CAPACITY AND AVAILABILITY MANAGEMENT

A Project Management Process Area at Maturity Level 3

Purpose

The purpose of Capacity and Availability Management (CAM) is to plan and monitor the effective provision of resources to support service requirements.

Introductory Notes

The Capacity and Availability Management process area involves establishing and maintaining capacity at a justifiable cost and with an efficient use of resources. Capacity and Availability Management is about managing the current and future capacity based on demand. Capacity management includes taking a proactive approach to managing demand to meet business requirements (i.e., capacity management is not simply a passive or reactive process). At its core, Capacity and Availability Management is about managing the performance of the service system with the overriding purpose of meeting business requirements.

Unavailability is one of the most visible indicators of service quality (or lack of quality) in the eyes of the service user and customer. Availability of the services will depend on the availability of service system components, the resilience of the service system to failure, the quality of the maintenance performed on the service system, the quality of the support provided to the service system, the effectiveness of service processes, and security practices.

The scope of Capacity and Availability Management can be one service system or multiple service systems. If the service provider is dependent on multiple service systems, CAM can be performed independently on each discrete service system, but the organization will realize reduced value.

Related Process Areas

Refer to the Requirements Management process area for more information about using information reported by the Capacity and Availability Management process area to establish service requirements.
Refer to the Measurement and Analysis process area for more information about specifying measures.

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 Capacity and Availability Management Measures and Analytic Techniques
- SP 1.3 Establish the Service’s Baselines and Models

SG 2 Analyze and Monitor Capacity and Availability
- SP 2.1 Analyze and Monitor Capacity
- SP 2.2 Analyze and Monitor 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 is conducted by establishing and maintaining a strategy for managing capacity and availability to meet business requirements, selecting measures and analytic techniques to support availability and capacity management objectives, and establishing and maintaining baselines and models to understand current capacity, availability, and levels of service provision (i.e., describe what the normal capacity, availability, and service levels are). In addition to understanding the capacity and availability of the current service system, forecasting is done for future capacity, availability, and service levels based on trends in service resource use, service system performance, and expected business requirements.

SP 1.1 Establish a Capacity and Availability Management Strategy

Establish and maintain the strategy for capacity and availability management.

The strategy for capacity and availability management is based on business requirements, current resource use, and service system performance. It is important to create a forecast of future resources required for the service to meet business requirements. The strategy addresses the minimum, maximum, and average use of services (i.e., service resources) over the short-term (less than a week), medium (several weeks) and long-term (a year) as appropriate to the duration of the service.

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 is more sophisticated.
Typical Work Products
1. Capacity and availability management strategy

Subpractices
1. Document resource and service use, performance, and availability.
2. Forecast future resource and service capacity and availability requirements.
3. Develop a strategy to address the demand for resources and services.
4. Document quantified costs and benefits of the strategy and any assumptions.
5. Revise the strategy on a periodic basis.

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

SP 1.2 Select Capacity and Availability Management Measures and Analytic Techniques

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

The measures specified may require the collection of business data, financial data, service data, technical data, service resource use data, performance data, and other data about the service resources.

Examples of availability measures are as follows:

- Percentage available within agreed hours (this can be overall service availability or service component availability)
- Percentage unavailable within agreed hours (this can be overall service unavailability or service component unavailability)
- Duration of downtime due to failure (typically minutes, hours, or hours/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 incidents, transaction response times, service response times (this can be a capacity measure or availability measure)
- Resolution time (time to resolve incidents)
- Reliability (the number of service breaks, mean time between failures, mean time between system incidents)
Examples of capacity measures are as follows:

- use of service resources that are finite
- use of service components
- unused service resources that are finite
- 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 at x times (this can be monitored by calendar time)

**Typical Work Products**
1. Operational definitions of the capacity and availability measures
2. Traceability of the capacity and availability measures to the business requirements
3. Tools to support collection and analysis of capacity and availability data

**Subpractices**
1. Identify common measures from the organizational process assets that support capacity and availability management objectives to meet service requirements.
2. Identify and specify additional measures that may be needed to support capacity and availability management objectives for this service.
3. Analyze the relationship of the identified measures to the service requirements and derive objectives that state specific target measures or ranges to be met for each measured attribute

**SP 1.3 Establish the Service’s Baselines and Models**

*Establish and maintain baselines and models to support capacity and availability management.*

Descriptions of the normal use of service resources and levels of service provision are established and maintained. Models are used to achieve an understanding of the impact of change requests that are likely to affect availability and capacity. Models are used to predict future demand and the impact on the service system of required service levels. Models may be accomplished in spreadsheets, COTS tools, or tools developed in-house.
Typical Work Products
1. Models of resource and service use
2. Models of service levels
3. Baseline data on the use of resources and services
4. Baseline data on the provision of current service levels

Subpractices
1. Collect measurements on the use of resources and services, and provision of current service levels
2. Establish and maintain the service’s baselines and models from the collected measurements and analyses.
3. Review and get agreement with relevant stakeholders about the service’s baselines and models.
4. Make the service’s baselines available as appropriate.

