were emphasized in the training because many complaints had been received in the past about "being kept in the dark" and having to call the service desk to find out what was happening with an incident. These weaknesses were publicly acknowledged, and the new procedures were advertised to make sure stakeholders were aware that the IT department was doing something to address its poor service image.

The processes included preparing for incident resolution and prevention by establishing an approach to them and establishing an incident management system (SG 1). The approach included definitions of incidents and incident categories, incident handling, and incident reporting mechanisms.

Following the introduction of incident management processes based on CMMI-SVC's IRP process area, the target response time is being met 85 percent of the time, and the number of recurring incidents has dropped.

Conclusion

Five years after initiating service process improvements at HeRus, Shandra received a Success Contributor Award on behalf of the internal IT department. The improvements implemented there have been adopted throughout HeRus and have been a major contributor to HeRus's achievement of its growth plans. Service process improvements have helped HeRus remain competitive by delivering quality and performance while holding costs in check and increasing customer satisfaction. With this foundation of using data and measurement to ensure that quality and performance are well established, HeRus is positioned for even higher maturity and capability, and the business results associated with them.

Are Services Agile?

By Hillel Glazer

Book authors' comments: Practitioners who are champions of Agile principles and practitioners using CMMI have been realizing recently just how much they have in common, rather than what separates them. This isn't a recent insight for Hillel Glazer from Entinex, however, who has been a thought leader in both communities for some time. In this essay, Hillel considers the ways in which services may already be agile, an interesting insight into the nature of services as a means of organizing product development, and what CMMI for Services might bring to the conversation about using Agile methods and CMMI together. He is a certified instructor and high maturity lead appraiser for CMMI.

Some argue that "Agile" in the context of software development came about in response to an unhealthy trend. That trend distracted the attention of development projects from customer service and product excellence to demonstrable proof of process fidelity. That love affair with tools and an obsession with plans, contracts, and rigidity usurped relationships with customers and calcified responsiveness.

Look at the Agile Manifesto:

> *We are uncovering better ways of developing*
> *software by doing it and helping others do it.*
> *Through this work we have come to value:*
>
> ***Individuals and interactions*** *over processes and tools*
>
> ***Working software*** *over comprehensive documentation*
>
> ***Customer collaboration*** *over contract negotiation*
>
> ***Responding to change*** *over following a plan*
>
> *That is, while there is value in the items on*
> *the right, we value the items on the left more* [Beck 2001].

The values in the Agile Manifesto are clearly in favor of individuals, interactions, results, customers, and responsiveness: all attributes classically characteristic of the business and the operation of a service.

Services are not performed in the vacuum of a cubicle where the people doing the work can throw their results "over the wall." Under most circumstances, services require a human touch somewhere in the delivery of the service. Further, services generally require people to work together—whether in sync with policy and management or in coordination with coworkers.

The impact, output, and outcome of services are often detectable by the customer immediately. This characteristic of services makes meeting expectations through demonstrable results imperative to the service provider. People who can recall a great service experience will note that the experience was not with a machine or with a document, but with a person in the business who was working with them to meet their needs.

Truly, if a single attribute of services can be found among the many service situations, it's that services generally account for a wide variety of inputs simultaneously. These inputs are often unpredictable and as often unknowable until some aspect of the service is provided. Overall, it is very much a dynamic situation in which a broad spectrum of inputs must be normalized to fit the pattern the organization created to provide the consistent "level of service" customers come to expect.

One might argue that whether intentionally, surreptitiously, or serendipitously, the progenitors, proponents, and practitioners of Agile principles and methods were creating a systematic approach to serving software clients better. In other words, in many ways, Agile puts the "services" back into software development.

Providing services for a living involves processes that are among the least likely to work well in "cookie-cutter" fashion. It's true that at a macro level, many instantiations of a service will have common elements or fit a pattern for that class of service. For example, a hospital has check-in and registration steps, evaluation and analysis steps, diagnosis, prognosis, treatment or prescription, follow-up and discharge, and so forth. But at the specific, case-by-case point of delivery ("work", "project," or "patient" in our example), the services have the potential to be as unique as the customer (patient) receiving the service.

To enhance the provision of services amid the delivery of those services is akin to the classic metaphor of "changing the tires on a moving car." To achieve this state, the processes involved in providing and improving services must themselves be responsive, adaptive, nonobstructive, and unobtrusive.

CMMI for Services was created with a keen eye toward this reality; in other words, the modelers did not want improvement processes that hinder service delivery processes. With this in mind, service-oriented process areas in CMMI-SVC (as well as the CMMI Model Foundation process areas) are written (and additional informative material is included) to discourage process improvement from overtaking the ongoing service to be provided and to accommodate the dynamic environment in which services are provided.

While agility and responsiveness are critical to services and to Agile software development, a simple concept cannot be overemphasized and must not be dismissed: Think through what will be done before it's time to do it.

The creators of CMMI for Services do not expect that each time a customer walks into a bank or a patient is rushed into the emergency room, a work plan will be created. However, they do expect that when the banking customer steps into the branch or the patient emerges through the doors that the respective organizations have a pretty good idea of what they will be doing with the incoming service request, "work order," "project," or "ticket."

When someone calls the help desk, the person who takes the call should not have to invent how to proceed, what information to collect, and where or how to record the information he or she gathers. A restaurant does not invent its menu with each customer and invent recipes with each order, even though some tailoring is usually allowed.

CMMI for Services operates at this level. It also has provisions for situations in which the customer does, in fact, have an unusual request, or the organization has to stretch its operations to meet a new need, or has to create a "project" to meet a particularly unique situation. We want the print, copy, and ship locations to make our custom order to our specifications, but we don't want them having to learn on-the-job whether what we've requested is a custom order or to learn on-the-job how to operate the copier machine.

In CMMI for Services, the seven service specific process areas are designed to facilitate the continuous delivery of services while also providing the infrastructure for the continuous collection of experience and data to help to improve those services. In each process area case, the notion of standardization prevails. Knowing which services a customer expects, which services a customer can expect, and which services a customer should not expect may seem like an obvious consideration, but reconciling expectations is likely an experience most readers can relate to when it comes to a bad service experience. Knowing which services are routine and which aren't seems like a common-sense, basic notion. Despite its simplicity, these are necessary early steps in the ability to improve services.

These ideas fit well with the development ideas of "agility." A relentless focus on the customer and on value enhances the relationship between provider and customer. Innovation and creativity used to meet the needs of a customer may trump established processes in most well-run service organizations. Established processes can provide the basis for reliable service, but these processes must not be allowed to hinder the meeting of customer expectations. Ideally, the established processes themselves are set up to encourage innovation and improvement, and may even help the provider anticipate additional needs and tailoring.

It's interesting to note recent developments in product development management techniques known as "pull" systems, or as popularized by David J. Anderson using the Japanese term *Kanban*. In this technique, the concept of "services" and "service levels" is used to differentiate the various paths and subsequent expectation management of product development. For example, requests for features will follow different development paths as a function of the type of request, its urgency, and particular attributes of the feature. Based on these characteristics, the expectations of the customer would be managed to know when to expect their feature will be delivered. Like many other services, the state of all requests in this technique is visually conveyed and viewable by all involved. Another parallel between this approach and traditional services is the notion of a continuous flow of value to the customer.

These concepts lead to other innovative ideas in the Agile and traditional product development fields. Borrowing from value streams, lean, and TQM (Total Quality Management), we learn the notion of "internal customers" where each step in the production of a product or service is considered the "customer" of the prior step. Add to this the idea that product development can be modeled as the specific organization of services such that the result of the services produces a product. When viewed in this regard, even the engineering of the product is a service and all the process areas unique to CMMI for Services add value to product development efforts.

It is important for users of CMMI-SVC to never abandon their customer orientation and their ability to respond to the dynamics of their service operations in pursuit of demonstrating a faithful implementation of a process improvement model.

- Service agreements need be no more formal than a list of services provided, costs, and other means of establishing expectations. A published, visible service menu or an order form may suffice for simple services.

- The means by which incidents are resolved and prevented should be no more complicated than the nature of the incidents, but having no means to resolve or prevent incidents would be as unforgivable to a service operation as not testing the product would be to a product operation.
- Managing the service operation's capacity and availability seems basic enough, though anyone on hold waiting on the phone has clearly experienced the implementation (or lack thereof) of this idea. To an agile organization, knowing where and why bottlenecks occur facilitates workarounds and preferably the avoidance of bottlenecks. What can be more disruptive to a service or its ability to be agile than the total and complete loss of use of the primary operation? This situation is accounted for in disaster-recovery and continuity of operations concepts found in any well-run service organization, and also in the CMMI-SVC constellation. In agile organizations, this would be the ultimate expression of responding to change where the organization can continue to provide value-added services despite the absence of its usual facility, let alone its processes. But deciding which services must be foregone, which services can still be provided, and how they will be provided under unusual circumstances should be known ahead of needing to implement the backup plan.
- Ever experience the bumps and hiccups associated with a service provider trying out a new service, or switching from one way of delivering its service to another? Such spikes in the usual operational scenario can be avoided with some consideration of the impact of the change on the customers, on the operations, and on the people who provide the services. This consideration of impact is as much a courtesy as it is a necessity, agile or otherwise.
- While developing products relies on resources just as much as services do, in the context of services, and in a strong parallel to the values of agility, a strategic view of services to be provided relies heavily on the individuals and their interactions. In particular, service businesses must plan the availability of the right kind of people and forecast the types of services to be provided. In some ways, anticipating the direction of markets and resources and deciding which services to standardize and which to keep on the periphery until the market demonstrates the demand and validity of a service are somewhat forward-thinking concepts. But in any business, these are not far-fetched concepts, merely ones that prudent companies pursue. When providing services is your business, these activities are how you ensure that you are relevant now to your customers' needs, and remain relevant in the future.

Finally, there's a remaining aspect of CMMI-SVC that bears a clear resemblance to concepts that promote an agile organization: The notion of having to develop a service system in CMMI for Services was derived from taking the absolute minimum practices from the Engineering process areas of CMMI for Development and incorporating them into a single process area in CMMI-SVC. What in CMMI-DEV were five unique process areas, comprising 13 goals and 40 practices, were whittled down to one process area comprising three goals and 12 practices. For organizations whose primary efforts are in services and not developing systems (at least not developing very complicated ones), CMMI-SVC provides an abridged version of improvement practices in the engineering space. And those organizations that need simple service systems, perhaps consisting of just people and procedures, can opt out of this process area.

Where Agile development parts ways with CMMI-SVC is that most services themselves tend to not work well when delivered in increments or provided iteratively. People don't want part of their shirts laundered and pressed, they don't want some of their stock purchased at the target price, they don't want a portion of their house saved from fire, and they don't want to be taken 30 percent of the way to the airport. Customers also don't want the services rendered for them to be experiments in early or frequent failures. They don't want their change miscounted, they don't want their meals undercooked, and they'd prefer to avoid someone getting lost on the way to the airport.

Nonetheless, despite this departure from Agile in the "development" sense, other concepts of agility such as eliminating wasteful effort, promoting self-organization, continuously delivering value, and facilitating trust and high morale among the team are all hallmarks of well-run service organizations.

Should organizations seek to adopt Agile approaches to services or to incorporate a service approach to development, and include an improvement schema that allows Agile approaches to flourish, the lessons learned from CMMI-DEV apply equally well to CMMI-SVC.

- CMMI (regardless of constellation) is a model; how to actually create an improvement system using this model will be unique to each organization.
- The artifacts of an improvement system come from the operation of the improvement system.
- Appraisals for CMMI determine whether (not how well) its improvement system shows signs that it was created using CMMI as the improvement model.
- It's critical that the context of an improvement system—the service itself—be the arbiter of how to evaluate the artifacts created by that system.

Each service system requires a custom-fit improvement system or customers will leave. To do otherwise would not be agile and would not be good service. And that would be entirely unforgivable.

What We Can Learn from High-Performing IT Organizations to Stop the Madness in IT Outsourcing

By Gene Kim and Kevin Behr

Book authors' comments: These two authors—who lead the IT Process Institute and work as C-level executives in commercial practice—have spent a decade researching the processes in IT that lead to high performance. Based on research in more than 1,500 IT organizations, they describe what processes make the difference between high performance and low or even medium performance. Their observations about the distinguishing characteristics of high performers are consistent with the goals and practices in CMMI for Services. They further note the potential downside of the pervasive trend of outsourcing IT services. Without adept and informed management of these outsourced IT contracts, harm is suffered by both provider and client. In response to this trend, they call on CMMI practitioners to use their experience and techniques to bring sanity to the world of IT outsourcing.

Introduction

Since 1999, a common area of passion for the coauthors has been studying high-performing IT operations and information security organizations. To facilitate our studies, in 2001 we co-founded the IT Process Institute, which was chartered to facilitate research, benchmarking, and development of prescriptive guidance.

In our journey, we studied high-performing IT organizations both qualitatively and quantitatively. We initially captured and codified the observed qualitative behaviors they had in common in the book *The Visible Ops Handbook: Starting ITIL in Four Practical Steps*.[1]

Seeking a better understanding of the mechanics, practice, and measurements of the high performers, we used operations research techniques to understand what specific behaviors resulted in their remarkable performance. This work led to the largest empirical research project of how IT organizations work; we have benchmarked more than 1,500 IT organizations in six successive studies.

1. Behr, Kevin; Kim, Gene; and Spafford, George. *Visible Ops Handbook: Starting ITIL in Four Practical Steps*. IT Process Institute, 2004. Introductory and ordering information is available at www.itpi.org. Since its publication, more than 120,000 copies have been sold.

What we learned in that journey will likely be no surprise to CMMI-SVC practitioners. High-performing IT organizations invest in the right processes and controls, combine that investment with a management commitment to enforcing appropriate rigor in daily operations, and are rewarded with a four to five times advantage in productivity over their non-high-performing IT cohorts.

In the first section of this essay, we will briefly outline the key findings of our ten years of research, describing the differences between high- and low-performing IT organizations, both in their performance and in their controls.

In the second section, we will describe a disturbing problem that we have observed for nearly a decade around how outsourced IT services are acquired and managed, both by the client and by the outsourcer. We have observed a recurring cycle of problems that occur in many (if not most) IT outsourcing contracts, suggesting that an inherent flaw exists in how these agreements are solicited, bid upon, and then managed. We believe these problems are a root cause of why many IT outsourcing relationships fail and, when left unaddressed, will cause the next provider to fail as well.

We will conclude with a call to action to the IT process improvement, management, and vendor communities, which we believe can be both a vanguard and a vanquisher of many of these dysfunctions. Our hope is that you will act and take decisive action, either because you will benefit from fixing these problems or because it is already your job to fix them.

Our Ten-Year Study of High-Performing IT Organizations

From the outset, high-performing IT organizations were easy to spot. By 2001, we had identified 11 organizations that had similar outstanding performance characteristics. All of these organizations had the following attributes:

- High service levels, measured by high mean time between failures (MTBFs) and low mean time to repair (MTTR)
- The earliest and most consistent integration of security controls into IT operational processes, measured by control location and security staff participation in the IT operations lifecycle
- The best posture of compliance, measured by the fewest number of repeat audit findings and lowest staff count required to stay compliant
- High efficiencies, measured by high server-to-system administrator ratios and low amounts of unplanned work (reactive work that is unexpectedly introduced during incidents, security breaches, audit preparation, etc.)

Common Culture Among High Performers

As we studied these high performers, we found three common cultural characteristics.

A culture of change management: In each of the high-performing IT organizations, the first step when the IT staff implements changes is *not* to first log in to the infrastructure. Instead, it is to go to some change advisory board and get authorization that the change should be made. Surprisingly, this process is not viewed as bureaucratic, needlessly slowing things down, lowering productivity, and decreasing the quality of life. Instead, these organizations view change management as absolutely critical to the organization for maintaining its high performance.

A culture of causality: Each of the high-performing IT organizations has a common way to resolve service outages and impairments. They realize that 80 percent of their outages are due to changes and that 80 percent of their MTTR is spent trying to find what changed. Consequently, when working on problems, they look at changes first in the repair cycle. Evidence of this can be seen in the incident management systems of the high performers: Inside the incident record for an outage are all the scheduled and authorized changes for the affected assets, as well as the actual detected changes on the asset. By looking at this information, problem managers can recommend a fix to the problem more than 80 percent of the time, with a first fix rate exceeding 90 percent (i.e., 90 percent of the recommended fixes work the first time).

A culture of planned work and continuous improvement: In each of the high-performing IT organizations, there is a continual desire to find production variance early before it causes a production outage or an episode of unplanned work. The difference is analogous to paying attention to the low-fuel warning light on an automobile to avoid running out of gas on the highway. In the first case, the organization can fix the problem in a planned manner, without much urgency or disruption to other scheduled work. In the second case, the organization must fix the problem in a highly urgent way, often requiring an all-hands-on-deck situation (e.g., six staff members must drop everything they are doing and run down the highway with gas cans to refuel the stranded car).

For long-time CMMI practitioners, these characteristics will sound familiar and the supports for them available in the model will be obvious. For those IT practitioners new to CMMI, CMMI-SVC has not only the practices to support these cultural characteristics, but also the organizational supports and institutionalization practices that make it possible to embrace these characteristics and then make them stick.

The Performance Differences between High and Low Performers

In 2003, our goal was to confirm more systematically that there was an empirically observable link between certain IT procedures and controls to improvements in performance. In other words, one doesn't need to implement all the processes and controls described in the various practice frameworks (ITIL for IT operations, CobiT or ISO 27001 for information security practitioners, etc.).

The 2006 and 2007 ITPI IT Controls Performance Study was conducted to establish the link between controls and operational performance. The 2007 Change Configuration and Release Performance Study was conducted to determine which best practices in these areas drive performance improvement. The studies revealed that, in comparison with low-performing organizations, high-performing organizations enjoy the following effectiveness and efficiency advantages:

- Higher throughput of work
- Fourteen times more production changes
- One-half the change failure rate
- One-quarter the first fix failure rate
- Severity 1 (representing the highest level of urgency and impact) outages requiring one-tenth the time to fix
- One-half the amount of unplanned work and firefighting
- One-quarter of the frequency of emergency change requests
- Server-to-system-administrator ratios that are two to five times higher
- More projects completed with better performance to project due date
- Eight times more projects completed
- Six times more applications and IT services managed

These differences validate the Visible Ops hypothesis that IT controls and basic change and configuration practices improve IT operations effectiveness and efficiency. But the studies also determined that the same high performers have superior information security effectiveness as well. The 2007 IT controls study found that when high performers had security breaches the following conditions were true.

The security breaches are far less likely to result in loss events (e.g., financial, reputational, and customer). High performers are half as likely as medium performers and one-fifth as likely as low performers to experience security breaches that result in loss.

The security breaches are far more likely to be detected using automated controls (as opposed to an external source such as the newspaper headlines or a customer). High performers automatically detect security breaches 15 percent more often than medium performers and twice as often as low performers.

Security access breaches are detected far more quickly. High performers have a mean time to detect measured in minutes, compared with hours for medium performers and days for low performers.

These organizations also had one-quarter the frequency of repeat audit findings.

Which Controls Really Matter

By 2006, we had established by analyzing the link between controls and performance that not all controls are created equal. By that time, we had benchmarked about one thousand IT organizations, and had concluded that of all the practices outlined in the ITIL process and CobiT control frameworks, we could predict 60 percent of their performance by asking three questions: To what extent does the IT organization define, monitor, and enforce the following three types of behaviors?

- A standardized configuration strategy
- A culture of process discipline
- A systematic way of restricting privileged access to production systems

In ITIL, these three behaviors correspond to the release, controls, and resolution process areas, as we had posited early in our journey. In CMMI-SVC, these correspond to the Service System Transition, Service System Development, and Incident Resolution and Prevention process areas.

Throughout our journey, culminating in having benchmarked more than 1,500 IT organizations, we find that culture matters, and that certain processes and controls are required to ensure that those cultural values exist in daily operations.

Furthermore, ensuring that these controls are defined, monitored, and enforced can predict with astonishing accuracy IT operational, information security, and compliance performance.

Although behaviors prescribed by this guidance may be common sense, they are far from common practice.

What Goes Wrong in Too Many IT Outsourcing Programs

When organizations decide to outsource the management and ongoing operations of IT services, they should expect not only that the IT outsourcers will "manage their mess for less," but also that those IT outsourcers are very effective and efficient. After all, as the logical argument goes, managing IT is their competitive core competency.