SG 2 Analyze and Monitor Capacity and Availability

Capacity and availability are analyzed and monitored to manage resources and demand

The contribution of each component of the service system to meeting service requirements is analyzed to successfully manage the capacity and availability of services. 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 directly or otherwise influence demand for services and the requirement to do so is not implied by the phrase “manage resources and demand.”

Forecasts of growth in use of service resources are made using collected capacity and availability data. Thresholds are established to define exception conditions in the service system and breaches or near-breaches of service requirements. Regular monitoring and comparison with baselines identify exception conditions in the service system and breaches or near-breaches of service requirements. For example, regular monitoring of actual service resource use against forecasted service resource use might reveal a pending breach of service requirements.

SP 2.1 Analyze and Monitor Capacity

Analyze and monitor the use of resources and services on an ongoing basis
An understanding is achieved and documented of the total use of specific service resources as well as the use of specific resources by service (i.e., for a given service resource, what is the level of use by each service). The impact of specific service component failures on resources is analyzed.

Typical Work Products
1. Service resource data
2. Use growth analysis
3. Identification of resources not use as predicted

Subpractices
1. Monitor use of service resources against thresholds and normal operating level baselines.
2. Monitor service response times.
3. Identify breaches of thresholds and the occurrence of exceptions.
4. Determine what corrective action should be taken.
   Corrective actions can include adjustments to resources and services to prevent performance problems or improve service performance.
5. Ensure that corrective action is taken.
   Adjustments may be automated, performed manually, or both.
6. Predict growth in use of resources and services using appropriate methods and tools.
   Methods for predicting service system behavior include trend analysis, analytical modeling, simulation modeling, baseline models, application sizing, and tools.
7. Store capacity and availability data, specifications, analysis results, and monitoring data.

SP 2.2 Analyze and Monitor Availability

Monitor availability against agreed targets
To prevent the failure of service system components and support the availability of the system to meet business requirements, the service system must be monitored. At a minimum, availability is monitored but there are other "ilities" that may be appropriate to monitor for the specific type of service provided. Examples of other "ilities" that may be appropriate to monitor for many types of service systems are reliability and maintainability. Resilience of the service system to service component failure is also monitored and the impact of specific failures on service system availability is identified.

**Typical Work Products**
1. Alarms
2. Reliability data
3. Maintainability data

**Subpractices**
1. Monitor against availability, reliability, and maintainability requirements.
2. Identify breaches of availability, reliability, and maintainability requirements.
3. Determine what corrective action(s) should be taken.

**SP 2.3 Report Capacity and Availability Management Data**

*Report capacity and availability management data to relevant stakeholders.*

**Typical Work Products**
1. Service system performance reports
2. Service resource use projections
3. Service resource use reports
4. Service availability reports

**Subpractices**
1. Report the performance and use of resources and services.
2. Report exceptions.
4. Report the availability, reliability, and maintainability of resources and services.
### Generic Practices by Goal

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Elaboration:

This plan for performing the capacity and availability management process can be included in (or referenced by) the project plan, which is described in the Project Planning process area.
GP 2.3 **Provide Resources**

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

**Elaboration:**

Examples of resources provided include the following tools:
- Remote analysis tools
- Monitoring tools

GP 2.4 **Assign Responsibility**

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

GP 2.5 **Train People**

*Train the people performing or supporting the capacity and availability management process as needed.*

**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

GP 2.6 **Manage Configurations**

*Place designated work products of the capacity and availability management process under appropriate levels of control.*

**Elaboration:**

Examples of work products placed under control include the following:
- Capacity and availability management records
- Capacity and availability management reports

GP 2.7 **Identify and Involve Relevant Stakeholders**

*Identify and involve the relevant stakeholders of the capacity and availability management process as planned.*
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 use of resources.

**GP 2.8 Monitor and Control the Process**

*Monitor and control the capacity and availability management process against the plan for performing the process and take appropriate corrective action*

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
- Percent of service response time requirements not met due to causes associated with capacity and availability management
- Accuracy of forecasts of trends in resource use

**GP 2.9 Objectively Evaluate Adherence**

*Objectively evaluate adherence of the capacity and availability management process against its process description, standards, and procedures, and address noncompliance.*

**GP 2.10 Review Status with Higher Level Management**

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

**Continuous Only**

**GG 3 Institutionalize a Defined Process**

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the continuous representation.
### GP 3.1 Establish a Defined Process

*Establish and maintain the description of a defined capacity and availability management process with higher level management and resolve issues.*

### GP 3.2 Collect Improvement Information

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the capacity and availability management process to support the future use and improvement of the organization’s processes and process assets.*

### Continuous Only

#### GG 4 Institutionalize a Quantitatively Managed Process

*The process is institutionalized as a quantitatively managed process.*

#### GP 4.1 Establish Quantitative Objectives for the Process

*Establish and maintain quantitative objectives for the decision analysis and resolution process, which address quality and process performance, based on customer needs and business objectives.*

#### GP 4.2 Stabilize Subprocess Performance

*Stabilize the performance of one or more subprocesses to determine the ability of the decision analysis and resolution process to achieve the established quantitative quality and process-performance objectives.*

### GG 5 Institutionalize an Optimizing Process

*The process is institutionalized as an optimizing process.*

#### GP 5.1 Ensure Continuous Process Improvement

*Ensure continuous improvement of the decision analysis and resolution process in fulfilling the relevant business objectives of the organization.*

#### GP 5.2 Correct Root Causes of Problems

*Identify and correct the root causes of defects and other problems in the decision analysis and resolution process.*
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 defects and other problems and take action to prevent them from occurring in the future.

Introductory Notes

The Causal Analysis and Resolution process area involves the following:

- Identifying and analyzing causes of defects and other problems
- Taking specific actions to remove the causes and prevent the occurrence of those types of defects and problems in the future

Causal analysis and resolution improves quality and productivity by preventing the introduction of defects into a product. Reliance on detecting defects after they have been introduced is not cost effective. It is more effective to prevent defects from being introduced by integrating causal analysis and resolution activities into each phase of the project.

Since defects and problems may have been previously encountered on other projects or in earlier phases or tasks of the current project, causal analysis and resolution activities are a mechanism for communicating lessons learned among projects.

The types of defects and other problems encountered are analyzed to identify any trends. Based on an understanding of the defined process and how it is implemented, the root causes of the defects and the future implications of the defects are determined.

Causal analysis may also be performed on problems unrelated to defects. For example, causal analysis may be used to improve quality attributes such as cycle time. Improvement proposals, simulations, dynamic systems models, engineering analyses, new business directives, or other items may initiate such analysis.

When it is impractical to perform causal analysis on all defects, defect targets are selected by tradeoffs on estimated investments and estimated returns of quality, productivity and cycle time.
A measurement process should already be in place. The defined measures can be used, though in some instances new measures may be needed to analyze the effects of the process change.

Refer to the Measurement and Analysis process area for more information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.

Causal Analysis and Resolution activities provide a mechanism for projects 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 extended to the organizational level.

Refer to the Organizational Innovation and Deployment process area for more information about improving organizational level processes through proposed improvements and action proposals.

The informative material in this process area is written with the assumption that the specific practices are applied to a quantitatively managed process. The specific practices of this process area may be applicable, but with reduced value, if this assumption is not met.

See the definitions of “stable process” and “common cause of process variation” in the glossary.

Related Process Areas

Refer to the Quantitative Project Management process area for more information about the analysis of process performance and the creation of process capability measures for selected project processes.

Refer to the Organizational Innovation and Deployment process area for more information about the selection and deployment of improvements to organizational processes and technologies.

Refer to the Measurement and Analysis process area for more information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.
Specific Goal and Practice Summary

SG 1 Determine Causes of Defects
   SP 1.1 Select Defect Data for Analysis
   SP 1.2 Analyze Causes

SG 2 Address Causes of Defects
   SP 2.1 Implement the Action Proposals
   SP 2.2 Evaluate the Effect of Changes
   SP 2.3 Record Data

Specific Practices by Goal

SG 1 Determine Causes of Defects

Root causes of defects and other problems are systematically determined.

A root cause is a source of a defect such that, if it is removed, the defect is decreased or removed.

SP 1.1 Select Defect Data for Analysis

Select the defects and other problems for analysis.

Typical Work Products
1. Defect and problem data selected for further analysis

Subpractices
1. Gather relevant defect or problem data.

Examples of relevant defect data may include the following:
   • Defects reported by the customer
   • Defects reported by end users
   • Defects found in peer reviews
   • Defects found in testing

Examples of relevant problem data may include the following:
   • Project management problem reports requiring corrective action
   • Process capability problems
   • Process duration measurements
   • Earned value measurements by process (e.g., cost performance index)
   • Resource throughput, utilization, or response time measurements

Refer to the Verification process area for more information about work product verification.
Refer to the Quantitative Project Management process area for more information about statistical management.

2. Determine which defects and other problems will be analyzed further.

When determining which defects to analyze further, consider the impact of the defects, their frequency of occurrence, the similarity between defects, the cost of analysis, the time and resources needed, the safety considerations, etc.

Examples of methods for selecting defects and other problems include the following:

- Pareto analysis
- Histograms
- Process capability analysis

SP 1.2 Analyze Causes

Perform causal analysis of selected defects and other problems and propose actions to address them.

The purpose of this analysis is to develop solutions to the identified problems by analyzing the relevant data and producing action proposals for implementation.

Typical Work Products

1. Action proposal

Subpractices

1. Conduct causal analysis with the people who are responsible for performing the task.

Causal analysis is performed, typically in meetings, with those people who have an understanding of the selected defect or problem under study. The people who have the best understanding of the selected defect are typically those responsible for performing the task.