However, what we have found in our journey spanning more than ten years is that the opposite is often true. Often the organizations that have the greatest pressure to outsource services are also the organizations with the weakest management capabilities and the lowest amount of process and control maturity.

We postulate two distinct predictors of chronic low performance in IT.

IT operational failures: Technology in general provides business value only when it removes some sort of business obstacle. When business processes are automated, IT failures and outages cause business operations to halt, slowing or stopping the extraction of value from assets (e.g., revenue generation, sales order entry, bill of materials generation, etc.).

When these failures are unpredictable both in occurrence and in duration (as they often are), the business not only is significantly affected, but also loses trust in IT. This is evidenced by many business executives using IT as a two-letter word with four-letter connotations.

IT capital project failures: When IT staff members are consumed with unpredictable outages and firefighting, by definition this is often at the expense of planned activity (i.e., projects). Unplanned work and technical escalations due to outages often cause top management to “take the best and brightest staff members and put them on the problem, regardless of what they’re working on.” So, critical project resources are pulled into firefighting, instead of working on high-value projects and process improvement initiatives.

Managers will recognize that these critical resources are often unavailable, with little visibility into the many sources of urgent work. Dates are often missed for critical path tasks with devastating effects on project due dates.

From the business perspective, these two factors lead to the conclusion that IT can neither keep the existing lights on nor install the new lighting that the business needs (i.e., operate or maintain IT and complete IT projects). This conclusion is often the driver to outsource IT management.

However, there is an unstated risk: An IT management organization that cannot manage IT operations in-house may not be able to manage the outsourcing arrangement and governance when the moving parts are outsourced.

A Hypothetical Case Study

This case study reflects a commonly experienced syndrome while protecting the identities of the innocent. The cycle starts as the IT management function is sourced for bids. These are often long-term and expensive contracts, often in the billions of dollars, extending over many years. And as the IT outsourcing providers exist in a competitive and concentrated industry segment, cost is a significant factor.

Unfortunately, the structure of the cost model for many of the outsourcing bids is often fundamentally flawed. For instance, in a hypothetical five-year contract bid, positive cash flow for the outsourcer is jeopardized by year 2. Year 1 cost reduction goals are often accomplished by pay reductions and consolidating software licenses. After that, the outsourcer becomes very reliant on change fees and offering new services to cover up a growing gap between projected and actual expenditures.

By year 3, the outsourcer often has to reduce their head count, often letting their most expensive and experienced people go. We know this because service levels start to decline: There are an ever-increasing number of unplanned outages, and more Severity 1 outages become protracted multiday outages, and often the provider never successfully resolves the underlying or root cause.

This leads to more and more service level agreement (SLA) penalties, with money now being paid from the outsourcer to the client (a disturbing enough trend), but then something far more disturbing occurs. The service request backlog of client requests continues to grow. If these projects could be completed by the outsourcer, some of the cash flow problems could be solved, but instead, the outsourcer is mired with reactive and unplanned work.

So, client projects never get completed, project dollars are never billed, and client satisfaction continues to drop. Furthermore, sufficient cycles for internal process improvement projects cannot be allocated, and service levels also keep dropping. Thus continues the downward spiral for the outsourcer. By year 4 and year 5, customer satisfaction is so low that it becomes almost inevitable that the client puts the contract out for rebid by other providers.

And so the cycle begins again. The cumulative cost to the client and outsourcer, as measured by human cost, harm to stakeholders, damage to competitive ability, and loss to shareholders, is immense.

An Effective System of IT Operations

We believe that it doesn't really matter who is doing the work if an appropriate system for "doing IT operations" is not in place. The system starts with how IT contributes to the company's strategy (what must we do to have success?). A clear understanding of what is necessary, the definition of the work to be done, and a detailed specification of quantity, quality, and time are critical to creating accountability and defect prevention. Only then can a system of controls be designed to protect the goals of the company, and the output of those controls used to illuminate success or failure.

This situation is betrayed by the focus on SLAs by IT management—which is classic after-the-fact management—versus a broader systemic approach that prevents issues with leading indicator measurements. The cost of defects in this scenario is akin to manufacturing, where orders of magnitude in expense reduction are realized by doing quality early versus picking up wreckage and finding flight recorders and reassembling a crashed airplane to figure out what happened and who is at fault.

Call to Action

In our research, we find a four to five times productivity difference between high and low performers.

IT operations

- Are Severity 1 outages measured in minutes or hours versus days or weeks?
- What percentage of the organization's fixes work the first time? Because they have a culture of causality, high performers average around 90 percent versus 50 percent for low performers.
- What percentage of changes fail, causing some sort of episode of unplanned work? High performers have a culture of change management and average around 95 percent to 99 percent, versus around 80 percent for low performers.

Compliance

- What percentage of audit findings are repeat findings? In high performers, typically fewer than 5 percent of audit findings are not fixed within one year.

Security

- What percentage of security breaches are detected by an automated internal control? In high performers, security breaches are so quickly detected and corrected that they rarely impact customers.

Many of these can be collected by observation, as opposed to substantive audits, and are very accurate predictors of daily operations. Formulating the profile of an outsourcer's daily operations can help to guide the selection of an effective outsourcer, as well as ensuring that the selected outsourcer remains effective.

We can verify that an effective system of operations exists by finding evidence of the following.

- The company has stated its goals.
- IT has defined what it must do to help the company reach its goals.
- IT understands and has documented the work that needs to be done (e.g., projects and IT operations).
- IT has created detailed specifications with respect to the quantity of work, the quality required to meet the company's goals, and the time needed to do this work.
- IT understands the capabilities needed to deliver the aforementioned work in terms of time horizons, and other key management skills and organization must be constructed to do the work.
- IT has created a process infrastructure to accomplish the work consistently in tandem with the organizational design.
- IT has created an appropriate system of controls to instrument the effectiveness of the execution of the system and its key components.

CMMI for Services includes practices for all of these, and with its associated appraisal method, the means to gather the evidence of these practices. Without an understanding of the preceding profile (and there is much more to consider), outsourcing success would be more akin to winning the lottery than picking up a telephone in your office and getting a dial tone.

Public Education in an Age of Accountability

By Betsey Cox-Buteau

Book authors' comments: The field of education is among the service types in which we frequently hear people say that they hope to see application of CMMI for Services. (The other two areas most commonly mentioned are health care and finance.) Because good results in education are important to society, process champions are eager to see the benefits of process improvement that have been realized in other fields. Betsey Cox-Buteau is a career educator, administrator, and consultant, who works with struggling schools to improve performance and learning. Here she makes the case for how CMMI-SVC could make a difference in U.S. schools.

Federal Legislation Drives Change

On January 8, 2002, then-President George W. Bush signed into law his administration's version of the expiring Elementary and Secondary Education Act (ESEA). This legislation was given the title of "No Child Left Behind" (NCLB). (You may remember Goals 2000 under the Clinton administration.) As I write, Congress is working on the rewrite of the now expiring NCLB law. Those of us in the field of public K–12 education await the next set of regulations that will be churned out when the Obama administration's version of ESEA becomes law.

No Child Left Behind was written to force change onto an institution well known for its lethargy. Each state was required under NCLB to formulate an annual assessment process. Under these new requirements, if schools did not show adequate yearly progress (AYP), then they would fall subject to varying levels of consequences to be imposed by their state. The consequences included allowing students to attend other schools in their district, creating written school improvement plans, and even replacing teachers and administrators. School boards and administrations had to reconsider the frequently used excuse that public schools were different from businesses because their products were human beings; therefore, business standards and processes did not apply to them. NCLB forced all stakeholders to revisit the *real* product of a public school because of this new accountability. The product of the public school became defined as "student learning," and that is measurable.

As the curriculum accountability required by NCLB became institutionalized through state testing over the life of the law, and the focus tightened on data analysis regarding levels of student learning, the concept that schools provide a "service" to students, parents, and society became clearer to those who work in our schools and those who create educational policy. The only hint of what is now under the new legislation is the change from the requirement of employing "Highly Qualified Teachers" to employing "Highly Effective Teachers." Yet, how the new law will measure that effectiveness is still unknown to those of us on the outside of the revision process.

Orienting Education to Delivering Services

With the evolving definition of the purpose of our schools being to produce high levels of "student learning," those of us in central office find ourselves tired of reinventing the wheel and desirous of creating processes that we can use efficiently and repeatedly, that are self-improving, and that are entirely data-driven. On the other hand, those of us in central office must also wrestle with the fact that to produce these high levels of student learning that will produce students ready for twenty-first century jobs, we are still expected to do so with twentieth century budgets. So, this twofold challenge brings a different "look" to what we do. We are to produce the highest quality product (student learning for the twenty-first century) at the lowest cost possible. This is not a new situation. Education administrators have always been supposed to deliver well-educated students on a shoestring budget, but we have never been held accountable through real-time data before. With data, we can truly begin to give our stakeholders more than "happy, well-adjusted students," and instead can give them a high level of student learning with measurable outcomes while becoming more economically efficient.

A Service Agreement for Education

How can public education begin to take advantage of the CMMI for Services model? The education service system is already in place, and students have been graduating for a long, long time, so the system must be working, *right?* It may be "working" in some sense, but the same questions present themselves to each new administrator when he or she comes into a building or a central office. Is the present system working *well?* Is it efficient? Are the processes institutionalized or will they fade away over time? It is time for school administrators, from the central office to the individual buildings, to examine the processes involved in their service system and determine their efficacy against their "service agreement" with taxpayers. The CMMI for Services model provides many process areas within which to accomplish this task.

For example, look at any school's mission statement. It often begins something like this: "Our school is dedicated to serving the individual academic, social-emotional, and physical needs of each student, to create lifelong learners...." Are these goals real? Are they measurable? If so, do our public schools have in place a reliable method to measure the achievement of these goals? If schools begin to look at themselves as service providers, then those services must be defined in a measurable manner. When the goals are measurable, then the processes to deliver those services can be measured and analyzed. Using these data, the services can be redesigned, refined, and institutionalized.

Although the nomenclature is different, the "mission statement" is, in essence, a school's "service agreement" with its customers. The CMMI for Services model offers guidance in the Service Delivery process area (SP 1.1 and 1.2) to address the process for developing a measurable service agreement. Once a measurable service agreement is in place, all the stakeholders will have a firm foundation on which to build the processes necessary to successfully meet the requirements of that agreement.

A Process for Producing Consistently High Levels of Student Learning

In this age of measuring levels of student learning, we have to ask several questions of ourselves as educators. Chief among them is, "What do we want our students to learn?" This is the most basic of all questions for the public school system, and it is ever-changing as the needs of society change.

This critical question involves the determination of the desired curriculum. What is it that the student needs to learn? This area is another in which the CMMI for Services model can move a school system toward a streamlined, dynamic curriculum renewal and delivery refinement system. Public schools are ripe for a well-documented structuring of the delivery of their services in this area due to the legislative accountability requirements for student learning. A high-quality curriculum and its delivery tie directly to student learning and ultimately to test scores. The challenge here is to be consistent in how we assess student learning so that progress (or the lack of it) can be recognized and understood. A systematic review of the curriculum and its delivery in the various subject areas needs to be a standardized process.

One of the many possible applications of the Process and Product Quality Assurance process area of the CMMI for Services model is curriculum auditing or program evaluation. This would benefit much of the curriculum development and delivery area by enabling curriculum refinement and a delivery review system. Also, this process area can be used to develop an appropriate process for measuring employee compliance with delivering those curricular items efficiently to the highest level of student learning.

Ideally, curriculum review cycles should remain in place no matter who is in the front or central office. All too often, the superintendent or building principal leaves and the curriculum review and improvement process breaks down. The reasons for this breakdown are many, not the least of which is personnel turnover. Yet when the process is created using the CMMI for Services Process and Product Quality Assurance process area, assuring stakeholder buy-in, full enculturation of the process, and continuous improvement, these changes will not affect the continuation of good practice.

A Process for Efficient Decision Making

Beyond the more obvious areas of application such as curriculum review and its delivery, other education practices can benefit from the discipline of the CMMI for Services model. For example, the decision making in school buildings can be as simple as a librarian choosing a book, or as an involved as a large committee choosing a curriculum program. Decisions can be made by a harried teacher attempting to avoid internal conflict, or a principal who wants to defuse the anger of a parent. Many decisions are made. Some decisions affect few, and some affect many. Some decisions may have long-lasting implications for a child's life, or for a parent's or taxpayer's trust in the system; and that trust (or lack of it) shows up in the voting booth each year. If the processes of each service delivery subsystem are mature and transparent, the provider and the customers will be satisfied and trust each other. When applied to refine the decision-making process in a school district, the Decision Analysis and Resolution process area of the model can be instrumental in ensuring that personnel make the best decisions possible using a standard, approved, and embedded process; the result is the establishment of greater trust with the customer.

Providing for Continuity

In this era of rapid turnover in school administration, the institutionalization of effective processes is paramount to the continuity of providing high-quality service to all stakeholders. As superintendents and school principals move to other administrative positions and school districts, the embedding of the generic goals and generic practices can provide a means of ensuring that these effective system processes will have continuity. Each time a process area is set in motion and refined, the generic goals and practices require that there is a framework in place behind it that ensures its continuity. That is where Part Two of the CMMI for Services model can truly make a difference in our schools. Policies documenting the adopted processes, positions of responsibility named for the implementation and follow-through of these new procedures, and other generic practices will remain intact and in effect long after any one person moves through the organization.

Other Applications for the Model in Education

These process areas are just a few of the many process areas of the CMMI for Services model that would be beneficial when applied to the public education system. Others would include

- Integrated Work Management: for the inclusion of stakeholders (i.e., parents and the community) in the education of children

- Measurement and Analysis: to ensure the correct and continuous use of data to inform all aspects of the educational process
- Organizational Performance Management: to ensure an orderly and organized process for the piloting and adoption of new curricula and/or educational programs
- Organizational Process Definition: to organize the standard processes in a school district ranging from purchasing supplies to curriculum review cycles
- Organizational Process Performance: to establish the use of data to provide measures of improvement of the processes used in the district in an effort to continually improve them
- Organizational Training: to establish the training of teachers and other staff members so that as they transition in and out of a building or position, continuity of the delivery of curricula and other services is maintained
- Service System Transition: to establish a smooth transition from one way of doing things to another while minimizing disruption to student learning

A Better Future for American Education

With no particular reason to believe that there will be a lifting or easing of the assessment and accountability measures placed on the public schools by the sunset of the No Child Left Behind Act, these institutions of student learning can benefit from the application of this model. If our schools are to deliver the highest rate of student learning using the least amount of taxpayer dollars, the CMMI for Services model is a natural and essential tool for accomplishing this goal.

Applying CMMI-SVC for Educational Institutions

By Urs Andelginger

Book authors' comments: Urs Andelfinger is an SEI visiting scientist and CMMI instructor, as well as a university faculty member. Given those roles, he is particularly well positioned to consider the application of CMMI-SVC to education. The work described in the following essay is partially based on ideas jointly developed with Daniel Nyuyki from the University of Applied Sciences Darmstadt. The possible application of CMMI-SVC to education is the most frequent domain inquiry the SEI receives, so the use cases he details are especially interesting and practical.

Introduction

The best practices in the CMMI-SVC model are intended to apply to all organizations in the service industry. Education can also be considered part of the service industry, and educational institutions (both public and private) are the main players. Educational institutions provide educational services to students (external view) and other services to their staff members (internal view). However, most public educational institutions have institutionalized a functional structure rather than a service-oriented structure.

This essay aims to determine how and to what extent CMMI-SVC can be interpreted and applied in the educational sector using the Department of Computer Science (DCS) at the University of Applied Science Darmstadt (Germany) as a point of reference. It will also investigate how the CMMI-SVC model can be used to restructure an educational institution to become more service-oriented.

The essay does not aim to reinvent and completely (re)define the entire business model of DCS as a service. The purpose of the essay is instead to focus on investigating the applicability and benefits of CMMI-SVC in an educational environment and to demonstrate how CMMI-SVC can be used as an improvement roadmap. We therefore have adopted a "deep-not-wide" methodology: Some selected process areas will be detailed quite a lot for the sake of demonstrating their applicability and added value, while we will not cover the whole breadth of process areas from the CMMI-SVC model. The remainder of the essay is structured as follows:

First we describe our methodological approach, which takes a use-case-based perspective and follows a three-step procedure. Then we describe extracts from our sample interpretation of the Service Delivery (SD) process area for the educational domain. Based on our use-case-driven methodology, we then demonstrate how SD might be interpreted with respect to two selected use cases. We conclude with a description of some of our experiences and lessons learned.

Methodological Approach

Use-Case Orientation

As pointed out in the introduction, educational institutions (at least in the public educational system in Europe) are often organized according to functional criteria. This has led to the emergence of a mindset that is very much aligned with functional responsibilities. This mindset does not necessarily take into account the needs of the people expecting a service (e.g., registering a student, registering for a specific lecture, etc.). Instead, the prevailing functional mindset is often characterized by professionally delivering products or product components, but not necessarily entire solutions. The student's perception is therefore quite often a very fragmented mode of delivery with respect to the original requirement (e.g., registering for a specific lecture).

As a first step toward the required service shift in the organizational mindset, we have therefore chosen a use-case orientation. A use case is a well-known concept in software engineering. It describes the externally visible behavior of an IT system to be developed. Use cases try to capture a description of the functionality that users of the system are expecting. Use cases then drive further development of the IT system.

To us, it seems to be an intuitive and smooth transition to leverage the use-case concept to describe the services that the service system of an educational institution should deliver. What use cases or services is the user expecting from the service system (i.e., the educational institution)?

The selected use cases for which we conducted our feasibility study are as follows.

1. Provision of degree programs—bachelor's, master's, Ph.D.:
   - Besides the strategic value of this use case, the institution should also specify the requirements for each degree program and the final degree that will be obtained upon completion of the course. A student therefore has the option to choose a degree program that he or she wishes to study depending on his or her current educational background.
2. Application and admission for a degree program:
   - A guide on how to apply for a degree program should be provided to interested candidates. Deadlines should also be specified.
3. Provision of a detailed syllabus for each degree program.
4. Provision of counseling services (mentoring):
   - Counselors should be appointed and each student assigned to a counselor. This is usually an essential service for first-year students.
5. Provision of lectures and lab sessions, including lecture and lab materials, such as presentation slides and/or lecture notes in good quality.
6. Student assessments and exams.
7. Lecture evaluation.
8. Provision of library services.

The Three-Step Methodological Approach

As pointed out in the introduction, the aim of this essay is not to present a complete interpretation of the CMMI-SVC model for educational institutions, but to demonstrate the model's applicability and to show how it can be effectively applied for process improvement in this domain. Therefore, we have developed the following three-step approach in applying CMMI-SVC.

Step 1: Interpret the SVC-Relevant Process Areas for the Educational Institution (To-Be Requirements)

In the first step, we used the following approach: Take the CMMI-SVC specific process areas (from the Service Establishment and Delivery category) and try to interpret them with respect to the needs and requirements of an educational service provider. As these process areas are not really to be implemented on their own, we complemented them with a collection of other process areas, also mainly from maturity level 2. Overall, we selected the following process areas from the model, for which we then developed an interpretation for our problem domain:

- Service Establishment and Delivery process areas:
  1. SD: Service Delivery
  2. CAM: Capacity and Availability Management
  3. IRP: Incident Resolution and Prevention
  4. SCON: Service Continuity
  5. SSD: Service System Development
  6. SST: Service System Transition
  7. STSM: Strategic Service Management
- Additional process areas included in our interpretation for the educational sector:
  1. CM: Configuration Management
  2. MA: Measurement and Analysis
  3. WMC: Work Monitoring and Control
  4. WP: Work Planning
  5. PPQA: Process and Product Quality Assurance
  6. REQM: Requirements Management

We used the sample use cases (as mentioned earlier) as guidance for interpreting the selected process areas. The result of this step is a perfect (To-Be) service-oriented process model and a collection of requirements for a perfect educational service provider. (You can easily extend the result of this step toward a reference process model for educational service providers.) As always with CMMI, the result of this step is *not* a collection of ready-to-implement master processes, as the process areas are typically not directly implemented in their current form. Instead, they are a type of requirement that has to be met while executing the typical processes in the educational institution. For example, you do not implement SD as is, and instead will probably implement it in slightly different ways, seamlessly embedded (e.g., in the "register for a degree program" use case and in the "deliver lectures and lab sessions" use case). However, in both use cases, you will have to meet such requirements as, for example, SP 3.2, "Operate the system," with respect to, for example, SP 8, "Collect customer satisfaction information immediately after services are delivered or service requests are fulfilled."