Examples of when to perform causal analysis include the following:

- When a stable process does not meet its specified quality and process-performance objectives
- During the task, if and when problems warrant a causal analysis meeting
- When a work product exhibits an unexpected deviation from its requirements

Refer to the Quantitative Project Management process area for more information about achieving the project's quality and process-performance objectives.
2. Analyze selected defects and other problems to determine their root causes.

Depending on the type and number of defects, it may make sense to first group the defects before identifying their root causes.

Examples of methods to determine root causes include the following:
- Cause-and-effect (fishbone) diagrams
- Check sheets

3. Group the selected defects and other problems based on their root causes.

Examples of cause groups, or categories, include the following:
- Inadequate training
- Breakdown of communications
- Not accounting for all details of a task
- Making mistakes in manual procedures (e.g., typing)
- Process deficiency

4. Propose and document actions that need to be taken to prevent the future occurrence of similar defects or other problems.

Examples of proposed actions include changes to the following:
- The process in question
- Training
- Tools
- Methods
- Communications
- Work products

Examples of specific actions include the following:
- Providing training in 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 to prevent defects, such as task kickoff meetings to review common defects and actions to prevent them
An action proposal usually documents the following:

- Originator of the action proposal
- Description of the problem
- Description of the defect cause
- Defect cause category
- Phase when the problem was introduced
- Phase when the defect was identified
- Description of the action proposal
- Action proposal category

**SG 2 Address Causes of Defects**

*Root causes of defects and other problems are systematically addressed to prevent their future occurrence.*

Projects operating according to a well-defined process will systematically analyze the operation where problems still occur and implement process changes to eliminate root causes of selected problems.

**SP 2.1 Implement the Action Proposals**

*Implement the selected action proposals that were developed in causal analysis.*

Action proposals describe the tasks necessary to remove the root causes of the analyzed defects or problems and avoid their reoccurrence.

Only changes that prove to be of value should be considered for broad implementation.

**Typical Work Products**

1. Action proposals selected for implementation
2. Improvement proposals

**Subpractices**

1. Analyze the action proposals and determine their priorities.

Criteria for prioritizing action proposals include the following:

- Implications of not addressing the defects
- Cost to implement process improvements to prevent the defects
- Expected impact on quality

2. Select the action proposals that will be implemented.
3. Create action items for implementing the action proposals.
Examples of information provided in an action item include the following:

- Person responsible for implementing it
- Description of the areas affected by it
- People who are to be kept informed of its status
- Next date that status will be reviewed
- Rationale for key decisions
- Description of implementation actions
- Time and cost for identifying the defect and correcting it
- Estimated cost of not fixing the problem

To implement the action proposals, the following tasks must be done:

- Make assignments
- Coordinate the persons doing the work
- Review the results
- Track the 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

Action items may be assigned to members of the causal analysis team, members of the project team, or other members of the organization.

4. Identify and remove similar defects that may exist in other processes and work products.

5. Identify and document improvement proposals for the organization’s set of standard processes.

Refer to the Organizational Innovation and Deployment process area for more information about the selection and deployment of improvement proposals for the organization’s set of standard processes.

**SP 2.2 Evaluate the Effect of Changes**

*Evaluate the effect of changes on process performance.*

Refer to the Quantitative Project Management process area for more information about analyzing process performance and creating process capability measures for selected processes.
Once the changed process is deployed across the project, the effect of the changes must be checked to gather evidence that the process change has corrected the problem and improved performance.

**Typical Work Products**

1. Measures of performance and performance change

**Subpractices**

1. Measure the change in the performance of the project's defined process as appropriate.

   This subpractice determines whether the selected change has positively influenced the process performance and by how much.

   An example of a change in the performance of the project's defined design process would be the change in the defect density of the design documentation, as statistically measured through peer reviews before and after the improvement has been made. On a statistical process control chart, this would be represented by a change in the mean.

2. Measure the capability of the project's defined process as appropriate.

   This subpractice determines whether the selected change has positively influenced the ability of the process to meet its quality and process-performance objectives, as determined by relevant stakeholders.

   An example of a change in the capability of the project's defined design process would be a change in the ability of the process to stay within its process-specification boundaries. This can be statistically measured by calculating the range of the defect density of design documentation, as collected in peer reviews before and after the improvement has been made. On a statistical process control chart, this would be represented by lowered control limits.

**SP 2.3 Record Data**

*Record causal analysis and resolution data for use across the project and organization.*

Data are recorded so that other projects and organizations can make appropriate process changes and achieve similar results.
Record the following:

- Data on defects and other problems that were analyzed
- Rationale for decisions
- Action proposals from causal analysis meetings
- Action items resulting from action proposals
- Cost of the analysis and resolution activities
- Measures of changes to the performance of the defined process resulting from resolutions

**Typical Work Products**
1. Causal analysis and resolution records

### Generic Practices by Goal

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Elaboration:

This policy establishes organizational expectations for identifying and systematically addressing root causes of defects and other problems.