Step 2: Gap Analysis: Analyze the Chosen Use Cases with the Help of the To-Be Requirements

In step 2, the currently executed (As-Is) use cases and As-Is processes were analyzed together with experienced members of the Department of Computer Science with respect to the defined requirements coming from the To-Be processes. This step capitalized on CMMI's long-standing definition of process: "In the CMMI Product Suite, activities that can be recognized as implementations of practices in a CMMI model." The gap analysis was based on this understanding of *process*. The main focus of this step was to find out how the defined use cases were really executed to identify the degree of conformance and domains of deviation with respect to the previously defined To-Be model. We successfully applied graphical process representations, interview sessions, and questionnaires as valuable techniques for conducting this step.

Step 3: Derive Improvement Opportunities

Based on the identified conformances and noncompliances of the As-Is processes with the To-Be model, we identified a prioritized improvement program for DCS. We also successfully applied interview sessions and questionnaires as valuable techniques for conducting this step. It is important to note that during this step, we included GG 2 and GG 3 and the related generic practices. This helped us to identify systematic improvement opportunities in our department, such as a lack of clearly defined and communicated responsibilities and authorities (GP 2.4) and incomplete organizational policies (GP 2.1).

Sample Interpretation of the SD Process Area for the Educational Domain

In this section, we will demonstrate how the SD process area might be interpreted with respect to the following two use cases:

1. Delivering degree programs
2. Offering a specific lecture

The intent of this section is not to completely document all details of the interpretation, but to give an impression of the applicability and added value of interpreting *Service Delivery* for an educational institution. It should also be noted that the interpretation assumes that the service-oriented shift in the mindset of the relevant stakeholders has already taken place (i.e., they understand their business already as providing educational services).

Interpretive Guidance for Use Case 1: Delivering Degree Programs

SG 1 Establish Service Agreements[2]

SP 1.1 Analyze Existing Agreements and Service Data

To achieve this, the following information should be collected and analyzed:

- Number of students who enrolled from the last semester or academic year
- Feedback from students for each lecture offered in the previous semester
- Student attendance for each lecture offered in the previous semester
- Suggestions from last general staff or board meeting
- Review of the current study regulations

SP 1.2 Establish the Service Agreement

Draw up a detailed study regulation, which should include, among other things:

- The detailed structure of a degree program
- The syllabus of a degree program

2. All titles for the specific goals and specific practices in this section are taken from the CMMI-SVC model.

- The examination regulations
- The type of certificate to be obtained upon completion of the program

Publicize the study regulations so that students can easily have access to it without restrictions.

Make sure changes in study requirements are reflected in the regulations by periodic (e.g., annual) reviews.

SG 2 Prepare for Service Delivery

SP 2.1 Establish the Service Delivery Approach

Identify channels to be used by students to submit

- Application for admission
- Enrollment
- Application for withdrawal

Sample channels could be Web forms, telephone, or a service center.

Set deadlines for applications.

Set maximum duration for processing student requests (e.g., a student gets a response after applying for a degree program after a maximum of six to eight weeks).

SP 2.2 Prepare for Service System Operations

Define interfaces (roles and responsibilities) for receiving and processing student requests. For example:

All requests concerning application for admission should be sent to the secretary of the department that is responsible for forwarding the requests, *if necessary*, to the respective individuals or departments in charge of further processing.

Examination issues should be sent directly to the department of examinations. However, in some minor cases, lecturers concerned can be contacted directly.

SP 2.3 Establish a Request Management System

Typical student requests may include

- A new student requesting admission into a degree program
- A registered student requesting withdrawal
- Amendment proposals of the study regulations from the student board

A request management system can be put in place to manage and track the status of each student request

SG 3 Deliver Services

SP 3.1 Receive and Process Service Requests

Based on the interfaces defined for receiving and processing student requests, each new request is simply forwarded to the appropriate station.

For each request, define a detailed action line for its processing.

SP 3.2 Operate the Service System

Offer lectures each semester as stipulated in the study regulations.

Offer counseling to students by assigning each student to a mentor.

Offer library services as well as learning centers.

SP 3.3 Maintain the Service System

Regularly maintain the infrastructure and equipment (i.e., lecture rooms, hardware and software products)

Interpretive Guidance for Use Case 3: Offering a Specific Lecture

SG 1 Establish Service Agreements

SP 1.1 Analyze Existing Agreements and Service Data

Number of students registered for a lecture

Lecture materials, such as slides, notes

SP 1.2 Establish the Service Agreement

Draw up regulations for undertaking a lecture, which may include

- Active participation during lectures
- Active participation in lecture assessments (e.g., assignments and lab sessions)
- Exam registration
- Passing examination

SG 2 Prepare for Service Delivery

SP 2.1 Establish the Service Delivery Approach

Lectures will be offered as defined in the lecture schedule (i.e., lecture room, lecturer, and time slot).

Lectures will be provided using beamers, whiteboards, or overhead projectors.

SP 2.2 Prepare for Service System Operations

Ensure lecture rooms, lab rooms, hardware, and software are all in good condition.

SP 2.3 Establish a Request Management System

Put a system in place whereby students may register for participation in the lecture, for participation in the exam, and so on.

SG 3 Deliver Services

SP 3.1 Receive and Process Service Requests

Based on the interfaces defined for receiving and processing student requests, allocate each student into the courses he or she has registered for.

SP 3.2 Operate the Service System

Have qualified lecturers give lectures.

Allocate office hours for each lecturer.

Assess students (e.g., through assignments, tests, and/or examinations)

Have students evaluate lectures.

SP 3.3 Maintain the Service System

Maintain the lecture rooms and equipment.

Review lecture material.

Lessons Learned

Understanding the business in our Department of Computer Science as a service helped a lot in terms of clarifying a general understanding of what our department was currently doing and what it should be doing if we want to become a professional service provider of educational services. The application of the selected process areas to our business contributed greatly in terms of improving process transparency and identifying improvement opportunities. Additionally, a much better mutual understanding between the department's staff and the students emerged. This can be interpreted as a big step from a functional mindset toward a (real) service-oriented mindshift in our department. Eventually, applying generic goals 2 and 3 (in combination with the related generic practices, e.g., GP 2.1 and GP 2.4) contributed toward making the identified process improvements sustainable. In the remainder of this section, we will point out two specific findings that we find worth mentioning:

- Recursive nesting of services and service components
- Educational services relying on a very cooperative culture

Finding 1: Recursive Nesting of Services and Service Components: Structural Similarity to Engineering Process Areas

During our analysis, we discovered that one person's use case typically is composed of use cases of a finer granularity from another person's perspective. So, what seems to be "a" use case typically is just a component of a use case for another person. This situation appears to be similar to the recursive understanding of the Engineering process areas of the CMMI-DEV model. The authors of the CMMI-SVC model confirm that this is not just similar, but the same intended relationship. Here is an example:

Apparently, use case 1, *provisioning of degree programs,* can be decomposed into delivering several study programs, each of which leads to one of the degrees offered in the overall degree program. Each study program in turn can be further refined by a set of syllabuses and related courses. Finally, each course needs to be further decomposed into single lecture units which will be offered on, for example, a weekly basis. In turn, the service *delivering a lecture on a specific date* for which a specific lecturer is responsible can be considered a service component from a more abstract level. This seems to be similar in structure to the relationship between a product and a product component from the CMMI-DEV model.

We created Figure 6.5 to depict this idea of recursive nesting (and repeated application of the CMMI-SVC process areas) more clearly.

Finding 2: Educational Services Are Relying on a Very Cooperative Culture

During our analysis, we discovered that in some cases, the service can be successfully delivered with low participation from the service consumers (i.e., the students involved). This is basically true for most administrative processes and services (e.g., the registration processes): Based on some data from the student, this service can successfully be accomplished by the educational institution regardless of the student's further willingness to cooperate.

But for the core processes, such as providing degree programs or giving specific lectures, successful service delivery relies considerably

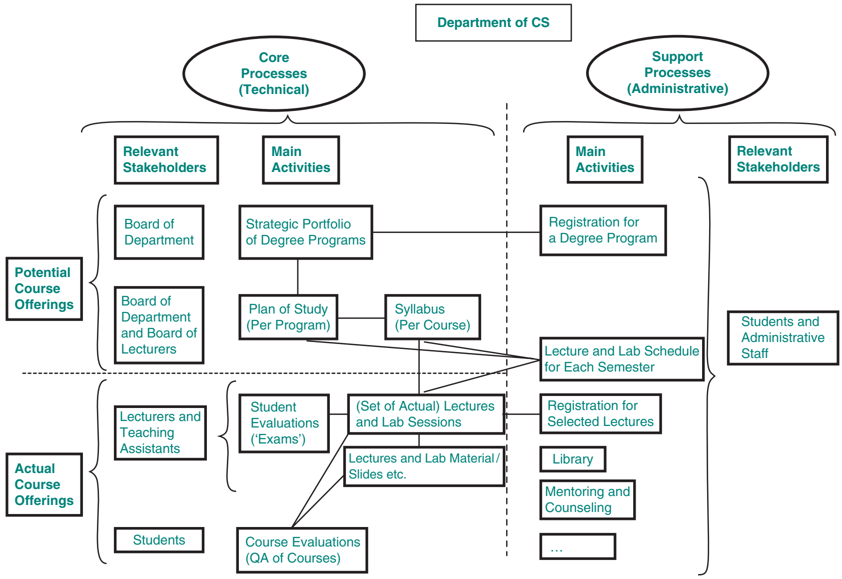

FIGURE 6.5
Separation of Concerns and Recursive Nesting of Services and Service Components in the Educational Domain

on the willingness of students to actively cooperate. In particular, *successful* delivery of a lecture or degree program cannot, by the nature of the learning process, be the sole responsibility of the educational institution. Even the best educational service provider cannot guarantee the success of its degree programs if there is no willingness on the service consumer's side (the students) to contribute their share of responsibility to the overall process.

Instead, successful delivery of educational services always requires active cooperation on the part of the student as well (e.g., preparing for lectures and actively doing homework). Successful service delivery in the educational domain is therefore more of a joint service production than just a one-way service offering *from* an educational institution *to* a student consumer. Nevertheless, the educational institution can do a lot to facilitate and improve such a successful learning process. And the CMMI-SVC model offers a lot of advice for doing just that.

Additional Findings

While we found that CMMI-SVC in general offers a high degree of applicability and practical advice for improving delivery of educational services, we have not yet determined how and where CMMI's high maturity levels might be useful in this application domain. More work and more practical experience are required.

Also, we found out that it is hard for some academics to get used to the idea of understanding (academic) education as a service. Their mindset is often dominated by ideas of being researchers in pursuit of scientific truth and innovation. Our use-case-driven approach and our focus on the process aspects of academic work helped to improve their acceptance of the service paradigm substantially. The secret recipe for them is to have them understand that the main focus of this mindshift is the process side, while they remain in the driver's seat for all content related aspects.

Next Steps

Our initial experience with applying CMMI-SVC in the educational domain was so rewarding and promising that we plan to further pursue that path in two directions.

We are currently investigating relationships between the CMMI-SVC approach and the general approach of Business Process Management (BPM). Some of the research questions in that regard are: To what extent might BPM benefit from a systematic service orientation, and how can BPM capitalize on the maturity model contained in CMMI-SVC?

During our work, we identified many interfaces to central organizational entities of our university. Thus far, we have not actively included them in the scope of our work, as we need them to become more service-aware and eventually service-oriented. Some of the research questions toward that end are the following: Do all departments simultaneously have to undergo a CMMI-SVC restructuring in order to make this work for an educational institution? Can we possibly identify appropriate organizational boundaries so that we can successfully apply CMMI-SVC without having to reorganize the whole institution at once? What incremental transition techniques might be available for this purpose?

Plans Are Worthless

By Brad Nelson

Book authors' comments: From early in the development of the CMMI-SVC model, we began to hear concerns from users about the guidance or policy that might be imposed by government acquirers on providers bidding on service contracts. We sought the participation of experts such as Brad Nelson on our Advisory Group to ensure that we were considering these issues. In this essay, the author, who works on industrial policy for the Office of the Secretary of Defense, makes clear that it is appropriate capability that is sought, not the single digits of a maturity level rating. Further, he describes the ongoing responsibility of the government acquirer, rather than just the responsibility of the provider.

The Limits of the Maturity Level Number

The CMMI model developed by the CMMI Product Development Team (involving representatives from industry, government, and the Software Engineering Institute [SEI] of Carnegie Mellon) can be thought of as an advanced process planning tool. CMMI defines maturity levels ranging from level 1—ad hoc performance—through level 5—process and subprocess optimization.

Stated colloquially, a level 1 organization accomplishes goals without a well-developed organizational memory to ensure that good decisions leading to work accomplishment will be repeated. It's sometimes said that a level 1 organization is dependent on individual heroes who react well to events and other people. On the other end of the spectrum, a level 5 organization has measurable processes that repeatedly guide good decisions and those processes are continuously improved.

A level 5 organization has a breadth and depth of institutional capability and culture to reliably optimize workflows and isn't dependent on any one person. It's certainly reasonable to expect a much higher probability of project success from a level 5 organization than from a level 1 organization. The SEI certifies individuals to provide CMMI maturity level appraisals using a Standard CMMI Appraisal Method for Process Improvement (SCAMPI). Given this well-organized CMMI infrastructure, wouldn't it make sense for a buyer to require minimum maturity level ratings for potential suppliers?

What's wrong with Department of Defense (DoD) staff members who provide opinions that "DoD does not place significant emphasis on capability level or maturity level ratings…?"[3] Don't they get it?

Some understanding of this opinion might be gained through the examination of a quote from General Dwight D. Eisenhower, who said that "plans are worthless but planning is everything." It's quite a pithy saying, and a couple of things can be quickly inferred. The first is that given complex endeavors with a large number of variables, plans are at high risk of obsolescence. The second is that the familiarization and insights gained from the planning process are invaluable to making informed adaptations to changing conditions.

Perhaps oversimplifying a bit, a plan is a static artifact and those who rely on static artifacts do so at their own peril. The real value of a plan is that its completion facilitates the detailed situational awareness

3. CMMI Guidebook for Acquirers Team. *Understanding and Leveraging a Supplier's CMMI Efforts: A Guidebook for Acquirers (CMU/SEI-2007-TR-004)*. Pittsburgh: Software Engineering Institute, Carnegie Mellon University, March 2007;www.sei.cmu.edu/publications/documents/07.reports/07tr004.html.

of the planner and his or her ability to perform well in a changing environment. But don't continuously improving level 5 organizations avoid the trap of static process planning?

While it may appear like "hairsplitting" to some, it's critical to observe that the preceding discussion of the value of a plan applies to the CMMI *rating*, not process plans. In fact, it's actually the CMMI rating that's the static artifact.

Viewed from a different angle, even though a high maturity organization may have process plans that are adapted and optimized over time, the appraiser's observation of that organization is static. Organizations and the people in them change over time. Furthermore, careful consideration must be given to the relationship between a SCAMPI appraiser's observations of prior work by one group of people to the new work with possibly different people. What was relevant yesterday may not be relevant today.

Considerations for the Responsible Buyer

When committing hard-earned money to a purchase, a buyer hopes for the best results. Going beyond hope, a smart buyer looks for indicators that a seller actually has the capability to achieve expected results. An experienced smart buyer establishes requirements to accomplish the desired results by a capable supplier. Understanding what a CMMI rating is and isn't helps the smart and experienced buyer evaluate CMMI ratings appropriately.

To estimate a supplier's probability of success, a good buyer must first understand what is being purchased. A buyer expecting that a supplier's mature processes will enhance the buyer's probability of success must do more than hope that a past CMMI rating is applicable to the current project. Due diligence requires the buyer to analyze the relevance of a potential supplier's processes to the buyer's particular project.

When this analysis is done, it should carry substantially more weight than a CMMI rating. When it's not done and significant weight is given to a rating, the buyer is effectively placing due diligence in the hands of the appraiser. This is an obvious misuse of the rating. A CMMI rating can be one of many indicators of past performance, but a rating is a "rating" and not a "qualification." CMMI appraisers do not qualify suppliers.

Remaining Engaged after Buying

Once a savvy buyer chooses a qualified supplier, the buyer's real work begins. In the words of ADM Hyman Rickover, father of the nuclear navy, "You get what you inspect, not what you expect." This principle is applied every day by smart, experienced buyers when they plan and perform contract monitoring. It's an axiom that performance monitoring should focus on results rather than process.

Nevertheless, intermediate results of many endeavors are ambiguous, and forward-looking process monitoring can reduce the ambiguity and point to future results. CMMI can provide valuable goals and benchmarks that help a supplier to develop mature processes leading to successful results, and SCAMPI ratings can provide constructive independent feedback to the process owner.

A rating, though, carries with it no binding obligation to apply processes at appraised levels to particular projects or endeavors. A rating is not a qualification and it's also not a license. Qualifications and licenses imply mutual responsibilities and oversight by the granting authority. Once a CMMI rating is granted, neither responsibilities nor oversight is associated with it.

A failure or inability to maintain process performance at a rated level carries no penalty. There is no mechanism for the SEI or a SCAMPI appraiser to reduce or revoke a rating for inadequate performance. The appraiser has no monitoring function he or she uses after providing an appraisal rating at a point in time, and certainly has no responsibility to a buyer.

The obligation to perform to any particular standard is between the buyer and the supplier. Essentially, if a buyer depends on a supplier's CMMI rating for project performance and uses it as justification for reducing project oversight, it would be a misunderstanding and misuse of the CMMI rating as well as an abdication of the buyer's own responsibility.

Seeking Accomplishment as Well as Capability

It is intuitive that mature processes enable high-quality completion of complex tasks. CMMI provides an advanced framework for the self-examination necessary to develop those processes. The satisfaction of reaching a high level of capability represented by a CMMI rating is well justified. It is possible, though, to lose perspective and confuse capability with accomplishments.

It's been said that astute hiring officials can detect resumes from job applicants that are over-weighted with documented capabilities and under-weighted with documented accomplishments. This may be a good analogy for proposal evaluation teams. The familiar term *ticket punching* cynically captures some of this imbalance. Herein lies another reason why CMMI can be quite valuable, yet entirely inappropriate, as a contract requirement.

In the cold, hard, literal world of contracts and acquisitions, buyers must be careful what they ask for. Buyers want suppliers that embrace minimum levels of process maturity, but "embrace" just doesn't make for good contract language. While it might at first seem to be a good substitute to require CMMI ratings instead, it can inadvertently encourage a cynical "ticket punching" approach to the qualification of potential suppliers. Because ratings themselves engender no accountability, there should be no expectation that ratings will improve project outcomes.

Pulling this thread a bit more, it's not uncommon to hear requests for templates to develop the CMMI artifacts necessary for an appraisal. While templates could be useful to an organization embracing process maturity, they could also be misused by a more cynical organization to shortcut process maturation and get to the artifact necessary for a "ticket punching" rating. Appraisers are aware of this trap and do more than merely examine the standard artifacts. But as a practical matter, it can be difficult to distinguish between the minimum necessary to get the "ticket punch" and a more sincere effort to develop mature processes.

If an influential buyer such as the Department of Defense were to require CMMI ratings, it would likely lead to more CMMI ticket punching rather than CMMI embracing. The best that the DoD can do to accomplish the positive and avoid the negative has already been stated as "not placing significant emphasis on capability level or maturity level ratings, but rather promot[ing] CMMI as a tool for internal process improvement."[4]

Summary

To summarize, it certainly appears reasonable to expect more mature organizations to have a higher probability of consistently achieving positive results than less mature organizations. CMMI ratings are external indicators that provide information, but they are only indicators. A savvy buyer must know what the indicators mean and what they don't mean. Ultimately, accountability for project success is between the buyer and the seller. CMMI and SCAMPI ratings are well structured to provide important guidance and feedback to an organization on its process maturity, but responsible buyers must perform their own due diligence, appraisal of supplier capabilities, and monitoring of work in progress.

4. CMMI Guidebook.

CMMI Ensures Vehicle Insurance Services

By Gary H. Lunsford and Tobin A. Lunsford

Book authors' comments: The vehicle insurance industry is a prime example of a large, complex service arena where the principles of the CMMI for Services model can play very effectively in promoting continuous process improvement. In this essay, the authors present an overview of the vehicle insurance industry and then demonstrate how two process areas from the CMMI for Services model can help to ensure significant process improvement in this highly competitive industry. Dr. Gary Lunsford is a senior principal analyst with ARINC Engineering Services, LLC, an SEI Partner. He is an SEI Certified Lead Appraiser and Instructor for the three CMMI models—Development, Services, and Acquisition. Tobin Lunsford, Dr. Lunsford's son, is the AVP, National Material Damage, for the Infinity Insurance Companies. He is responsible for salvage, rental management, company estimatics, quality control, and coordination of the material damage training curriculum.

An Overview of the Vehicle Insurance Industry

Vehicle insurance is insurance purchased for cars, trucks, buses, and other vehicles. Vehicle insurance is also known as auto insurance, car insurance, or motor insurance and is considered to be part of property and casualty insurance. Vehicle insurance primarily provides protection against losses incurred as a result of accidents as well as the resulting liability.

In the United States, most states require a driver to purchase insurance before operating a motor vehicle on public roads. Although states vary in requirements and their enforcement, drivers who fail to purchase vehicle insurance may incur fines, have their driver's license suspended or revoked, or face a jail sentence. Drivers who purchase vehicle insurance can protect themselves against both collision and comprehensive events. Collision insurance covers the insured's vehicle in the event of a traffic accident. Comprehensive insurance covers vehicle damage incurred in incidents such as fire, theft, vandalism, and weather related events.

In most cases, whenever an insured motorist makes a claim involving repairs, the insured usually pays a fixed fee called a deductible. Normally, the payment is made directly to the repair facility that restores the damaged vehicle to preloss condition. If an accident is severe enough that the damage costs more to repair than the vehicle is worth, the car is declared a "write-off" or "total loss" and payment for the claim, minus the deductible, is made directly to the insured and/or to the lien holder.

Since large amounts of money are involved in providing, tracking, and monitoring these services, the vehicle insurance industry is constantly looking for ways to reduce costs for companies, streamline service for customers, and garner profits for stakeholders. However, a number of factors complicate the effort. We will look briefly at four factors that affect the cost of doing business in the insurance industry: determining premiums, securing reinsurance, providing training, and complying with regulations.

Determining Premiums

An often-overlooked cost factor is determining the premium that a policyholder pays for coverage. The premium may be mandated by the government or determined by the insurance company in accordance with governmental regulations that vary from state to state. Insurance companies hire actuaries to determine best estimates for premiums based on statistical data representing historical activity and future claim projections for given risk factors. These risk factors include the driver's gender, age, marital status, driving history, anticipated annual mileage, and vehicle classification.

Securing Reinsurance

Another factor driving the vehicle insurance business is the cost of reinsurance. Simply stated, reinsurance is insurance for insurers (the companies) that face special needs or catastrophic loss potential. This type of insurance is designed to mitigate the significant risks that can financially threaten a given insurance company, particularly those with smaller capitalization, and affect the continuity of its service.

Providing Training

Because the vehicle insurance industry is complex, highly competitive, numbers-driven, and ever-changing, it has become very high-tech; therefore, domain training is essential. It is not surprising that several companies have developed specialized software applications exclusively for the insurance industry.

Complying with Regulations

Until recently, the government regulated the vehicle insurance industry mainly at the state level. Although the underlying goal of the regulations is to ensure that the insurance companies properly cover the losses of their policyholders, regulations are not uniform. All states have Departments of Insurance that strongly influence how companies operate within their jurisdictions. Interacting responsibly with

50 state insurance departments is a time-consuming, costly affair to vehicle insurance companies.

Currently, the U.S. Congress is considering legislation that will regulate some insurance functions at the national level. *[Note: The vehicle insurance business is part of Finance within the U. S. Department of the Treasury.]* In late 2009, the federal government began requiring every insurance carrier to report all instances of total loss to the Department of Justice. These reports and statistics have become the nucleus for the formation of a common database of information for insurers; the effort is being heralded very positively by the insurance companies themselves.

This overview of some of the business considerations within the vehicle insurance industry illustrates the complexity of the marketplace and highlights several performance issues facing insurance companies, stakeholders, and policyholders. Note some of the common terminology used in the industry: *incidents, risks, risk mitigation, damages, claims, continuity of service,* and *training*. These terms occur frequently in the CMMI for Services model. We will focus on two selected process areas within the model, namely Work Planning and Service Delivery, and see how they can positively affect insurance companies and policyholders. We will then indicate some specific areas in data management where the vehicle insurance industry can improve by using these process areas and related practices from the Measurement and Analysis process area.

Work Planning

The purpose of Work Planning is to establish and maintain plans for defined service activities. Sometimes the work involves obtaining services from outside vendors or providing services to outside vendors. Some service engagements have definite termination conditions, while others are long-term, ongoing, and continuous. In the flow of business, the vehicle insurance industry uses both types of service engagements, as we will illustrate shortly.

The specific goals of the Work Planning process area are threefold: estimating the attributes of the work products and tasks, developing a work plan, and obtaining commitment to the plan.

Estimating the Attributes of the Work Products and Tasks

The vehicle insurance industry uses a number of approaches to scope and define work products and tasks embedded in a proposed service. As a precursor to developing a strategy, insurance carriers often complete a trend analysis of data covering a two- or three-year period to investigate problem areas or identify new or expanded business areas. Comparisons are made with peer competitors' performance profiles and strategies. Part of this activity involves asking strategic questions. For example, what is the real driving metric for a proposed project to improve settlement performance for damage claims? Is it to reduce cycle times (i.e., the time elapsed between a vehicle being declared a total loss to when the insured actually receives the settlement check), or to increase profitability in a certain area of salvage operations? The answers to this type of question help to define life-cycle phases for the work, determine necessary resources, and establish the estimates for effort and cost.

Another strategizing approach used is to form a focus group to assist in defining the scope of a proposed service. These special-purpose groups often consider business support and customer service indices in determining strategy. Once begun, they ensure that projects are reevaluated every two or three weeks for fine-tuning and possible revisiting of the early planning activities, assumptions, and rationales.

As another early step in developing estimates, many vehicle insurance companies establish preliminary work breakdown structures (WBS). Constructing a WBS can help in the following ways.

- Clarify understanding of the intended area by interviewing any previous managers and/or former process leaders.
- Determine the status of competitors' activities—establish performance metrics to capture relative standing.
- Develop a marketing case for upper management buy-in.
- Look for any existing contracts that might constrain or bind activities.

Sizing activities can fan out in several different directions. For example, a focus or study group could do any or all of the following activities.

- Perform an analysis at the individual claim level by asking if adding more staff members would increase the throughput proportionately.
- Define metrics for the nature of the vehicles involved (personal passenger cars, business fleet cars, trucks, custom vehicles, etc.).
- Evaluate whether or not specialized knowledge is required to do specific processing.
- Revamp operations (e.g., introduce more software automation enhancements) in order to free staff members for other assignments.
- Differentiate between fixed costs and variable costs when establishing sizing type attributes.

Developing a Plan

At the heart of developing a work plan are budgeting and scheduling activities. Consider how one vehicle insurance company plans and manages its salvage operations. The salvage unit publishes a schedule that assigns adjusters and handlers to various claims units and identifies where and when various resources will be needed. A Material Damage Quarterly Planner (MDQP) is published and updated as needed. The MDQP, which essentially functions as the work plan for many of the salvage unit's efforts, indicates when various salvage initiatives will be implemented. Field operating units are given 90 days advanced notice of a specific initiative, which could involve transferring all or most of their operations back to corporate headquarters or could lead to a significant increase of field staff members to handle additional responsibilities. *Note: The trend is to move functions back to corporate headquarters from the field as the operations are more efficient in centralized organizations.* Impacts on sister organizations are considered in establishing and maintaining schedules. Since dependence on specific tools and software packages is critical, the progress of the schedule is monitored closely and corrective actions are taken as often as biweekly.

Risks are identified early and tracked closely. Using the calendar year as their business operations year, many vehicle insurers formulate risk management activities in January or February for initiatives that will take place later in the year. Risks are reevaluated whenever there are changes in either external or internal circumstances, in the operating environment, or in the behavior or attitudes of customers. One of the continuing risks that plague insurance companies is the constant need to validate that their statistical models are properly tuned to changing market conditions. The trend is toward using more specialized models rather than generalized models.

Vehicle insurance carriers mine extensive amounts of data, especially when analyzing the damage claims of policyholders. Results are reported to management and the set of stakeholders. As mentioned previously, national data banks also provide commonly collected vehicle data.

The involvement of stakeholders is planned early and monitored as work progresses. From the standpoint of the vehicle insurance companies, the primary stakeholders are the members of the upper management team who approve initiatives and provide resources and staffing. The insureds (the policyholders) are really secondary stakeholders whose driving interests are that the insurance companies remain solvent and provide satisfactory resolution of damage claims.

Obtaining Commitment

To be effective, a plan must be feasible and backed by responsible participants committed to executing the provisions of the plan. Two of the biggest factors that can affect the success of a work plan in the vehicle insurance industry are the adequacy and training of staff members and government regulations. As a fundamental commitment, upper management must provide the necessary staffing, resources, and training called for in plans. Furthermore, when changes in state and federal insurance regulations occur (e.g., across-the-board rate increases or significant changes in reporting requirements), vehicle insurers need to quickly reconcile the differences between estimated resources and actual needs.

In conclusion, all plans require continuing commitment from participants. In the complex vehicle insurance industry, performance requires unusual cooperation across many people and facilities—from agents to adjusters to body shop operators and tow truck drivers.

Service Delivery

The purpose of Service Delivery is to deliver services in accordance with service agreements. Vehicle insurance companies set up service delivery agreements with their vendors and policyholders, take care of the various service requests they receive, and strive to maintain and operate their many-faceted service systems as efficiently as possible. Their service delivery operations map to the three specific goals of the Service Delivery process area: establishing service agreements, preparing for service delivery, and delivering services.

Establishing Service Agreements

The essence of service agreements lies in accurately capturing the requirements stated by the customer or end user. The service agreement is the vehicle insurance policy itself; this document establishes the relationship between the insurance company and the policyholder (the insured). Applicants obtain coverage by working with an insurance agent or by directly purchasing a policy from the company itself. Processing applications takes into account several factors including the type of vehicle to be insured and the credit rating and driving history of the applicant. Four different categories of service agreements (policies) are widely recognized: Non-Standard; Standard; Preferred; and Ultra-Preferred. Non-Standard equates to high risk. Standard policies, which account for about 60 percent of the policies written, reflect higher credit scores on the part of the applicants. Preferred indicates that the applicant has a high credit score but may have had an accident in the past. The Ultra-Preferred category is reserved for those applicants with the highest credit scores and lowest risk profiles.

Preparing for Service Delivery

When preparing to deliver services, a vehicle insurance company must develop an effective system to process requests from the policyholders in accordance with the provisions of their policies (service agreements). This preparation includes the following activities:

- Establishing an infrastructure and the statistical base necessary to determine the appropriate policy provisions and premiums
- Building the capability to write policies and track premium payments
- Establishing an environment to adjudicate and process accident claims—the primary type of service request
- Ensuring that the personnel and facilities are in place to support the full range of required support services that can range from addressing legal and/or medical issues to establishing national agreements with tow truck companies to certifying body shops for repairing damaged or impacted vehicles

Delivering Services

Depending on the situation, policyholders will interact with the vehicle insurance system in different ways. For example, a service request could involve obtaining repair estimates when a vehicle has been involved in an accident. The appropriate, corresponding support service system requires that several components are in place, including adjusters to assess damages and body shops to repair the damaged vehicle. The service delivery approach must also consider the degree of automation involved in submitting a claim in accordance with the consumers' comfort level and their perceived need to deal with a "real live person" rather than simply filing a claim online.

Establishing and maintaining the service system(s) are complex tasks that must take into account the dynamics of state and federal regulatory laws as well as the types of service incidents themselves. Typical service incidents can include funding considerations, an unusual spate of accidents, or defaults on premium payments. When a policyholder defaults on a premium payment, it means that the insurance company has less discretionary funds to invest in capital improvements.

One particularly important component of service delivery is the claims system. Each carrier's claims system must interact with both internal and external vendors, as well as submit the reports required by the state and federal government. Currently, the reporting systems' data collection mechanisms vary widely from paper capture to electronic file transfers. Electronic data collection tools can be either mainframe-based or server-networked. In the vehicle insurance industry, frequent upgrades are common as the operational trend is to move away from mainframes toward server environments in order to interface more easily with vendors, government officials, and policyholders. Most platforms are Oracle-based.

Claims processing is often partitioned between internal servicing and external outsourcing in a way that is designed to be transparent to the service requester. Insurance companies are increasingly concerned with keeping the claimants informed about the progress of their claim requests and following up after the completion of service. Follow-up activities often involve a customer survey; vehicle insurance companies want customers to offer suggestions for service improvement. Some insurance companies define a Customer Service Index (CSI) that measures the customer's satisfaction with the services performed.

Information technology (IT) departments perform crucial services, including the following vehicle insurance service functions.

- Maintain early policy records, such as initial policy ratings and binding requests.
- Monitor administrative service requests from claimants and the status of premium payments.
- Analyze the scope of each damage claim and monitor the progress of claims processing.

Service maintenance is performed on all components of the insurance delivery system, including corrective and preventive maintenance on the application platforms and upgrade training for the employees who provide services directly to the public. As indicated earlier, both adaptive and perfective maintenance are also the rule of the day as systems are constantly being upgraded in response to dynamic governmental regulations and technological advances.

Areas Where CMMI-SVC Can Help to Improve Service Operations

Given that the vehicle insurance industry already enjoys fair process discipline and effective use of data, we might wonder how CMMI-SVC could be used to further improve the field. The practices of the Measurement and Analysis process area can be used more extensively, and some of the demands for further capability would align with the practices in the four high maturity process areas. In this way, it is possible that the vehicle insurance industry can demonstrate some of the first high maturity behavior in the service industry, and that insurance companies who move to implement these practices may enjoy a market advantage.

1. Identifying trends earlier and enhancing trend analysis activities

Move from a reactive mode to a more proactive mode. Identify vehicle specific issues sooner, which will save estimating costs, decrease rental expenses, compress claims cycle times, and increase customer satisfaction.

2. Developing a new type of measurement to predict potential issues in a class of vehicles

Drill through collected data to identify "early warning" alerts that there are potential issues with a particular class of vehicle. Examples might include improper airbag deployment on four-door passenger vehicles, tire manufacturing defects that can create vehicle hazards, and cruise control modules with faulty wiring that can create fire hazards.

3. Recognizing the important data to mine and analyze

"Put the pieces together" of the plethora of data available to property and casualty companies. Incorporate predictive analytics on the truly important components that are available in the vehicle insurance databases.

4. Thinking outside the box about training

Much of the current training curricula are reflective of the data presently being processed by the insurance carriers. Innovative training could enhance their ability to identify and investigate data trends more imaginatively and target learning experiences toward more effective customer support. These activities would certainly increase an insurance carrier's ROI.

5. Enhancing processes to accommodate the transition of new technologies more adeptly

The rapid increase of technology change will continue to require vehicle insurance carriers to incorporate and transition innovations into their service delivery systems while improving service response times and quality. The best practices of several process areas of CMMI-SVC can be invoked to help in this important area of vehicle insurance services.

Conclusions

In this essay, we showed how two specific process areas from the CMMI for Services model apply directly to the vehicle insurance industry. The authors' own experiences have shown that practices in the CMMI for Services model can ensure continuous process improvement in vehicle insurance services in most, if not all, of their areas of responsibility and concern.

The vehicle insurance business, like all public and private enterprises, has a responsibility to provide services effectively and efficiently to their stakeholders and the communities that they serve. However, not all business performance can be measured in bottom-line monetary terms or reduced to data analysis. Process improvement and long-term business success must also take into account a company's contribution to the overall economic, social, and environmental welfare of the larger community that it serves.

References

Selected general information was drawn from Wikipedia, The Free Encyclopedia (online).

Security and CMMI for Services

By Kieran Doyle and Eileen Forrester

Book authors' comments: CMMI users regularly consider how to include security during implementation of improvement programs and during appraisal. For the first edition of this book, Kieran Doyle, an instructor and certified high maturity lead appraiser, described his field experience meeting a client need to include security during a SCAMPI appraisal for CMMI-SVC. For this edition, the essay is now expanded and in three parts. In the first section by Kieran, he updates that experience and explains how content from any other framework or model might be included in a SCAMPI appraisal. In the second section, Eileen Forrester describes the factors to consider in leaving security in or out of CMMI models and CMMI-SVC in particular. In the third section, Kieran and Eileen include a work product that shows possible content for something like a CMMI-SVC process area about security management.

How to Appraise Security Using CMMI for Services

By Kieran Doyle

Prior to the first edition of this book, interest in multimodel appraisals was beginning to appear. My own first tangible involvement with the problem came when a client laid down the gauntlet with these words:

"We would like to include security in the scope of our CMMI for Services appraisal."

The subtext was, "We are already using something that includes security. I like CMMI, but I want to continue covering everything that I am currently doing." These were the instructions received from the change sponsor. In this particular instance, I needed to determine from where the challenge emerges to include security in the appraisal scope. More importantly, was there a way to use the power of CMMI and SCAMPI to address *all* the client's needs?

Information security is already an intrinsic part of both the Information Technology Infrastructure Library (ITIL) and the international standard for IT service management, ISO 20000. Both are in common use in the IT industry. The ISO 20000 standard provides good guidance on *what* is needed to implement an appropriate IT service management system. ITIL provides guidance on *how* IT service management may be implemented.

So, there is at least an implied requirement with many organizations that CMMI-SVC should be able to deal with most, if not all, of the topics that ISO 20000 and ITIL already address; and by and large it does! Indeed, there are probably advantages to using all three frameworks as useful tools in your process and business improvement toolbox.

As I've mentioned, ISO 20000 provides guidance on the requirements for an IT service management system. But it does not have the *evolutionary* structure that CMMI contains. In other words, CMMI-SVC can provide a roadmap along which the process capability of the organization can evolve.

Similarly, ITIL is a useful library of *how* to go about implementing IT service processes. In ITIL Version 3, this sense of it being a *library* of good ideas has come even more to the fore. But it needs something like CMMI-SVC to structure why we are doing it, and to help select the most important elements in the library for the individual implementation.

Thus, ISO 20000, ITIL, and CMMI-SVC work extremely well together. But CMMI-SVC doesn't cover IT security, and it is not unreasonable for organizations already using ISO 20000 or ITIL to ask a lead appraiser if they can include their security practices in the appraisal scope, particularly when conducting baseline and diagnostic appraisals. So, how can we realistically answer this question?

One answer is just to say, sorry, CMMI-SVC is not designed to cover this area, at least not yet. But there is another tack we can take.

The SCAMPI approach is probably one of the most rigorous appraisal methods available. Although it is closely linked with

CMMI, it can potentially be used with any reference framework to evaluate the processes of an organization. So, if we had a suitable reference framework, SCAMPI could readily cope with IT security.

What might such a reference framework look like? Well, we could look to ISO 27001 for ideas. This standard provides the *requirements* for setting up, then running and maintaining, the *system* that an organization needs for effective IT information security. How could we use this standard with the principles of both CMMI and SCAMPI?

One thing that CMMI, in all its shapes, is very good at helping organizations do is to institutionalize their processes. As long-time CMMI users know, the generic goals and practices are extremely effective at getting the right kind of management attention for setting up and keeping an infrastructure that supports the continued, effective operation of an organization's processes. No matter what discipline we need to institutionalize, CMMI's generic goals and practices would need to be in the mix somewhere.

So, in our appraisal of an IT security system, we would need to look for evidence of its institutionalization. The generic practices as they currently stand in CMMI-SVC can be used to look for evidence of planning the IT security processes, providing adequate resources and training for the support of the IT security system, and so on. But it turns out that ISO 27001 has some useful content in this respect as well.