**GP 2.2 Plan the Process**

*Establish and maintain the plan for performing the causal analysis and resolution process.*

Elaboration:

This plan for performing the causal analysis and resolution process can be included in (or referenced by) the project plan, which is described in the Project 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 would address the project’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 remove a specific root cause under study.

**GP 2.3 Provide Resources**

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

Elaboration:

Examples of resources provided include the following tools:

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

**GP 2.4 Assign Responsibility**

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

**GP 2.5 Train People**

*Train the people performing or supporting the causal analysis and resolution process as needed.*
Causal Analysis and Resolution (CAR)

Elaboration:

Examples of training topics include the following:

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

GP 2.6 Manage Configurations

**Place designated work products of the causal analysis and resolution process under appropriate levels of control.**

Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

**Identify and involve the relevant stakeholders of the causal analysis and resolution process as planned.**

Elaboration:

Examples of activities for stakeholder involvement include the following:

- Conducting causal analysis
- Assessing the action proposals

GP 2.8 Monitor and Control the Process

**Monitor and control the causal analysis and resolution process against the plan for performing the process and take appropriate corrective action.**

Elaboration:

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

- Number of root causes removed
- Change in quality or process performance per instance of the causal analysis and resolution process
- Schedule of activities for implementing a selected action proposal
GP 2.9  Objectively Evaluate Adherence

Objectively evaluate adherence of the causal analysis and resolution process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Determining causes of defects
- Addressing causes of defects

Examples of work products reviewed include the following:

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

GP 2.10  Review Status with Higher Level Management

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

Continuous Only

GG 3  Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the continuous representation.

GP 3.1  Establish a Defined Process

Establish and maintain the description of a defined causal analysis and resolution process.

GP 3.2  Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the causal analysis and resolution process to support the future use and improvement of the organization’s processes and process assets.
Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

**GG 4** Institutionalize a Quantitatively Managed Process

*The process is institutionalized as a quantitatively managed process.*

**GP 4.1** Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the causal analysis and resolution process, which address quality and process performance, based on customer needs and business objectives.

**GP 4.2** Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the causal analysis and resolution process to achieve the established quantitative quality and process-performance objectives.

**GG 5** Institutionalize an Optimizing Process

*The process is institutionalized as an optimizing process.*

**GP 5.1** Ensure Continuous Process Improvement

Ensure continuous improvement of the causal analysis and resolution process in fulfilling the relevant business objectives of the organization.

**GP 5.2** Correct Root Causes of Problems

Identify and correct the root causes of defects and other problems in the causal analysis and resolution process.
CONFIGURATION MANAGEMENT

A Support Process Area at Maturity Level 2

Purpose

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

Introductory Notes

The Configuration Management process area involves the following:

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

The work products placed under configuration management include the products that are delivered to the customer, designated internal work products, acquired products, tools, and other items that are used in creating and describing these work products. (See the definition of “configuration management” in the glossary.)

Acquired products may need to be placed under configuration management by both the supplier and the project. Provisions for conducting configuration management should be established in supplier agreements. Methods to ensure that the data is complete and consistent should be established and maintained.

Refer to the Supplier Agreement Management process area for more information about establishing and maintaining agreements with suppliers.
Examples of work products that may be placed under configuration management include the following:

- Plans
- Process descriptions
- Requirements
- Design data
- Drawings
- Product specifications
- Code
- Compilers
- Product data files
- Product technical publications

Configuration management of work products may be performed at several levels of granularity. Configuration items can be decomposed into configuration components and configuration units. 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 continuing evolution of configuration items.

An example of a baseline is an approved description of a product that includes internally consistent versions of requirements, requirement traceability matrices, design, discipline-specific items, and end-user documentation.

Baselines are added to the configuration management system as they are developed. Changes to baselines and the release of work products built from the configuration management system are systematically controlled and monitored via the configuration control, change management, and configuration auditing functions of configuration management.

This process area applies not only to configuration management on projects, but also to configuration management on organizational work products such as standards, procedures, and reuse libraries.

Configuration management is focused on the rigorous control of the managerial and technical aspects of work products, including the delivered system.
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.

Related Process Areas

Refer to the Project Planning process area for information on developing plans and work breakdown structures, which may be useful for determining configuration items.

Refer to the Project Monitoring and Control process area for more information about performance analyses and corrective actions.

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 the configuration items, components, and related work products that will be placed under configuration management.*

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

- Products that are delivered to the customer
- Designated internal work products
- Acquired products
- Tools and other capital assets of the project's work environment
• Other items that are used in creating and describing these work products

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

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

Typical Work Products
1. Identified configuration items

Subpractices
1. Select the configuration items and the 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 may be used by two or more groups
• Work products that are expected to change over time either because of errors or change of requirements
• Work products that are dependent on each other in that a change in one mandates a change in the others
• Work products that are critical for the project

Examples of work products that may be part of a configuration item include the following:

• Process descriptions
• Requirements
• Design
• Test plans and procedures
• Test results
• Interface descriptions
• Drawings
• Source code
• Tools (e.g., compilers)

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, and programming language for software code files.

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:

- Stage of the project lifecycle
- When the work product is ready for test
- Degree of control desired on the work product
- Cost and schedule limitations
- Customer requirements

5. Identify the owner responsible for each configuration item.

**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, the procedures, and the tools for accessing the configuration system.

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

**Typical Work Products**

1. Configuration management system with controlled work products
2. Configuration management system access control procedures
3. Change request database

**Subpractices**

1. Establish a mechanism to manage multiple control levels of configuration management.

The level of control is typically selected based on project objectives, risk, and/or resources. Control levels may vary in relation to the project lifecycle, type of system under development, and specific project requirements.
Example levels of control include the following:

- Create – controlled by author
- Engineering – notification to relevant stakeholders when changes are made
- Development – lower level CCB control
- Formal – higher level CCB control with customer involvement

Levels of control can range from informal control that simply tracks changes made when the 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. Store and retrieve configuration items in a configuration management system.

Examples of configuration management systems include the following:

- Dynamic (or author’s) systems contain components currently being created or revised. They are in the author’s workspace and are controlled by the author. Configuration items in a dynamic system are under version control.
- Master (or controlled) systems contain current baselines and changes to them. Configuration items in a master system are under full configuration management as described in this process area.
- Static systems contain archives of various baselines released for use. Static systems are under full configuration management as described in this process area.

3. Share and transfer configuration items between control levels within the configuration management system.

4. Store and recover archived versions of configuration items.

5. Store, update, and retrieve configuration management records.

6. Create configuration management reports from the configuration management system.

7. Preserve the contents of the configuration management system.

Examples of preservation functions of the configuration management system include the following:

- Backups and restoration of configuration management files
- Archiving of configuration management files
- Recovery from configuration management errors

8. Revise the configuration management structure as necessary.
Create or Release Baselines

Create or release baselines for internal use and for delivery to the customer.

A baseline is a set of specifications or work products that has been formally reviewed and agreed on, that thereafter serves as the basis for further development or delivery, and that can be changed only through change control procedures. A baseline represents the assignment of an identifier to a configuration item or a collection of configuration items and associated entities. As a product evolves, several baselines may be used to control its development and testing.

For Systems Engineering

One common set of baselines includes the system-level requirements, system-element-level design requirements, and the product definition at the end of development/beginning of production. These are typically referred to as the “functional baseline,” “allocated baseline,” and “product baseline.”

For Software Engineering

A software baseline can be a set of requirements, design, source code files and the associated executable code, build files, and user documentation (associated entities) that have been assigned a unique identifier.

Typical Work Products

1. Baselines
2. Description of baselines

Subpractices

1. Obtain authorization from the configuration control board (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.

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 the baselines after they are established by the specific practices under the Establish Baselines specific goal.
SP 2.1 Track Change Requests

Track change requests for the configuration items.

Change requests address not only new or changed requirements, but also failures and defects in the work products.

Change requests are analyzed to determine the impact that the change will have on the work product, related work products, budget, and schedule.

Typical 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 the change requests.

Changes are evaluated through activities that ensure that they are consistent with all technical and project requirements.

Changes are evaluated for their impact beyond immediate project 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. Review change requests that will be addressed in the next baseline with the 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 the results to relevant stakeholders.

4. Track the status of change requests to closure.

Change requests brought into the system need to 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.

5. Categorize and prioritize change requests.

Emergency requests are identified and referred to emergency authority if appropriate.
Changes are allocated to future baselines.

### SP 2.2 Control Configuration Items

<table>
<thead>
<tr>
<th><strong>Control changes to the configuration items.</strong></th>
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Control is maintained over the configuration of the work product baseline. This control includes tracking the configuration of each of the configuration items, approving a new configuration if necessary, and updating the baseline.

**Typical Work Products**
1. Revision history of configuration items
2. Archives of the baselines

**Subpractices**
1. Control changes to configuration items throughout the life of the product.
2. Obtain appropriate authorization before changed configuration items are entered into the configuration management system.

For example, authorization may come from the CCB, the project manager, or the customer.

3. Check in and check out configuration items from the configuration management system for incorporation of changes in a manner that maintains the correctness and integrity of the 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

4. Perform reviews to ensure that changes have not caused unintended effects on the baselines (e.g., ensure that the changes have not compromised the safety and/or security of the system).

5. Record changes to configuration items and the reasons for the 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 the baselines, established by processes associated with the Establish Baselines specific goal, and maintained by processes associated with the Track and Control Changes specific goal, is provided by the specific practices under this specific goal.

SP 3.1 Establish Configuration Management Records

**Establish and maintain records describing configuration items.**

**Typical Work Products**

1. Revision history of configuration items
2. Change log
3. Copy of the change requests
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 the 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

3. Specify the latest version of the baselines.

4. Identify the version of configuration items that constitute a particular baseline.

5. Describe the differences between successive baselines.

6. Revise the status and history (i.e., changes and other actions) of each configuration item as necessary.
Perform Configuration Audits

Perform configuration audits to maintain integrity of the configuration baselines.