Certain clauses in the ISO 27001 standard map very neatly to the CMMI generic practices. For example, consider the following.

- Clause 4.3. Documentation Requirements: contains aspects of policy (GP 2.1) and configuration control (GP 2.6).
- Clause 5, Management Responsibility: details further aspects of policy (GP 2.1) plus the provision of resources (GP 2.3), training (GP 2.5), and assigning responsibility (GP 2.4).
- Clause 6, Internal ISMS Audits: requires that the control activities, processes, and procedures of the IT security management system are checked for conformance to the standard that they perform as expected (GP 2.9).
- Clause 7, Management Review of the IT Security Management System: necessitates that managers make sure that the system continues to operate suitably (GP 2.10). But additionally, this management check may take input from measurement and monitoring type activities (GP 2.8).
- Clause 8, IT Security Management System Improvement: looks to ensure continuous improvement of the system. Some of this section looks similar to GP 2.9, but there is also a flavor of GP 3.1 and GP 3.2.

So, collecting evidence in a practice implementation indicator (PII) for IT security as we do in SCAMPI, we could use these sections of the ISO 27001 standard like GPs to guide our examination. But what is it about the material that is more unique to setting up and running an IT security management system? In CMMI, this material would be contained in the specific goals and practices.

Looking once more to ISO 27001, we find material that is a suitable template for this type of content. The following clauses of the standard appear appropriate.

- Clause 4.2.1, Establish the Information Security Management System: This deals with scoping the security system; defining policies for it; defining an approach to identifying and evaluating security threats and how to deal with them; and obtaining management approval for the plans and mechanisms defined.
- Clause 4.2.2, Implement and Operate the Information Security Management System: This deals with formulating a plan to operate the security system to manage the level of threat and then implementing that plan.
- Clause 4.2.3, Monitor and Review the Information Security Management System: This uses the mechanisms of the system to monitor threats to information security. Where action is required to address a threat (e.g., a security breach), it is implemented and tracked to a satisfactory conclusion.
- Clause 4.2.4, Maintain and Improve the Information Security Management System: This uses the data from measuring and monitoring the system to implement corrections or improvements of the system.

Incorporating this content into the typical structure of a CMMI process area could provide a suitable framework for organizing the evidence in a SCAMPI type appraisal of IT security management. Often, CMMI process areas are structured with one or more specific goals concerned with "Preparing for operating a process or system" and one or more specific goals dealing with "Implementing or providing the resultant system." The match of this structure to the relevant ISO 27001 clauses is very appropriate.

We could structure our specific components of the PII to look for evidence in two main blocks.

1. Establishing and Maintaining an Information Security Management System: This involves activities guided by the principles in Clause 4.2.1 of the standard and would look something like this.
   - Identify the scope and objectives for the information security management system.

- Identify the approach to identifying and assessing information security threats.
- Identify, analyze, and evaluate information security threats.
- Select options for treating information security threats relevant to the threat control objectives.
- Obtain commitment to the information security management system from all relevant stakeholders.

2. Providing Information Security Using the Agreed Information Security Management System: This would then involve implementing the system devised in part 1 and would look something like this.
   - Implement and operate the agreed information security management system.
   - Monitor and review the information security management system.
   - Maintain and improve the information security management system.

Such an approach allows us to more easily include this discipline in the scope of a SCAMPI appraisal and enables the prior data collection and subsequent verification that is a signature of SCAMPI appraisals. *It means that a non-CMMI area can be included alongside CMMI process areas with ease.*

This approach has now been used a number of times. The advantage to the appraised organization is very clearly that it can use a single event to gain insight into strengths and weaknesses against more than one benchmark. The resulting appraisal results are also in a format that encourages a unified approach to addressing the issues. Separate appraisal and audit results sometimes result in different groups running different types of improvement activities. So, one set of results crossing the different "model" boundaries is more likely to lead to a coherent, consistent "solution." Also, in today's economic climate, there are savings to be made by running a single event.

This has led to speculation that this approach could be extended even further. Are there other models and standards that we could address in a similar manner? I believe the answer is a confident, "yes." Recently, I have looked at the British Standard BS 25999 from this perspective. This standard deals with Business Continuity Management and in many ways shares some of the space that SCON occupies in the CMMI for Services model. However, in looking at the standard, it occurred to me that many standards documents are structured in a very similar way.

There are usually sections dealing with the following:

- Policy
- Documentation
- Control of records and documents
- Management responsibility
- Internal audit, and corrective and preventive actions

As with ISO 27001, we can see that this approximates to many of the CMMI's generic practices. I would even suggest that if not all the CMMI GPs can be found in a particular standard, acting as if they were and making sure they were addressed in a particular implementation is likely to lead to a more enduring and effective system anyway.

In addition, a standard also holds some material that is unique to it, whether that is with setting up and running a business continuity system, an environmental management system, and so on. The essence of these unique clauses of the standards can be captured as "pseudo specific practices" in a PII in exactly the same way we have done for ISO 27001.

Thus, in principle, any standard could be converted to a "pseudo-CMMI format." I believe this has advantages for building consistent management systems across the organization. In particular, we can use the strength of the CMMI GPs to institutionalize the right types of behavior across the multiple viewpoints.

For improvement and quality departments the advantage comes in how we can sell this to the organization. We can use effectively one, unified approach to collecting data on the health of a set of potentially diverse models and standards. We can use a single event to collect the information, saving multiple trips to bother the hard-working frontline groups. This will definitely gain brownie points!

It is doubtful that the single-event approach would be acceptable to the standards agencies for their qualifying and certifying purposes. However, this does not detract from the value of this approach significantly. The organization will still need to run some form of audits. So, combining these with CMMI type events saves time and money.

When I first looked at combining security with CMMI, it was a challenge. But now I think the challenge is not how to combine other disciplines with CMMI, but what are the right things to combine with it? Which concepts are best suited to looking at from a CMMI perspective and which ones should we avoid because they dilute the power of this model? I have no firm answer to this latter question yet. However, I think the CMMI for Services model has taken CMMI more strongly into the general realm of business management than previously. The answer to the question probably lies in discovering in which business contexts we can successfully apply the model. Only by doing this will we discover the natural bounds of the capabilities of the present CMMI architecture.

Considering Security Content for CMMI for Services

By Eileen Forrester

When the original CMMI for Services model team worked on the scope and architecture for the first CMMI-SVC draft in 2006, we considered whether and how to include security content. We ultimately decided against normative model content on security.

Among the reasons for that decision were the preferences of the CMMI Architecture Team and the larger CMMI Product Team. In their view at the time, security can be conceived of during development as a class of requirement and a type of risk, and therefore was already covered by process areas treating those topics. In addition, several existing models such as ISO 20000 and 27001, CobIT, and ITIL have security content available. At that time, we also knew that another SEI CERT team was building the Resilience Management Model and including considerable security content. That team has now published their model. Further, in 2008 a team chartered by the CMMI Steering Group began writing an assurance focus topic for the CMMI models. We already regarded these frameworks and materials as complementary to CMMI-SVC, and as we worked, we did not attempt to include everything they included. We considered them excellent sources of practice information likely to cover the security landscape and chose not to write anything like a process area for security—or even a goal and practices in an existing process area—in CMMI-SVC, V1.2.

However, as use of the CMMI-SVC model grows, we frequently hear from users who would prefer, as they say, that we had simply "given us a process area or two on security," rather than asking them to look outside the model. This is not an issue for those users already combining CMMI-SVC and ITIL or ISO or RMM, but is more acute for those using CMMI-SVC alone and wanting to include security in their improvement program. We did not receive sufficient change requests on this topic to add security content to CMMI-SVC for V1.3, and even if we had, such a change would also have been beyond the scope of the V1.3 revision. Nonetheless, we often and increasingly hear a request from users for CMMI model content more directly on security, especially for CMMI-SVC.

In the first edition of *CMMI for Services, Guidelines for Superior Service,* Kieran Doyle wrote an essay at my invitation about including security in a SCAMPI appraisal on CMMI-SVC, which garnered attention and praise, and requests to take his work further. In addition, during the years before I worked on CMMI-SVC, I was working with colleagues in the SEI CERT program and elsewhere on including security content in CMMI. I still see a need for that content. Kieran and I have also worked as a subteam to a larger team I lead that works on combining CMMI-SVC effectively with other models and approaches. In the course of that work, we have experimented with the idea of what normative model content about security could look like. What follows is a work product from that subteam.

We took Kieran's idea of how to shape content from any model into something appraisable, and proceeded a step or two further to experiment with model-like or "pseudo process area" content on security. Clearly, this is far from full model content, nor is it presumed to be CMMI content. We chose a wide security management scope, which could include a range of security types. We have, to date, experimented only with purpose statement, goals, specific practice statements, some subpractices, and generic practice elaborations. Mostly missing is the informative content that serves as explanatory material and implementation guidance in a CMMI process area; we have not yet written the notes that are crucial to assist with comprehension, implementation, and improvement, for example. Our purpose on the subteam was to examine whether credible content on security could be created at all in a smaller footprint than models like RMM.

Given the persistence of the requests for fuller content on security to be used with CMMI models, we provide it here to begin to get community comments and input. Should this work be taken further? Is the scope useful for improvement? What could be done next to make it more credible? Would you participate in developing it into something fuller? Our call to action is to ask you to take a look at the example that follows and provide us with comments by writing to cmmi-comments@sei.cmu.edu. This content will change frequently, so please check the CMMI-SVC website for the latest information: www.sei.cmu.edu/cmmi/tools/svc/.

Example Security Content for Comment

By Eileen Forrester and Kieran Doyle

SECURITY MANAGEMENT (SM)

A work product to experiment with an example process area structure for CMMI for Services

PURPOSE

The purpose of Security Management is to establish and maintain a security management system (ISMS) that safeguards the essential assets of the organization.

NOTE

Essential assets cover such things as the essential functions and resources on which service and the organization depend. They can include, for example, staff and intellectual property of the organization. Some assets may be stored in many different forms, including physical documents, databases, websites, and other forms. Essential assets may also incorporate the computing systems themselves (e.g., servers) and even personnel. See the Service Continuity process area for more information on the essential functions and resources on which services depend. See the Resilience Management Model for more information on defining and safeguarding a range of assets.

Example Specific Goal and Practice Summary

ESG 1 – Establish a Security Management System
- ESP 1.1 Establish Security Objectives
- ESP 1.2 Establish an Approach to Threat Assessment
- ESP 1.3 Identify Security Threats
- ESP 1.4 Evaluate and Prioritize Security Threats
- ESP 1.5 Establish a Security Management Plan
- ESP 1.6 Obtain Commitment to the Security Management Plan

ESG 2 – Provide Security
- ESP 2.1 Operate the Security Management System
- ESP 2.2 Monitor the Security Management System

Example Specific Practices by Example Goal

ESG 1 Establish a Security Management System

A security management system is established and maintained.

ESP 1.1 Establish Security Objectives

Identify the scope and objectives for the security management system.

ESP 1.2 Establish an Approach to Threat Assessment

Establish and maintain an approach to assessing vulnerabilities and threats to essential assets.

Subpractices

1. Select methods for assessing security threats.
2. Define criteria for evaluating and quantifying security threats.
3. Describe responsibility and resources for evaluating vulnerabilities and threats.

ESP 1.3 Identify Security Threats

Identify and record security threats.

Subpractices

1. Identify security threats.
2. Record information about security threats.
3. Categorize security threats.

ESP 1.4 Evaluate and Prioritize Security Threats

Evaluate each identified security threat using defined criteria and determine its relative priority.

ESP 1.5 Establish a Security Management Plan

Establish and maintain a plan for achieving security objectives.

Subpractices

1. Describe responsibility for treating vulnerabilities and threats.
2. Identify resources for treating vulnerabilities and threats.

ESP 1.6 Obtain Commitment to the Security Management Plan

Obtain commitment to the security management system from all relevant stakeholders.

ESG 2 Provide Security

Security is provided using the security management system.

ESP 2.1 Operate the Security Management System

Implement and operate the agreed security management system.

Subpractices

1. Monitor the status of individual security vulnerabilities and threats.
2. Respond to and prevent security incidents. For more information on incident management, see Incident Resolution and Prevention.
3. Maintain and improve the security management system.

ESP 2.2 Monitor the Security Management System

Monitor the security management system.

Subpractices

1. Monitor the performance of the security management system.
2. Evaluate the effectiveness of security.
3. Consult national and international threat agencies on developments in security issues.

Generic Practice Elaborations

GP 2.1 Establish an Organizational Policy

SM Elaboration

This policy establishes the organizational expectation for defining and operating a security strategy and system.

GP 2.2 Plan the Work

SM Elaboration

This plan for performing the security management process can be included in the work management plan, described in the Work Planning process area. This plan encompasses both the strategy for maintaining security and the specific activities to establish, operate, and maintain the security management system.

GP 2.3 Provide Resources

SM Elaboration

Examples of resources provided for IT related security situations may include the following:

- Modeling and simulation tools
- Malware databases
- Firewalls
- Antivirus software

Examples of resources provided for non-IT related situations may include the following:

- Safes
- Restricted access rooms
- Restricted access file cabinets or other physical locations
- Guard and other security staff

GP 2.4 Assign Responsibility

SM Elaboration

Responsibility is assigned for planning, operating, and monitoring the security management system.

GP 2.5 Train People

SM Elaboration

Examples of training topics may include the following:
- Information security management concepts
- Physical security
- Network security
- Cryptography
- Data encryption
- Protocols

GP 2.6 Manage Configurations

SM Elaboration

Example work products placed under control include the following:
- Antivirus software
- Malware databases
- Security Management System representations
- Security Management plans

GP 2.7 Identify and Involve Relevant Stakeholders

SM Elaboration

Example activities for stakeholder involvement include the following:
- Identifying security objectives
- Gathering information on potential security threats
- Prioritizing security threats
- Reviewing the security management plan

GP 2.8 Monitor and Control the Process

SM Elaboration

Examples of measures and work products used in monitoring and controlling include the following:
- Number and type of security breaches
- Pareto analysis of categories of security incidents
- Schedule for conducting security system audits

GP 2.9 Objectively Evaluate Adherence

SM Elaboration

Examples of activities reviewed include the following:
- Identifying and analyzing security threats
- Operating the security management system
- Certifying and accrediting appropriate assets

Examples of work products reviewed include the following:
- Security management strategy
- Security management plans
- Designs for the security management system

GP 2.10 Review Status with Higher Level Management

SM Elaboration

Reviews of the security management system are held on a periodic and event-driven basis. The status of the security management system and the potential for new and developing security threats are typically considered. In the aftermath of specific security threats (e.g., a cyber attack), reviews may be held with appropriate levels of management to assess the damage to knowledge assets and agree on corrective actions.

GP 3.2 Collect Improvement Information

SM Elaboration

Examples of work products, measures, measurement results, and improvement information include the following:
- Reports on trends in security threat developments
- Reports on lessons learned from security breaches

PART TWO

Generic Goals and Generic Practices, and the Process Areas

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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 7.1.

TABLE 7.1 Generic Goals and Process Names

Generic Goal	*Progression of Processes*
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 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.

SSD ADDITION

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
>
> *Continues*

Continued

- 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.

WP Elaboration

Refer to Table 7.2 in Generic Goals and Generic Practices for more information about the relationship between generic practice 2.2 and the Work Planning process area.

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 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.

SSD ADD

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 7.2 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 Elaboration

Examples of resources provided include the following:
- Requirements specification tools
- Simulation and modeling tools
- Prototyping tools
- Scenario definition and tracking tools

SSD ADDITION

- 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 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.

SSD ADDITION

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 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

SSD ADDITION

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 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

SSD ADDITION

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

Continues

Continued

- 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 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

SSD ADDITION

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

Continues

Continued

- 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 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

SSD ADDITION

- 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 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

SSD ADDITION

- 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 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

SSD ADDITION

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 7.2 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.

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.

TABLE 7.2 Generic Practice and Process Area Relationships

Generic Practice	*Roles of Process Areas in Implementation of the Generic Practice*	*How the Generic Practice Recursively Applies to its Related Process Area(s)*[1]
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.

1. 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).

Continues

TABLE 7.2 Generic Practice and Process Area Relationships *(Continued)*

Generic Practice	*Roles of Process Areas in Implementation of the Generic Practice*	*How the Generic Practice Recursively Applies to its Related Process Area(s)*
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.
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.

TABLE 7.2 Generic Practice and Process Area Relationships *(Continued)*

Generic Practice	*Roles of Process Areas in Implementation of the Generic Practice*	*How the Generic Practice Recursively Applies to its Related Process Area(s)*
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.
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.	

Continues

TABLE 7.2 Generic Practice and Process Area Relationships *(Continued)*

Generic Practice	*Roles of Process Areas in Implementation of the Generic Practice*	*How the Generic Practice Recursively Applies to its Related Process Area(s)*
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.	GP 3.1 applied to the integrated work management process covers establishing defined processes for integrated work management activities.
	Organizational Process Definition: For all processes, the organizational process definition process establishes the organizational process assets needed to implement GP 3.1.	
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.	GP 3.2 applied to the integrated work management process covers collecting process related experiences derived from planning and performing integrated work management activities.
	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.	

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.

IN OTHER WORDS

CAM is about making sure you have the resources you need to deliver services and that they are available when needed—at an appropriate cost.

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

WHY DO THE PRACTICES IN CAM?

Customer satisfaction is increased because of the high availability of services. Your costs are managed and the risk of service failure is reduced.

"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.

CAPACITY, AVAILABILITY, AND SERVICE SYSTEM REPRESENTATIONS

Since capacity and availability are distinct attributes of service systems and their components, a question naturally arises: Why did the CMMI for Services model team place the management of these important properties in the same process area? The introductory notes in this process area suggest two different answers to this question: "… 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." So, capacity and availability are handled together by the model because they share some common goals and practices, and because they are managing a common collection of entities (resources) to achieve objectives that are distinct but intrinsically intertwined.

Additional reasons for integrating capacity management with availability management are that both depend on the use of explicit service system representations. These representations may be integrated in ways yielding both capacity and availability information, and capacity and availability estimates derived from these representations may be dependent on each other. Overall capacity of a service system can often be increased by extending the availability of key resources, either by adding additional resources or by extending their in-service cycle length. Conversely, overall availability of a service can often be increased by providing enlarged capacity. There are too many contexts in which it simply doesn't make sense to manage capacity and availability independently of each other.

Some CMMI for Services reviewers have also questioned why the model team chose to use the somewhat fuzzy term *service system representations* rather than the more intuitive term *service system models* in CAM. The informative material in the CAM process area discusses service system representations at length in SP 1.3 without ever addressing this question, although it is careful to explain why service system representations and process performance models are distinct.

Continues

The need for that careful explanation is a hint of the real answer: The term *model* is already overloaded in the CMMI context with two distinct and specialized meanings (one related to process performance and one related to the collection of CMMI best practices). The CMMI for Services model team concluded that it would create too much confusion to establish a third distinct specialized meaning for the word *model* when referring to artifacts that describe components, relationships, and properties of service systems. The team selected the term *representation* rather than *model* as a way of preventing this potential significant confusion (at the price of occasional questions raised about service system representations).

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.

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

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.

CAM

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.

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

SSD ADD

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 ADD

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.

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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.

IN OTHER WORDS

CAR is about getting to the sources of important results of processes and taking effective action to ensure that good results are enabled in other work and bad results are prevented in other work.

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

WHY DO THE PRACTICES IN CAR?

You won't waste time investigating and acting on every result, but you will tackle the most important ones that affect service delivery. You are more likely to get at causes and not just symptoms. These practices can be applied simply to get some benefit. If you are a high maturity organization, you use quantitative data to figure out what is affecting your performance both positively and negatively.

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,

CAR

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

Continues

CAR

Continued

- 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.

CAR

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.

CAR

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

CAR

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.

IN OTHER WORDS

CM is about controlling changes to your crucial work products.

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

WHY DO THE PRACTICES IN CM?

Without them, you will waste money, time, and effort, and perhaps hurt your reputation. With these practices, you will better manage your availability, security, and service performance, because the components on which you depend are in the state that you expect.

CM

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

Continues

Continued

- 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.)