Configuration audits confirm that the resulting baselines and documentation conform to a specified standard or requirement. Audit results should be recorded as appropriate. (See the glossary for a definition of “configuration audit.”)

Examples of audit types include the following:

- Functional Configuration Audits (FCA) – Audits conducted to verify that the as-tested functional characteristics of a configuration item have achieved the requirements specified in its functional baseline documentation and that the operational and support documentation is complete and satisfactory.
- Physical Configuration Audit (PCA) – Audits conducted to verify that the as-built configuration item conforms to the technical documentation that defines it.
- Configuration management audits – Audits conducted to confirm that configuration management records and configuration items are complete, consistent, and accurate.

Typical Work Products
1. Configuration audit results
2. Action items

Subpractices
1. Assess the integrity of the baselines.
2. Confirm that the configuration management records correctly identify the configuration items.
3. Review the structure and integrity of the items in the configuration management system.
4. Confirm the completeness and correctness of the items in the configuration management system.

Completeness and correctness of the content is based on the 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.
## Generic Practices by Goal

### Continuous Only

**GG 1** Achieve Specific Goals

*The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.*

**GP 1.1** Perform Specific Practices

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

### 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 configuration management process.*

**Elaboration:**

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

*This policy must address authorizing and implementing emergency changes.*

**GP 2.2** Plan the Process

*Establish and maintain the plan for performing the configuration management process.*

**Elaboration:**

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

**GP 2.3** Provide Resources

*Provide adequate resources for performing the configuration management process, developing the work products, and providing the services of the process.*
Elaboration:

Examples of resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the configuration management process as needed.

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

GP 2.6 Manage Configurations

Place designated work products of the configuration management process under appropriate levels of control.

Elaboration:

Refer to Table 6.2 in Generic Goals and Generic Practices for more information about the relationship between generic practice 2.6 and the Configuration Management process area.

The levels of control must be sufficient to meet business needs, mitigate the risk of failure, and address service criticality.

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6 Retained for consistency with CMMI product suite. This draft document does not have this table or section.
Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

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

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 the configuration items
- Performing configuration audits
- Reviewing the results of configuration management audits

GP 2.8 Monitor and Control the Process

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

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

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the configuration management process against its process description, standards, and procedures, and address noncompliance.
Elaboration:

Examples of activities reviewed include the following:

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

Examples of work products reviewed include the following:

- Archives of the baselines
- Change request database

**GP 2.10  Review Status with Higher Level Management**

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

**Staged Only**

GG 3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

**Continuous/Maturity Levels 3 - 5 Only**

**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 configuration management process.*

**GP 3.2  Collect Improvement Information**

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the configuration management process to support the future use and improvement of the organization’s processes and process assets.*
Continuous/Maturity Levels 3 - 5 Only

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

GG 4  Institutionalize a Quantitatively Managed Process

*The process is institutionalized as a quantitatively managed process.*

GP 4.1  Establish Quantitative Objectives for the Process

*Establish and maintain quantitative objectives for the configuration management process, which address quality and process performance, based on customer needs and business objectives.*

GP 4.2  Stabilize Subprocess Performance

*Stabilize the performance of one or more subprocesses to determine the ability of the configuration management process to achieve the established quantitative quality and process-performance objectives.*

GG 5  Institutionalize an Optimizing Process

*The process is institutionalized as an optimizing process.*

GP 5.1  Ensure Continuous Process Improvement

*Ensure continuous improvement of the configuration management process in fulfilling the relevant business objectives of the organization.*

GP 5.2  Correct Root Causes of Problems

*Identify and correct the root causes of defects and other problems in the configuration management process.*
DECISION ANALYSIS AND RESOLUTION

A Support Process Area at Maturity Level 3

Purpose

The purpose of Decision Analysis and Resolution (DAR) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

Introductory Notes

The Decision Analysis and Resolution process area involves establishing guidelines to determine which issues should be subjected to a formal evaluation process and then 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 to address an issue. A formal evaluation process involves the following actions:

• Establishing the criteria for evaluating alternatives
• Identifying alternative solutions
• Selecting methods for evaluating alternatives
• Evaluating the alternative solutions using the established criteria and methods
• Selecting recommended solutions from the alternatives based on the evaluation criteria

Rather than using the phrase “alternative solutions to address issues” each time it is needed, we will use one of two shorter phrases: “alternative solutions” or “alternatives.”

A formal evaluation process reduces the subjective nature of the decision and has a higher probability of selecting a solution that meets the multiple demands of relevant stakeholders.

While the primary application of this process area is to technical concerns, formal evaluation processes can also be applied to many nontechnical issues, particularly when a project is being planned. Issues that have multiple alternative solutions and evaluation criteria lend themselves to a formal evaluation process.
Trade studies of equipment or software are typical examples of formal evaluation processes.

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 risks or when issues affect the ability to achieve project objectives.