CONFIGURATION ITEMS, CONFIGURATIONS, AND BASELINES FOR SERVICES

The practices of Configuration Management, which is a CMMI core process area, may seem a bit overwhelming to some in a service provider organization. There can be little doubt that some form of change control is necessary to maintain consistent repeatable service delivery, especially for any service requiring stakeholders to depend on particular service system components to remain the same over time. But what are configuration items, configurations, and baselines in the context of services, and why are they important to manage?

The discipline of configuration management originated in the domain of the management of complex hardware and software systems. While it is often necessary to make changes to these types of systems over time, there are many relationships and dependencies between the system components that drive a need for abundant caution. Even small but ill-considered changes, or bad combinations of otherwise individually good changes, can wreak havoc and make a complex system fail to function properly or at all. Care must be taken that some changed components are only applied or used when they are combined with other particular changed components.

In a service context, the same cautions apply even for simple service systems, and become especially significant if you are operating a complex service system. Imagine the confusion and loss of productivity at a repair shop if a diagnostic tool is upgraded to give new, more detailed analyses in a new format, but the operator instructions and process for using the tool are not updated at the same time. What if your organization delivers training that contains revisions to previous training content, but the assessment test at the end of training has not also been revised to reflect the same changes? Most service systems contain dependencies of these kinds. For life-critical services, the stakes are even higher.

Proper configuration management allows those in charge of a service system to clearly select and identify the important controllable components of the system (the configuration items); to control changes to those items through different versions over time; to identify different combinations

Continues

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and dependencies of components that are interrelated (configurations); to maintain knowledge about which changed versions of the configuration items combine to form a coherent working configuration for the system as a whole (baselines); and to control the integrity and release of those baselines so that only complete and correct baselines can actually be used.

The configuration items you need to manage might include IT system components, but they may also include tools of other kinds, as well as processes, work products, consumables, and even personnel roles. (For example, a diagnostician might not be allowed to operate a new diagnostic tool until he or she has received appropriate training. The "version" of the diagnostician might be represented by his or her skill level and training received.) Those configuration items that are not "storable" in some sense (like processes or roles) can still be managed as configuration items via specifications and other descriptive documentation that *can* be stored and managed. The point is to maintain an awareness of the dependencies among your key service system components and effectively control the changes to those components so that only proper combinations of changes come into effect together.

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

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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.

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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

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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.

IN OTHER WORDS

DAR is about using a formal decision-making process on the decisions that matter most in your business.

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

WHY DO THE PRACTICES IN DAR?

You will make better decisions. Because the rationale for important decisions is clear, support for these decisions is stronger. Over time, everyone is more inclined to trust the decision-making process because it is sensible and visible.

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.

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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.

IN OTHER WORDS

IRP is about handling what goes wrong—and preventing it from going wrong in the first place if you can.

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

WHY DO THE PRACTICES IN IRP?

Services can continue, even when something goes wrong, because you know how to work around the incident. You address underlying causes of incidents so that you can avoid or reduce costs and other adverse impacts.

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 work-arounds, 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

IRP

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.

IRP

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.

IRP

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.

IRP

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.

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

SSD ADD

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.

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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.

IN OTHER WORDS

IWM is about advanced and disciplined ways of managing your service work.

Introductory Notes

Integrated Work Management involves the following activities:

WHY DO THE PRACTICES IN IWM?

You make the most of your defined processes, people participate effectively in delivering services, and your work environment allows for high-quality services—even when you don't own the space.

- 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.

DEFINED PROCESSES AND WORK ENVIRONMENTS

Integrated Work Management takes service management up one level from Work Planning and Work Monitoring and Control to include integrated plans, defined processes, managed work environments, and better coordination among stakeholders. Both defined processes and work environments may contain components of service systems. If your service system is simple and focused primarily on people and their activities, you might not be planning to implement the Service System Development process area (which is an addition to the CMMI-SVC model and is therefore optional). In that case, establishing defined processes and work environments together with the service delivery approach created in SP 2.1 of the Service Delivery process area can help you achieve some of the benefits of the optional Service System Development process area without performing all of its practices.

Defined processes in a service context are an important "lever" for raising overall service performance and quality. A work group using a defined process is able to take advantage of organizational experience with prior service delivery activities and approaches that have been captured as a standard process for the organization. The defined process is tailored from the organization's standard process (within specific allowable limits set by tailoring guidelines) to meet the current service delivery and management needs, and it may be revised in a controlled manner over time as needed. This tailorability within limits allows different work groups to share best approaches for service delivery while enabling them to safely customize those approaches to meet their own specific requirements. Defined processes also place the organization in the position of eventually being able to compare and meaningfully combine the service performance and quality data collected by different work groups, as the organization moves toward higher levels of capability and maturity.

Related Process Areas

SSD Add

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 work group.

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.

Refer to the Service System Development process area for more information about performing peer reviews. SSD ADD

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.

Refer to the Service System Development process area for more information about performing peer reviews.

SSD ADD

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 work group 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 Add

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.

IN OTHER WORDS

MA is about knowing what to count and measure to help you to manage your service.

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

WHY DO THE PRACTICES IN MA?

You use objective, reliable data to inform your decisions. You measure the things that are most relevant to your service and to improve your business and performance goals.

CAM calls for measuring and monitoring particular contributors to service performance and quality: capacity and availability. MA is a more general set of measurement practices and can be applied to measure and analyze anything relevant to your business goals.

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

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

SSD ADD

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 managing 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

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements. SSD ADD

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 8.1.

TABLE 8.1 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

Continues

TABLE 8.1 Example Measurement Relationships *(Continued)*

Example Work, Organizational, or Business Objectives	*Information Need*	*Measurement Objective*	*Measurement Information Categories*	*Example Base Measures*	*Example Derived Measures*
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,

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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

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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.

IN OTHER WORDS

OPD is about establishing standard processes and spreading them throughout your organization.

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.

WHY DO THE PRACTICES IN OPD?

You get consistent performance from everyone in your organization because they use the same processes, or tailor them in defined ways. Because you enhance organizational learning and sharing of best practices, over the long term you get business benefits from your investment in 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

Continues

Continued

- 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.

Refer to the Service System Development process area for more information about performing peer reviews.

SSD ADD

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.

Refer to the Service System Development process area for more information about performing peer reviews.

SSD ADD

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.

Refer to the Service System Development process area for more information about performing peer reviews.

SSD ADD

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.

OPD

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.

   Refer to the Service System Development process area for more information about performing peer reviews.

SSD ADD

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.

OPD

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.

IN OTHER WORDS

OPF is about figuring out your current process strengths and weaknesses, planning what to do to improve, and putting those improvements in place.

Introductory Notes

WHY DO THE PRACTICES IN OPF?

You get a baseline of your current process, keep a focus on the process improvements that align with your business goals, and continue to improve.

OPF

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]

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- 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 2010d]

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

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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.

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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.

IN OTHER WORDS

OPM is about managing your improvements and innovations using a statistical understanding of your process performance.

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

WHY DO THE PRACTICES IN OPM?

Once you have mastered quantitative management of your processes, you can select and deploy improvements with sophisticated knowledge about how they will affect your work.

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.

OPM

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

Continues

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Continued

- 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

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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

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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.

IN OTHER WORDS

OPP is about making sure you understand your process performance and how it affects service quality.

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.)

WHY DO THE PRACTICES IN OPP?

Not only do you know what to expect from your processes, but you also have quantitative objectives for your standard processes. You are able to predict your performance and can use the data you have to quantitatively manage your services. The insight you have into your process performance allows you to adjust to changing conditions.

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 establishing and maintaining 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.

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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.

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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.

OPP

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

PROCESS PERFORMANCE BASELINES AND MODELS

Different organizations have different business models, service delivery frequencies, and acceptable ranges of tailoring for standard processes and services. In some organizations, portions of defined processes for service delivery may require little or no deviation from a standard process, service requests may be handled very frequently (e.g., many times a day per work group) in a simple scripted manner, and much data may be collected that cover service performance and quality. Many of the measures needed for modeling process performance may already be available along with significant histories of measurement results.

Service and organization managers in these situations should find it relatively simple to establish and take advantage of process performance baselines and models. The use of nearly identical processes across the organization reduces the number of potential variables to be considered, and the quantity of data available for analysis makes it easier to establish greater statistical significance of any analytical results. The challenge in this situation may be to determine which of the available measures is most relevant to the chosen quality and process performance objectives. Automated data mining tools may be able to assist with this effort.

At the other extreme, what if your organization's defined process for service delivery is highly tailored for each work group, service requests arrive infrequently (e.g., less than once a month per work group), and you have little organization-wide service performance and quality data available? In these contexts, you may have to invest more effort in the level 3 process areas of OPD and OPF to help minimize process tailoring where appropriate across work groups. Specific practices 1.3 and 1.4 of *this* process area (OPP), which refer to selecting processes or subprocesses and establishing appropriate process performance measures, may also require more care and resources to ensure that you are collecting useful measurements at more frequent intervals, milestones, or subprocess completion points.

Most organizations will find themselves somewhere between these relative extremes. You need enough of the right data from comparable processes across work groups and over time for process performance baselines and models to be sufficiently able to help determine process stability and capability. (Effective use of these baselines and models is covered in the QWM process area.) As part of the interplay between OPP and QWM practices, you should be trying to maximize the analytical value of your measures, baselines, and models, while minimizing the costs of measurement and the risks of inflexibility. Your overall target at level 4 maturity is to quantitatively ensure the stability and capability of your processes, and appropriate process performance baselines and models are essential to make this objective achievable.

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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.

IN OTHER WORDS

OT is about developing the skills and knowledge your people need to deliver superior service.

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.

WHY DO THE PRACTICES IN OT?

Your people have the skills they need because the right training is available and it is constantly coordinated and improved. You don't miss out on business opportunities, because when a service engagement pops up, your training records show you who already has the skills to deliver the desired service, or who can be quickly trained for it.

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

PPQA

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.

IN OTHER WORDS

PPQA is about checking to see that you are actually doing things the way you say you will in your policies, standards, and procedures.

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

WHY DO THE PRACTICES IN PPQA?

You have more confidence that your work is good. You will have objective insight into how you are delivering service and how well you will comply with any standards and regulations that affect you. Having this insight allows you to resolve any issues you find—perhaps before customers or regulators find them.

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

Refer to the Service System Development process area for more information about verifying selected service system components.

SSD ADD

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.

IN OTHER WORDS

QWM is about managing service to quantitative process and performance objectives.

Introductory Notes

The Quantitative Work Management process area involves the following activities:

WHY DO THE PRACTICES IN QWM?

You have confidence in your estimates and your ability to predict service performance. You make the most of all the measurement you do to understand variations in your performance and take the right actions when needed.

QWM

- 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 of 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.

QWM

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

QWM

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.

QWM

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.

IN OTHER WORDS

REQM is about keeping a clear understanding with your customers and other stakeholders about the service you provide, and adjusting when you find inconsistencies or mismatched expectations.

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

WHY DO THE PRACTICES IN REQM?

You and your customers, users, and suppliers will have the same understanding and expectation about your service. You can avoid customer and user disappointment and increase satisfaction by managing expectations. When needs change, you'll know how to adjust your service, training, communication, or service system without doing more rework than necessary.

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.

BIDIRECTIONAL TRACEABILITY

Many service provider organizations don't address bidirectional traceability adequately, and the impact can be significant. When well implemented, bidirectional traceability can save you from failing to address critical customer needs on the one hand and wasting resources on the other hand. How does it create this double benefit?

The essence of bidirectional traceability is that it ties everything back to your fundamental service requirements, which identify your customer's needs. Your customer's initial expression of their needs (or *your* initial expression of their needs when you are defining a standard service) may have varying degrees of specificity and completeness. Once you have an initial set of these needs refined into service requirements (which may already have been expressed that way in a service agreement), these initial requirements can serve as the basis for scoping much of the work you do.

Every derived service requirement, service system requirement, feature, process, skill, tool, test procedure—in short, everything you need to create or use to meet the initial requirements—should be linked directly or indirectly back to these initial requirements. You can even link individual service requests back to initial service requirements (again, directly or indirectly).

The establishment and management of these links allows you to ensure that every initial requirement can be supported by your service system, that the service system itself is complete, and that there are no "holes" in its design, implementation, verification, or validation. (This approach also requires you to develop your service system in a disciplined way. See the Service System Development process area for guidance on that subject.) The links also allow you to ensure that you are not wastefully creating capabilities or providing services that your customers do not actually require.

By the way, if you find that some customers are repeatedly requesting services that are *not* linkable to your initial service requirements, you may have discovered a requirements defect. If you treat these instances as incidents, the analytical and planning practices of the Incident Resolution and Prevention process area may lead you to an effective solution. For example, you might work with your customer to improve their understanding and awareness of what the service agreement covers, or even to revise the service agreement to begin to cover what were previously unspecified requirements.

Related Process Areas

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements. SSD ADD

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.

Refer to the Service System Development process area for more information about analyzing and validating requirements.

SSD ADD

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.

REQM

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 a 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.

REQM

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.

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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.

IN OTHER WORDS

RSKM is about supporting the success of your service mission by anticipating problems and how you will handle them—before they occur.

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.

WHY DO THE PRACTICES IN RSKM?

You can avoid costs, customer dissatisfaction, harm to your reputation, service failures, and even loss of health and life by thinking about what can go wrong and what you can do to prevent or respond to problems.

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).

RSKM

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
- Overreliance on key staff
- Strikes
- Diminishing sources of supply
- Technology cycle time
- Competition

RSKM

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.

RSKM

Risk prioritization helps to determine the most effective areas to which resources for risk 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.

RSKM

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.

IN OTHER WORDS

SAM is about getting what you need and what you expect from suppliers who affect your service.

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

WHY DO THE PRACTICES IN SAM?

You will make smarter choices about which suppliers you work with, and be constantly aware of their activities and ability to meet your needs. You will be clear about what is and isn't acceptable from your suppliers, and know which suppliers can contribute to successful services. If something goes wrong with a supplier, you can catch it before it gets worse.

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

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

SSD Add

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.

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

SSD ADD

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.

SAM

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.

   Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements. SSD ADD

   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

SAM

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

Refer to the Service System Development process area for more information about verifying and validating service systems.

SSD Add

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.

Refer to the Service System Development process area for more information about integrating service system components.

SSD Add

Example Work Products

1. Descriptions of how ongoing support obligations, such as warranties and licenses, will be satisfied

2. Transition plans

SAM

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.

IN OTHER WORDS

SCON is about being ready to recover from a disaster and get back to delivering your service.

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.

WHY DO THE PRACTICES IN SCON?

The consequences of Hurricane Katrina and 9/11 are proof for service businesses that those who prepare for disaster are better able to recover and stay in business.

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.

SERVICE CONTINUITY

If you've read and understood the Risk Management process area, you may wonder why service continuity requires its own process area. Isn't service continuity just a special kind of risk management? And if so, isn't it already covered by the Risk Management process area? If service continuity is *not* a kind of risk management, what is it all about? Disaster recovery?

In fact, service continuity as described in this process area *is* a type of risk management, one that focuses on risks that are so catastrophic or overwhelming that they can potentially bring an organization to a complete halt for extended periods of time, and at a minimum will severely cripple the full spectrum of its operations. Service continuity goals and practices help to ensure that the most critical services can continue to be delivered in some form in spite of such major disruptions.

Service continuity needs its own process area because the Risk Management process area is completely agnostic with respect to the selection of risks that work groups and organizations choose to address and mitigate. Because the probabilities of many types of major disasters are so low, and because most of them have causes that are outside any form of control by a service provider (and in some cases, are even outside the realm of predictability), it is quite possible for work groups and organizations to perform reasonable risk management without addressing potential major disasters at all.

The CMMI for Services model team believed that such a blind spot would be unacceptable for any sufficiently mature (level 3) service provider organization. The specific goals and practices of the Service Continuity process area are necessary to be certain that the risks of major disasters are not overlooked, and that appropriate types of mitigations are established, trained for, verified, and validated. In fact, the depth of service continuity preparation necessarily goes far beyond the types of mitigations required for routine risk management. Separate goals and practices are needed to ensure that mature service providers have made these necessary preparations.

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.

SCON

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 backup 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.

   Refer to the Service System Development process area for more information about performing peer reviews. SSD ADD

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.

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

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.

Refer to the Service System Development process area for more information about performing peer reviews.

SSD Add

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.

IN OTHER WORDS

SD is about setting up agreements, taking care of service requests, and operating the service system.

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

WHY DO THE PRACTICES IN SD?

You and your customers have the same expectations, your services are consistent and cost-effective, and customers know how to make requests.

The service delivery approach can be a more operational view of the material in SP 1.1 in Work Planning: Establish the Service Strategy.

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

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.

SSD ADDITION

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.

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

SSD ADD

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.

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

SSD ADD

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.

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

SSD ADD

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.

SD

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.

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.

SSD Add

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.

SD

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

SSD Add

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.

SERVICE DELIVERY APPROACHES, SERVICE STRATEGIES, AND STANDARD SERVICE PLANS

In the Work Planning process area, the model states that a service strategy "provides the business framework for planning and managing the work." What does this mean, and how does it differ from a service delivery approach (described here in the Service Delivery process area) and a plan for standard services (outlined in the Strategic Service Management process area)? Isn't there a lot of overlap?

The terminology *can* be confusing, but it is possible to sort out the differences. One way to understand these differences is to work from the bottom up. Both a service strategy and a service delivery approach are developed at level 2 maturity, and they should be closely related. The service strategy is primarily about what a service delivers, how it is expected to fit

Continues

into a larger current business context (including specific organizational and customer needs, constraints, stakeholders, and agreements), and what types of resources it is expected to require. If the organization has standard services, the service strategy may outline how one will be tailored for a specific customer or work group. The strategy may also establish general expectations for risks to a service, as well as an overview of the expected service delivery approach. However, these documented expectations will require further elaboration in other specific practices (especially Work Planning SP 2.2 for risks and Service Delivery SP 2.1 for the service delivery approach) to become detailed enough to directly support operational management of the service.

In contrast, the service delivery approach in this process area is a more detailed account of *how* a service is to be delivered and managed, including how service requests are received and handled, processes are performed, schedules are developed and updated, roles and responsibilities are assigned, tools are employed, and key data are collected. An effective service delivery approach is dependent on both the service strategy and the specifics of one or more service agreements with customers, or it may be misaligned with business or customer needs. Creating a service delivery approach at maturity level 2 implicitly requires you to identify key elements of your overall service system, and is a beginning step toward implementing practices in the Service System Development process area at maturity level 3.

Depending on the business model, a service strategy may normally be developed long before a service delivery approach or concurrently with it. In the latter case, it may be perfectly reasonable to treat them both as a single integrated work product, with the service strategy positioned as a kind of executive summary or contextual overview of the detailed service delivery approach. Even if they are handled separately, however, there is no ironclad dividing line about what might be included in either one: a service strategy is likely to be less detailed than a service delivery approach while looking at a broader picture, but your organization has the freedom to develop and structure these work products in ways that make the most sense for its business needs.

What about standard service plans? Since both the service strategy and service delivery approach are developed at maturity level 2, their focus is limited to the consideration of individual service agreements and work groups. Starting at maturity level 3, the focus of service improvement begins to shift to the organization as a whole, and the CMMI-SVC model establishes a requirement for standard services and plans for their evolution over time.

At this level, a standard service plan is a strategic plan that spans the business needs of the entire organization and the full range of its current or desired future customers. This type of plan is *organizationally* strategic, with a long-term perspective that goes beyond any one work group or service agreement. A standard service plan outlines what new standard services or changes to existing standard services are needed over time (including retirement), how they should be prioritized, and what fundamental business objectives they should satisfy.

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
>
> *Continues*

Continued

- 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.

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

   SSD ADD

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

SD

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

SD

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.

SD

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).

Refer to the Service System Development process area for more information about developing and analyzing stakeholder requirements.

SSD Add

SD

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.

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.

SSD ADD

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.

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

SSD ADDITION

IN OTHER WORDS

SSD is about making sure you have everything you need to deliver services, including people, processes, consumables, and equipment.

Remember that "system" does not mean an IT system; we intend the more general definition of system: a regularly interacting or interdependent group of items forming a unified whole.

It is common for service organizations to already have a service system in place for services in their portfolio. If you do, the practices in SSD are used to confirm and make adjustments as needed.

WHY DO THE PRACTICES IN SSD?

You anticipate service requirements and avoid costly changes. The service system does what is required for both the service provider and the customer.

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.

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

WHY IS SSD AN ADDITION?

We intended this option to be user-friendly for the large range of service types covered by CMMI-SVC. Very large, complex services may use the Engineering process areas of CMMI-DEV instead. Very small, simple services need not use SSD at all.

If SSD is too much, you can find service system help with small, simple services in the following two places in the model:

- The example box in SD SP 2.1 for what to include in the service delivery approach
- SP 1.3 in IWM, Establish the Work Environment

SSD ADDITION

SSD

SSD ADDITION

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 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

AGILITY IN SERVICE SYSTEM DEVELOPMENT

Those who develop or modify service systems and who are *not* familiar with the concepts of Agile methods may need some additional explanation to understand why the latest version of CMMI-SVC contains newly added material about these approaches. What makes Agile methods significant, how can they apply to services, and what issues come into play when applying Agile methods to service system development?

Agile methods were initially conceived and promoted primarily by software developers who concluded that too many software development efforts failed because of a lack of agility, or responsiveness to changing needs, by the development teams. The intentions driving Agile methods were defined by the Agile Manifesto as cited in the model; the effect of these methods is to increase the ability of work groups to handle an evolving understanding of product requirements and work processes. Despite their initial focus on software development, Agile methods have been successfully applied in other types of development and management, and organizations delivering services can certainly benefit from their use. (Viewed from some perspectives, services by their nature tend to *be* Agile to some extent; see the essay “Are Services Agile?” by Hillel Glazer in Chapter 6 for an extended discussion.) However, when applied in the context of service system development, some Agile methods will be more broadly useful than others.

There are *many* different methods that could be categorized as consistent with an Agile approach, and many different books that discuss them. While the variability among them is great, they also have many similarities that emphasize common themes consistent with the Agile Manifesto:

- Maximizing direct relevant communication and collocation among team members
- Collaboration and frequent interaction with end users
- Rapid incremental development cycles (on the order of a few weeks to months)
- Frequent team review and reflection on what is working well and what is not
- Reliance on *just* enough process and documentation to accomplish what needs to be done

Most of these methods could be helpful for services in general and for service system development in particular, with the possible exception of rapid incremental development cycles. The difficulties may range from a fundamental inability to deliver only "part" of a service to a problem motivating end users to provide you with unbiased continuing feedback on a service system as it rapidly evolves and changes. Unless your end users are themselves familiar with Agile methods, they may very well prefer to stick with a stable if somewhat inferior service system over one that is incomplete or changes frequently based on feedback, even if the latter might yield a better service system for them eventually.

If you have a large enough population of end users, you may be able to work around this problem by piloting successive incremental releases of your new or changed service system to different groups of end users over time; this approach limits the exposure of any one end user to at most only a single "change experience" prior to the eventual final release. You might also be lucky enough to have a small loyal corps of representative experienced end users who are happy to collaborate with you and will provide the ongoing feedback you need. Even in these situations, however, only limited subsets of your end-user population will see a version of a new or changed service system before its full-scale transition into operation.

Of course, those components of a service system that are not directly visible to end users through interactions and interfaces with the service system may well be good candidates for rapid incremental development cycles. For example, a major change to a service system to reduce the cost of operation or increase overall capacity without affecting the nature or quality of delivered services might more easily use rapid incremental development. In that case, the "end users" for Agile purposes become the stakeholders in your organization who *will* be directly affected by the expected changes.

SSD

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.

SSD ADDITION

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.

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.

SSD Addition

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 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.

SSD ADDITION

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

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.

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.

SSD Addition

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 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.

SSD ADDITION

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.

SSD Addition

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

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.

SSD Addition

SSD

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.

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

SSD ADDITION

- 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.

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.

Refer to the Supplier Agreement Management process area for more information about managing the acquisition of products and services from suppliers.

SSD ADDITION

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 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.

SSD Addition

SSD

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.

SSD ADDITION

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.

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.

SSD ADDITION

SSD

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 nonautomated 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).
- 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.

SSD Addition

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.

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.

SSD Addition

SSD

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
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
5. Assembled service system components
6. Interface evaluation reports

SSD Addition

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).

SSD ADDITION

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.

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.

SSD ADDITION

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."

Validation activities use approaches similar to verification (e.g., test, analysis, inspection, demonstration, simulation). These activities

SSD

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.

SSD Addition

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.

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

SSD Addition

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.

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.

SSD ADDITION

6. Prepare for the peer review.

> 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

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

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.

SSD ADDITION

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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.

> 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

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.

SSD ADDITION

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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 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.

VERIFICATION AND VALIDATION

How do you make sure that your service system works properly and delivers services that your customers actually need? If you still think that "working properly" and "delivering actually needed services" mean the same thing, keep reading. The distinction is familiar to some people but is foreign to most.

When you verify your service system, you are checking that it satisfies all your service requirements. These requirements include all the derived requirements for services, subservices, service system components, and interfaces, as well as the initial requirements derived from service agreements or standard service definitions. Verification can be performed by testing, but many other methods are available and may be appropriate for different situations, including inspections, peer reviews, prototyping, piloting, and modeling and simulation. The important thing to remember about verification is that it can *only* tell you if the service system satisfies all the expressed requirements. *Your service system can meet all of its expressed requirements and* still *fail to satisfy end users*.

A common way this can occur is through a requirements defect, in which one or more of the initial service requirements are ambiguous, incorrectly specified, outright wrong, or completely missing. If initial service requirements are specified well, derived requirements may have been developed inadequately. You may also have customers or end users with conflicting requirements that are not fully reflected in the initial requirements statements, or that are fully expressed but without sufficient guidance for prioritizing requirements or otherwise resolving the conflicts.

Too often, these types of issues come to light only when a service system is actually delivering services to end users. Fixing a requirements defect after a service system has been built can be expensive at best and can create a good deal of customer ill will at worst.

Validation practices help to keep these problems from occurring by making sure that customers and end users are involved throughout service system development. (The distinction between customers and end users is important here because they often have a different perspective on service requirements.) The model states, "Validation demonstrates that the service system, as developed, will deliver services as intended." What it fails to state explicitly, and what needs some reinforcement, is that the focus is on delivering services as intended *by the customer and the end user*. If the service system does only what the service provider organization intends, that may not be good enough.

Both verification and validation are important for service system development, but of the two, validation is probably the greater challenge for the work group. Validation makes the work group dependent on both input from and cooperation with customers and end users, and this dependency adds risks and management complications. (If you are employing Agile methods for service system development as described earlier in this

Continues

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process area, then you should automatically achieve some reduction in validation risks, because your end users are more likely to be integrated with development activities, including validation.)

Also, because services are intangible by definition and cannot be stored, validating the actual delivery of services requires a service system to be operational in a way that can legitimately deliver real value to real end users. For some work groups, performing this level of validation before a service system is fully deployed can be difficult. Piloting a new or modified service system with a sample group of informed and willing end users is one method of validating it, and piloting can even work in situations with high-impact risks (e.g., controlled clinical testing of a new medical procedure).

But piloting often requires extra resources to be set aside from ongoing service delivery that may simply be unavailable for some organizations. In these cases, a work group may be able to complete final validation of service delivery only *after* a new or changed service system is partially or fully deployed. Customer and end-user feedback can always be solicited at that point to help with validation.

Regardless of how you handle it, validation is *not* something you want to skip over simply because it can create difficulties for your work group. If you do, you risk encountering much greater challenges in the long run.

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.

IN OTHER WORDS

SST is about getting new systems in place, changing existing systems, or retiring obsolete systems—all while making sure nothing goes terribly wrong with the service.

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.

WHY DO THE PRACTICES IN SST?

Your service delivery doesn't degrade when you make a major change. You minimize customer and user dissatisfaction and make a smooth transition to operations.

"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.

SIGNIFICANT SERVICE SYSTEM TRANSITIONS

When is a change to a service system significant, when should service system transition practices be applied, and what if a service system changes only rarely? The model addresses these types of questions only briefly by stating that a significant change is one that "introduces unacceptable risk that the service system will not meet its objectives." This explanation leaves considerable room for judgment on the reader's part, and some further discussion is warranted.

Many types of changes can be made to a service system over time, ranging from minor periodic adjustments (such as restocking a consumable component) to rolling out completely new services, processes, and support infrastructure. One way to distinguish the relative magnitude of possible changes is to consider them from the perspective of service system development. To implement a change, did you use practices in specific goal 1 or 2 of the Service System Development process area? In other words, have the service system requirements, design, or interfaces changed? If so, then service system transition practices are probably recommended as well, because of the potential risks and unwanted impacts on stakeholders from having the changes thrust on them without preparation or warning; ongoing service delivery may also be compromised without adequate transition management.

If you aren't intending to implement practices in the Service System Development process area, you can still evaluate whether the changes to be made affect your overall service delivery approach. Will end users see any difference in how service requests or incidents are handled that might surprise or confuse them if they aren't expecting the changes? Will staff need orientation or training to properly perform revised procedures or to use new or changed tools? In general, the greater the potential impact on stakeholders, the greater the need for service system transition practices when the changes are deployed.

Remember that a service system encompasses everything required for service delivery, and this potentially includes your external dependencies and suppliers as well, especially those whom you are using to supply services directly to end users or with whom you have closely integrated processes. If you change suppliers of a generic consumable to get a more favorable price and the consumable is otherwise the same, you may not need to apply service system transition practices. However, if your supplier needs to change its process because your service system has changed, or if your supplier changes what it supplies in a way that will affect your service system, then service system transition practices will help prevent unexpected supplier failures and incidents.

If you think your service system rarely or never changes and you don't have a reason to pay attention to service system transitions, you may be thinking of the scope of your service system too narrowly. If you are using the CMMI-SVC model at all, then you are probably open to the idea of changing your service system to fix problems and make improvements. In either case, some of those changes will be bigger than others, and should benefit from service system transition practices. And remember, too, that even if you have the *perfect* service system for your service delivery needs right now, your end users and the rest of the world will change around you so that soon, your service system will need to change anyway.

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.

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.

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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 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.

SST

Refer to the Service System Development process area for more information about developing service systems, including ensuring interface compatibility.

SSD ADD

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.

SST

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.

SST

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.

   Refer to the Service System Development process area for more information about verifying and validating service systems.

   SSD ADD

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.

SST

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?

SST

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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.

IN OTHER WORDS

STSM is about portfolio management or deciding what services you should be providing, making them standard, and letting people know about them.

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

WHY DO THE PRACTICES IN STSM?

Because you have standard services, developing new services is faster and cheaper. You can increase business capture and market share. You and your customers agree about what you offer them.

Standard services are templates for services you offer more than once. They may include lifecycle options and suppliers you may use. SP 1.1 in the Work Planning process area makes the standard service more particular for the agreement.

SP 2.1 in the Service Delivery process area is used to make more tactical decisions (e.g., how to schedule the additional supplier staff).

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.

STANDARD PROCESSES, STANDARD SERVICES, AND SERVICE LEVELS

It's easy to forget that services and processes are distinct things, and when that happens, it becomes easy to lump standard services together with standard processes. They are not equivalent. Remember that a service is a type of product, and it is the *result* of performing a process. Services are results and processes are sets of activities. The service of being transported from one city to another at the time you have chosen is not the same as the complicated process required to deliver that service.

This distinction carries over into the terms *standard process* and *standard service.* Standard processes describe the common elements of processes used throughout an organization, and they are the central focus of several other process areas in the model (OPF, OPD, and OPP). Standard services are common sets of services that are requested by customers and delivered to end users.

Once it has been tailored and implemented, a single standard process might be associated with multiple standard services (e.g., a standard training process that delivers distinct courses of instruction), or it might support a single standard service having one or more service levels.

Distinct service levels represent varying defined degrees of magnitude, degree, or quality for the same overall service, as well as possible additional subservices to be included in the overall service. The gold, silver, and bronze service levels for a typical travel rewards program are a familiar example of this type of distinction. The choice of what service levels to make available and how to define them should be determined by an analysis of the priority needs of major customers or customer groups versus the business needs and strategic direction of the service provider organization.

From another perspective, standard services and service levels may be delivered with or without the existence of standard processes (although the latter approach is likely to be riskier and more difficult). Therefore, no matter how you look at them, standard processes and standard services are truly separate and distinct. The Strategic Service Management process area focuses on defining your standard services and service levels in ways that make the most business sense.

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 ADD

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.

STSM

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.

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

SSD Add

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.

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

SSD ADD

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.

IN OTHER WORDS

WMC is about making sure what's supposed to be happening in your service delivery is happening, and fixing what isn't going as planned.

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.

WHY DO THE PRACTICES IN WMC?

You can monitor your service levels, take action on incidents and breaches, and gradually get more proactive about solving problems early when they are less expensive to fix. Your management and customers will be more confident in your ability to deliver.

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

WMC

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.

WMC

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.

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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.

IN OTHER WORDS

WP is about estimating costs, effort, and schedules, figuring out how you'll attack the service engagement, and involving the right people—all while watching your risks and making sure you've got the resources you think you need.

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

WHY DO THE PRACTICES IN WP?

Along with the service agreement, a work plan can help everyone involved in delivering services to be clear about who does what, when, and with what resources. Over time, estimating and executing get easier because these plans can give you information about what it takes to deliver your service.

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.

WORK PLANNING FOR SERVICE DELIVERY

If you normally think of *planning* as an activity that determines how you're going to deal with each service request as it is received, you may wonder how any of these work planning goals and practices will be useful to you. How does work planning help with effective service delivery? Here is one interpretation that may help you to gain advantage from the practices in this process area; keep in mind that other valid interpretations may be possible.

At the lowest level of planning, a service delivery project needs to allocate and schedule resources *operationally* in response to a varying stream of service requests and incidents. The focus at this level is on how to plan and manage the next task, which may have just materialized.

Some work groups may have settled on an initial set of continuing service requests up front in a service agreement, but even in these cases, new requests may arise, and incidents still need to be dealt with in any event. This type of operational planning is constructed as needed through the use of the established request management and incident management systems (which may be a single integrated system) and their related processes. These operational plans rely on a well-specified set of available resources to respond to requests and incidents; the extent and availability of those resources over time are specified by an overall work plan.

The focus of work planning in a service context is therefore a level above task-focused operational planning at the level of an entire work group (e.g., for one or more closely related service agreements). Work planning for service delivery establishes and estimates overall work scope, resources, and costs; allocates and schedules specific resources to various service delivery functions (e.g., shift schedules); outlines how other management issues will be handled (e.g., data management and risk management); coordinates these plans with other plans; and gets appropriate commitment from those who will actually be performing or supporting the work. These practices come from the domain of project management and project planning, and are applicable to nonproject work as well; in fact, the Work Planning process area of CMMI-SVC contains essentially the same goals and practices contained in the Project Planning process areas of CMMI-DEV and CMMI-ACQ.

When the scope of work falls within a single service agreement with a single customer, most service requests are known at the start of the work, or the operational tempo of the work is low (i.e., there are few incidents or new service requests over time), work planning and operational planning might be handled more effectively as a single integrated activity. In any event, effective operational planning for service delivery depends on effective work planning to establish a stable service management framework.

Another use for work planning in a services context is when an organization needs to perform a major activity not specifically related to ongoing service requests or incidents. For example, creating and rolling out a major new or modified service system for service delivery may be managed as a separate work group or project of its own, or as part of an existing service delivery effort. (Remember that a single work group can have parts that are work groups themselves.) Other examples of these kinds of project-style work efforts include creating, deploying, and using a new customer survey system to gather data needed to define standard services; and establishing a new customer awareness program through a major marketing campaign.

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.

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

SSD ADD

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
>
> *Continues*

Continued

- 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

Continues

Continued

- 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.

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

SSD ADD

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

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APPENDIX A

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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

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)

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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 here 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, U.S. 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
- Lawrence Osiecki, U.S. Army ARDEC
- Robert Rassa, Raytheon Space and Airborne Systems (lead)
- Karen Richter, Institute for Defense Analyses
- Joan Weszka, Lockheed Martin Corporation
- Harold Wilson, Northrop Grumman
- Brenda Zettervall, U.S. 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, U.S. 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)
- Mary Lynn Russo, Software Engineering Institute (nonvoting member)
- Sandy Shrum, Software Engineering Institute
- Kathy Smith, Hewlett-Packard
- Barbara Tyson, Software Engineering Institute
- Rawdon Young, Software Engineering Institute

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 Corporation
- Sally Godfrey, NASA
- Stephen Gristock, JP Morgan Chase and Co.
- Eric Hayes, Software Engineering Institute (nonvoting member)
- Nils Jacobsen, Motorola
- Steve Kapurch, NASA
- Mike Konrad, Software Engineering Institute
- Chris Moore, U.S. 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, Software Engineering Institute (nonvoting member)
- Warren Schwoemeyer, Lockheed Martin Corporation
- John Scibilia, U.S. Army
- Dave Swidorsky, Bank of America
- Barbara Tyson, Software Engineering Institute
- Mary Van Tyne, Software Engineering Institute (nonvoting 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 Corporation
- Michael Campo, Raytheon
- Sandra Cepeda, Cepeda Systems & Software Analysis/RDECOM SED
- Mary Beth Chrissis, Software Engineering Institute
- Mike D'Ambrosa, 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 (nonvoting member)
- John Scibilia, U.S. Army
- Sandy Shrum, Software Engineering Institute (co-lead)
- Kathy Smith, Hewlett-Packard
- Katie Smith-McGarty, U.S. 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 (nonvoting member)
- Winfried Russwurm, Siemens AG
- Tomas San Feliu, Universidad Politecnica de Madrid

CMMI V1.3 High Maturity Team

The High Maturity Team develops high maturity model material.

- Dan Bennett, U.S. Air Force
- Will Hayes, Software Engineering Institute
- Rick Hefner, Northrop Grumman Corporation
- 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, U.S. 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 Corporation
- 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 Corporation
- Denise Kirkham, The Boeing Company
- Lisa Ming, BAE Systems
- Charlie Ryan, Software Engineering Institute
- Kevin Schaaff, Software Engineering Institute
- Alexander Stall, Software Engineering Institute
- Agapi Svolou, Software Engineering Institute
- Ron Ulrich, Northrop Grumman Corporation

CMMI Version 1.3 Training Teams

The two training teams (one for CMMI-DEV and CMMI-ACQ and the other for CMMI-SVC) develops 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 (nonvoting member)
- Sandy Shrum, Software Engineering Institute
- Katie Smith-McGarty, U.S. 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)
- Hillel Glazer, Entinex
- Christian Hertneck, Anywhere.24 GmbH

- Pat Kirwan, Software Engineering Institute
- Suzanne Miller, 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 (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 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 and 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.")

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Book Contributors

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BOOK AUTHORS

Eileen C. Forrester
Manager, CMMI for Services
Software Engineering Institute

Eileen C. Forrester is the manager of the CMMI for Services program at the SEI, a senior member of the technical staff, and the lead author of *CMMI for Services, Guidelines for Superior Service*. She was the co-chair of the International Process Research Consortium and the editor of the *IPRC Process Research Framework*. She is the developer of TransPlant, a transition-planning process, and her current research area is in process-oriented approaches to service delivery, technology change, risk management, and emergent system types. These approaches include GAIT, CMMI for Services, OCTAVE, MDA, and multimodel improvement approaches. She has more than 35 years of experience in technology transition, strategic planning, process improvement, communication planning, and managing product, service, and nonprofit organizations.

Brandon L. Buteau
Technical Fellow
Process Architect
Northrop Grumman Corporation

Brandon L. Buteau is a Technical Fellow, technologist, and process architect at Northrop Grumman Corporation. He has been a member of the CMMI for Services model development team from its beginning, and is both the chief architect for the model and the team's ontologist. His professional career of more than 35 years has spanned the analysis and development of advanced systems, technology, and processes. He currently helps to define and develop quality and process architectures as well as supporting tools. He leads, performs, coordinates, and consults on research, strategic analyses, technology assessments, knowledge/information modeling, and business development across a spectrum of technologies needed by customers. He received an AB in applied mathematics (computer science) from Harvard University in 1976.

Sandy Shrum
Senior Writer/Editor
Communications
Software Engineering Institute

Sandy Shrum is a senior writer/editor and communications point of contact for the Software Engineering Process Management program at the Software Engineering Institute (SEI). Besides this book, she has coauthored two other CMMI books: *CMMI-ACQ: Guidelines for Improving the Acquisition of Products and Services* and *CMMI: Guidelines for Process Integration and Product Improvement,* 1st and 2nd editions. She has been with the SEI since 1995 and has been a member of the CMMI Development Team since the CMMI project's inception in 1998. Her roles on the project have included model author, small review team member, reviewer, editor, model development process coordinator, and quality assurance process owner. Before joining the SEI, she worked for eight years as a document developer with Legent Corporation, a Virginia-based software company. Her experience as a technical communicator dates back to 1988, when she earned her MA in professional writing from Carnegie Mellon University. She earned her undergraduate degree, a BS in business administration, at Gannon University, Erie, Pennsylvania.

CONTRIBUTING AUTHORS

Drew Allison

Drew Allison is a Lead Appraiser and Instructor for the Systems and Software Consortium, Inc. (SSCI) and an SEI Affiliate. She is also an ITIL Expert (V3) and a member of the CMMI-SVC author team. She has more than 25 years of software and systems engineering, systems acquisitions, service management, and process improvement experience in the public and private sectors. She has appraised a wide variety of service and development organizations including government contractors and commercial organizations in the United States, Europe, and Asia.

Urs Andelfinger

Urs Andelfinger is an SEI visiting scientist and CMMI instructor, as well as a university faculty member at Darmstadt University of Applied Sciences, Germany. He is currently working on effective technology adoption processes with a focus on the financial services and educational industries. His research interests include adopting CMMI-SVC in educational settings and in business process management.

Kevin Behr

Kevin Behr is the founder of the Information Technology Process Institute (ITPI) and the CTO of the CIO Practice at Assemblage Pointe, which helps senior business executives transform IT organizations from chaos to business effectiveness. He has held the post of CTO and CIO at companies ranging from public corporations to technology startups. He is the author of six IT management books, including the popular *Visible Ops Guide,* which he coauthored with Gene Kim and George Spafford, and *The Definitive Guide to IT Management* published by Hewlett-Packard.

Gary Coleman

Gary Coleman pursued his BS in computer engineering at Case Western-Reserve University, and his MS in systems engineering at The University of Virginia. His early career was in manufacturing automation systems, where he worked on quality systems and was involved in the internal ISO 9001 and CMM programs. Currently he is working at CACI, Inc., in Chantilly, Virginia, where he has led various aspects of the company's process improvement program, which covers numerous quality standards and process frameworks. He consults on the performance improvement efforts of project teams throughout the company, and has participated on many appraisal teams. He was awarded the SEI Member Outstanding Advocate Award at the 2010 National SEPG Conference, and has been a member since 1994.

Betsey S. Cox-Buteau

Betsey S. Cox-Buteau, Ph.D., is a career educator whose interest is in educational system process continuity and the integration of assessment into decision making. She is the associate superintendent of schools in School Administrative Unit #41, Hollis/Brookline, New Hampshire. She is also a consultant who works with struggling schools to improve test scores through collecting data, improving processes, and providing high-quality professional development. She earned an AB from Dartmouth College, and completed her Ph.D. in education from the University of New Hampshire.

Alison Darken

Alison Darken is a senior process improvement staff member for Science Applications International Corporation (SAIC). She is involved in all aspects of process improvement, including process asset management for her SAIC organization, development and maintenance of organizational processes and training, process training and implementation on projects, and appraisal conduct and preparation. She supports the SAIC Corporate EngineeringEdge asset set. Recently, she led teams to develop ISO 20000 and CMMI for Services compliant process asset sets for SAIC Corporate.

Kieran Doyle

Kieran Doyle is a SCAMPI Lead Appraiser based in the United Kingdom and has extensive experience in systems and software engineering, service management, project management, and quality management, covering commercial and defense sectors and encompassing all lifecycle elements from requirements capture through to delivery and operations.

Peter Flower

Peter Flower is a specialist in effecting process change to deliver measurable expense reduction, increased productivity (reduced error rates and cycle times), improved schedule predictability, and service delivery. He has been providing consultancy services to blue-chip clients in all commercial sectors for more than 13 years and has a proven history of leading clients to levels 2 and 3 of the Capability Maturity Model (CMM) and CMM Integration (CMMI).

He is extremely customer oriented, and as the founder and managing director of Trinity Management Consultants, he understands the commercial drivers of his clients' businesses. With 30 years of experience in information technology he is able to combine a diverse range of skills in project and program management, quality management, process change management, and more to provide his clients with customer focused business solutions.

During his career, he has performed in varying roles, from systems engineer to IT manager, across a variety of industry sectors. He has been involved in software quality initiatives since 1989, first with BS5750, then IS0 9001, and since 1997 has specialized in business improvement using Software CMM and subsequently CMMI.

He is a certified IT professional and has been trained by the SEI in its Capability Maturity Models, CMM and CMMI, and is a PRINCE2 accredited project manager.

Hillel Glazer

Hillel Glazer has been working in process improvement since his first job out of college. He is a CMMI High Maturity Lead Appraiser and CMMI instructor working with Agile teams as well as an SEI Visiting Scientist. He is the lead author on the SEI's first-ever official publication addressing Agile development. His diverse experience base, which includes aerospace/defense and systems engineering, large and small consulting practices, federal agencies, dot-com operations, and financial systems support, is probably what gave him the necessary perspective to pioneer how to bring CMMI and Agile together as far back as his 2001 CrossTalk article highlighting the compatibilities of (then) CMM and XP.

Mary Jenifer

Mary Jenifer participated as a mini-team lead for the Support Office appraisal and has participated on CMMI-DEV and CMMI-SVC projects at AEM. Mary works with Maggie Pubustan and AEM groups to provide quality assurance and implement process improvements.

Gene Kim

Gene Kim is the CTO and co-founder of Tripwire, Inc. In 2004, he co-wrote *Visible Ops Handbook,* codifying how to successfully transform IT organizations from "good to great." In 2008, he coauthored *Security Visible Ops Handbook,* a handbook describing how to link IT security and operational objectives in four practical steps by integrating security controls into IT operational, software development, and project management processes. He is a certified IS auditor, and is part of the Institute of Internal Auditors GAIT task force that developed and published the GAIT Principles and Methodology in January 2007, designed to help management appropriately scope the IT portions of SOX-404. In 2007, *Computerworld* added him to the "40 Innovative IT People to Watch, Under the Age of 40" list, and he was given the Outstanding Alumnus Award by the Department of Computer Sciences at Purdue University for achievement and leadership in the profession.

Gary H. Lunsford

As a senior principal analyst and consultant at ARINC Engineering Services, LLC, an SEI Partner, Dr. Gary H. Lunsford helps management and technical personnel in both government and industry work together more effectively while improving their processes. As a founding officer of the Charleston-wide Joint Industrial Advisory Board, an organization co-sponsored by The Citadel and the College of Charleston, he enjoys helping academia, government, and industry work together in planning curricula and providing employment opportunities for students in science and engineering.

He is a seasoned professional with more than 30 years of direct experience in program management and development, providing engineering services to clients, designing and evaluating processes, and executing technical applications to support business goals.

He is a certified instructor and lead appraiser for the CMMI Development, Acquisition, and Services models and is pursuing instructor certification in the Practitioner classes.

He majored in physics, earning a BS from Duke University, an MS from the University of Illinois, and the Ph.D. from Georgia Tech. He joined Sigma Pi Sigma and Phi Beta Kappa at Duke and Omicron Delta Kappa at Georgia Tech.

He worked with IBM on the Apollo project where he programmed the trajectory equations that generated guidance commands for the Saturn vehicle. He also developed a course in celestial mechanics, conducted studies in Battlespace Management for ballistic missile defense, and programmed the reentry guidance equations for the Space Shuttle. He enjoyed working as a rocket scientist and interacting with the astronaut corps at the Johnson Space Center in Houston, Texas.

He worked on DoD contract defense work with Georgia Tech Research Institute and directed projects involving air defense systems. He also took a lead role in faculty governance as Secretary of the Faculty (a position appointed by the president of Georgia Tech), served on ten Institute-level committees, and helped to formulate Institute policies and procedures. He also taught physics classes and published more than 40 reports and papers.

He was a principal founder of the South Carolina (SC) SPIN (Software and Systems Process Improvement Network) and is currently serving as coordinator for their activities.

He provides direct support to the SPAWAR Systems Center-Atlantic (SSC-LANT) and is a process improvement consultant to the Office of the Chief Engineer. He works closely with SPAWAR personnel to develop documentation, evaluate training programs, and successfully prepare for CMMI appraisals.

He provides consulting, instructional, and appraisal services to a variety of government and commercial clients.

Tobin Lunsford

Tobin Lunsford is the AVP for National Material Damage at Infinity Property and Casualty in Birmingham, Alabama. He manages personnel in many lifecycle phases throughout the company and evaluates and improves current claims practices. He is currently working with all company departments to upgrade processes and increase the accuracy of work products while focusing on the customer experience and moving Infinity into the forefront of the property and casualty industry in estimating accuracy and severity of claims processing.

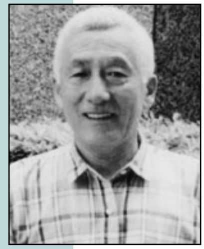
He has worked for more than 15 years in property and casualty insurance management, process review and development, and IT evaluation and integration. His experience covers automobile, marine, recreational vehicle, commercial auto, and motorcycle insurance, as well as catastrophe response management. Additionally, he has nearly ten years of direct experience in the automotive industry, including car sales, operations, and rental management.

He majored in business management, earning a BS from Auburn University. He is currently working on the CPCU designation for Insurance Services and carries training certificates from ICAR and Chief Automotive Technology.

Suzanne Miller

Suzanne Miller is a senior member of the technical staff in the Research, Technology, and System Solutions (RTSS) program at Carnegie Mellon University's Software Engineering Institute. Her research spans organizational issues in system of systems settings and organizations adopting new architectural practices. Before RTSS, she researched technology transition and process improvement, particularly development and implementation of CMM types of models, and coauthored *CMMI Survival Guide: Just Enough Process Improvement.*

Takeshige Miyoshi

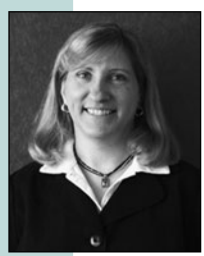


Takeshige Miyoshi is a professional at Software Research Associates, Inc. He is a CMMI instructor, SCAMPI High Maturity Lead Appraiser, and SCAMPI Lead Appraiser for services. He has extensive experience leading, participating in, and observing SW-CMM-based assessments and CMMI-based appraisals. He is a registered consulting engineer authorized by the Japanese government. He has more than 20 years of experience in developing, maintaining, and managing a number of software projects. He acted as a local trial coordinator in the Northern Asia region of the SPICE project during the late 1990s.

Brad Nelson

Brad Nelson is an engineer with the Department of Defense (DoD) Office of the Deputy Under Secretary of Defense for Industrial Policy (ODUSD [IP]) serving as an industrial base analyst for C4, Information Technology and Contract Services. He has more than 26 years of experience in systems engineering and technical leadership as a manager, project manager, headquarters program manager, and network systems engineer in the government, military, and private sectors. Prior to joining ODUSD (IP) in late 2006, he was a civilian employee of the U.S. Army where he held a variety of IT positions including chief systems engineer for the Program Executive Officer for Enterprise Information Systems (PEO EIS). Previously, he has held engineering and management positions with WorldCom, the Department of Energy, and the Environmental Protection Agency. He also served on active duty with the U.S. Navy as a submariner and retired from reserve duty as a captain.

Maggie Pabustan



Maggie Pabustan is an SEI Certified Lead Appraiser for CMMI-SVC and led the SCAMPI appraisal for the Support Office. She has participated as an appraisal team member on several CMMI-DEV and CMMI-SVC appraisals, and has more than 14 years of experience in services and development environments.

Lynn Penn

As director of process management at Lockheed Martin Corporation, Information Systems & Global Solutions (IS&GS), Lynn Penn oversees policies and process command media, process compliance via audits, and process improvement activities. She develops and manages compliance to multiple standards—CMMI-DEV, CMMI-SVC, ISO 9001, AS9100, and ISO 27001. Her previous experience includes serving as a program manager of two major Navy Software Development activities. She was assigned by the U.S. Navy onto their independent review board to consult and evaluate progress on other Navy contracts. She was director of Navy Business, which included six separate Navy Support contracts. She worked prior to this as a software development manager for a major development effort. Software Engineering Institute (SEI) Capability Maturity Model (CMM) involvement began with Version 1.0 and has progressed to the current CMMI Version 1.3. She is currently listed as one of the early adopters of CMMI, a CMMI Instructor, and a SCAMPI B/C Team Lead and SEI Affiliate. She has a BS in mathematics from Villanova University. She has done graduate studies in computer science and management information systems. She is a certified ISO 9000 internal auditor at Lockheed Martin Integrated Systems & Global Services. She is also a Certified Greenbelt and Blackbelt in Six Sigma and Lean Techniques. She has published a book called *CMMI and Six Sigma: Partners in Process Improvement*.

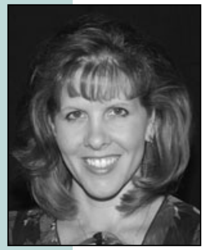
Mike Phillips

Mike Phillips is the program manager for CMMI at the Software Engineering Institute (SEI), a position created to lead the Capability Maturity Model Integration (CMMI) Product Suite evolution. He has led the team, which spans government, industry, and the SEI, through three significant upgrades to the original version of the integrated model, which now covers engineering, acquisition, and services. He was previously responsible for transition enabling activities at the SEI. He has authored technical reports, technical notes, CMMI columns, and various articles in addition to presenting CMMI material at conferences around the world. He is a coauthor of the first edition of the Addison-Wesley book on CMMI for Acquisition.

Prior to his retirement as a colonel from the U.S. Air Force, he was the program manager of the $36 billion development program for the B-2 stealth bomber in the B-2 System Program Office at

Wright-Patterson AFB, Ohio. In addition to more than five years of B-2 experience, he has four years of experience guiding acquisition programs in the Pentagon for both the Air Force and the Office of the Secretary of Defense. His BS in astronautical engineering is from the Air Force Academy, and he has an MS in nuclear engineering from Georgia Tech, in systems management from the University of Southern California, and in international affairs from Salve Regina College and the Naval War College. He is a graduate of the Program Management Course at the Defense Systems Management College and of the Air Force Test Pilot School.

Pam Schoppert



Quality, process, and change management have been the focus for Pam Schoppert for almost two decades. Her career at SAIC includes leading and supporting improvement efforts at all levels of the company, as well as consulting with external customers in the areas of defense, telecommunications, finance, national security, and intelligence. She now works at Citizant as a senior process advisor. She is a highly recognized expert in effectively implementing and appraising against industry improvement standards. Through her career, she has participated in dozens of recognized process improvement appraisals and assessments, including some at the highest attainable maturity levels. She also specializes in trail-blazing the standardization industry's alignment to the needs of today's information technology and services market spaces through the establishment of new models, process assets, and templates. She was invited by the Software Engineering Institute (SEI) to join a small group of industry, government, and SEI representatives to author the CMMI for Services model. She has written and implemented corporate policy and processes for software development, systems engineering, and IT services. She has authored and delivered corporate level training curricula for team building, peer review, and quality process innovation, impacting thousands of staff members within the company as well as customers and partners. She utilizes management and interpersonal skills to do what she loves best: help a team succeed to its fullest potential in delivering products and services with repeatable practices and maximum efficiency.

She has a BS in computer science and mathematics from Wheeling Jesuit University. She lives in Leesburg, Virginia, with her husband and three children. She is a board member of VSAarts of Loudoun and spends her free time advocating for children with special needs.

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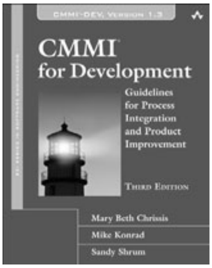

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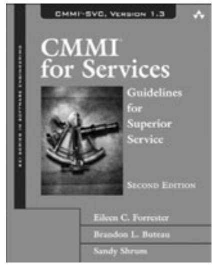

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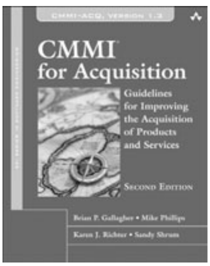

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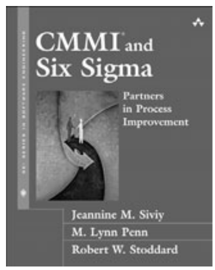

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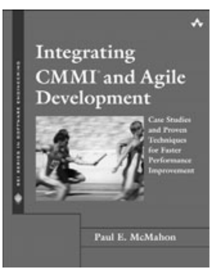

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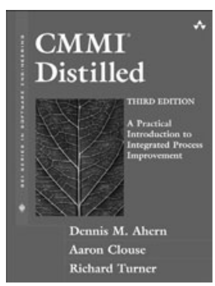

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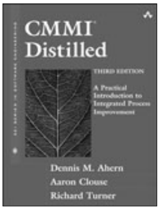

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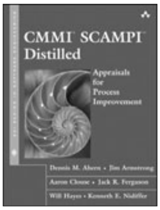

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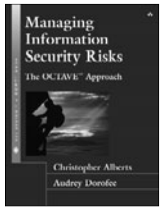

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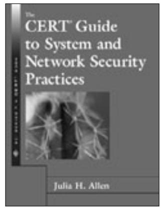

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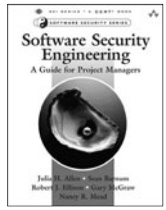

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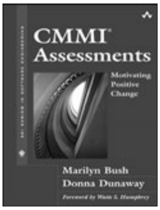

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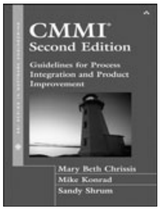

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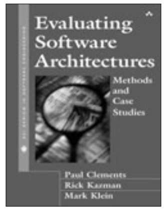

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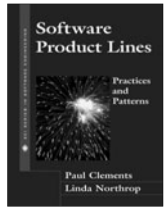

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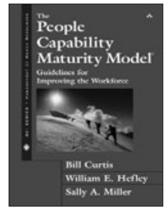

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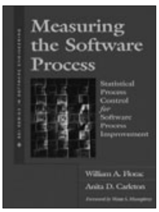

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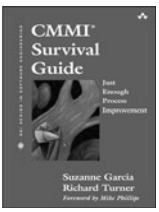

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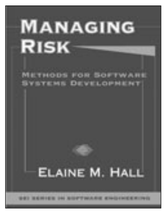

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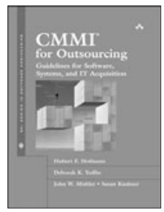

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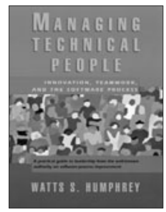

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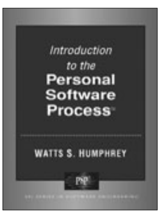

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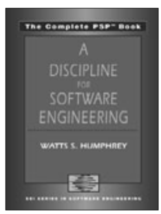

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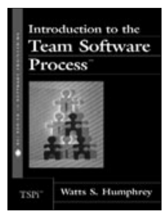

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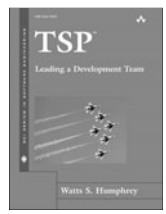

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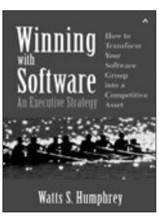

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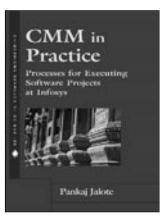

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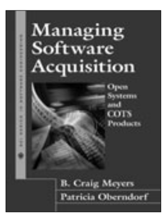

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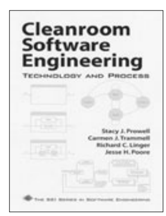

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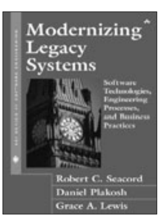

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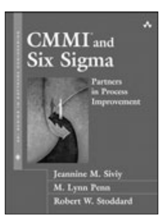

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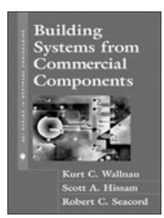

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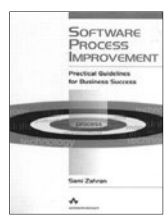

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