Formal evaluation processes can vary in formality, type of criteria, and methods employed. Less formal decisions can be analyzed in a few hours, use only a few criteria (e.g., effectiveness and cost to implement), and result in a one- or two-page report. More formal decisions may 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 the criteria. Non-numeric criteria use a more subjective ranking scale (e.g., high, medium, or low). More formal decisions may require a full trade study.

A formal evaluation process identifies and evaluates alternative solutions. The eventual selection of a solution may involve iterative activities of identification and evaluation. Portions of identified alternatives may be combined, emerging technologies may change alternatives, and the business situation of vendors may change during the evaluation period.

A recommended alternative is accompanied by documentation of the 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 that are useful to other projects that encounter a similar issue.

While some of the decisions made throughout the life of the project involve the use of a formal evaluation process, others do not. As mentioned earlier, guidelines should be established to determine which issues should be subjected to a formal evaluation process.
Related Process Areas

Refer to the Project Planning process area for more information about general planning for projects.

Refer to the Integrated Project Management process area for more information about establishing the project's defined process. The project’s defined process includes a formal evaluation process for each selected issue and incorporates the use of guidelines for applying a formal evaluation process to unforeseen issues.

Refer to the Risk Management process area for more information about identifying and mitigating risks. A formal evaluation process is often used to address issues with identified medium or high risks. Selected solutions typically affect risk mitigation plans.

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 Alternatives
- 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 may 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 will be unclear without explicit guidance. Whether a decision is significant or not is dependent on the project and circumstances, and is determined by the established guidelines.
Typical guidelines for determining when to require a formal evaluation process include the following:

- When a decision is directly related to topics assessed as being of medium or high risk
- When a decision is related to changing work products under configuration management
- When a decision would cause schedule delays over a certain percentage or specific amount of time
- When a decision affects the ability to achieve project objectives
- When the costs of the formal evaluation process are reasonable when compared to the decision’s impact
- When a legal obligation exists during a solicitation

Refer to the Risk Management process area for more information about determining which issues are medium or high risk.

Examples of when to use a formal evaluation process include the following:

- On decisions involving the procurement of material when 20 percent of the material parts constitute 80 percent of the total material costs
- On design-implementation decisions when technical performance failure may cause a catastrophic failure (e.g., safety of flight item)
- On decisions with the potential to significantly reduce design risk, engineering changes, cycle time, response time, and production costs (e.g., to use lithography models to assess form and fit capability before releasing engineering drawings and production builds)

Typical Work Products

1. Guidelines for when to apply a formal evaluation process

Subpractices

1. Establish guidelines.

2. Incorporate the use of the guidelines into the defined process where appropriate.

Refer to the Integrated Project Management process area for more information about establishing the project’s defined process.

SP 1.2 Establish Evaluation Criteria

Establish and maintain the criteria for evaluating alternatives, and the relative ranking of these criteria.
The evaluation criteria provide the basis for evaluating alternative solutions. The 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 there are 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.

Document the evaluation criteria to 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.

**Typical 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
   - Total ownership and lifecycle costs

2. Define the range and scale for ranking the evaluation criteria.

   Scales of relative importance for evaluation criteria can be established with non-numeric values or with formulas that relate the evaluation parameter to a numeric weight.

3. Rank the criteria.

   The criteria are ranked according to the defined range and scale to reflect the needs, objectives, and priorities of the relevant stakeholders.

4. Assess the criteria and their relative importance.

5. Evolve the evaluation criteria to improve their validity.

6. Document the rationale for the selection and rejection of evaluation criteria.
Documentation of selection criteria and rationale may be needed to justify solutions or for future reference and use.

**SP 1.3 Identify Alternative Solutions**

*Identify alternative solutions to address issues.*

A wider range of alternatives can surface by soliciting as many stakeholders as practical for input. Input from stakeholders with diverse skills and backgrounds can help teams identify and address assumptions, constraints, and biases. Brainstorming sessions may 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.

**Typical 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. It may 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 those that may be provided with the issue.

   Evaluation criteria are an effective starting point for identifying alternatives. The evaluation criteria identify the priorities of the 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 the proposed alternatives.

**SP 1.4 Select Evaluation Methods**

*Select the 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 need to be carefully selected. The level of detail of a method should be commensurate with cost, schedule, performance, and risk impacts.

While many problems may need only one evaluation method, some problems may require multiple methods. For instance, simulations may augment a trade study to determine which design alternative best meets a given criterion.

Typical Work Products
1. Selected evaluation methods

Subpractices
1. Select the 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
- Cost studies
- Business opportunity studies
- Surveys
- Extrapolations based on field experience and prototypes
- User review and comment
- Testing
- 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.
Evaluate Alternatives

Evaluate alternative solutions using the 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 cut. Challenges to criteria and assumptions should be encouraged.

Typical Work Products
1. Evaluation results

Subpractices
1. Evaluate the proposed alternative solutions using the established evaluation criteria and selected methods.

2. Evaluate the 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 as appropriate.

For instance, if the score can vary 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 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 may 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 the criteria on a solution. If the trials reveal problems, different criteria or alternatives might be considered to avoid biases.

5. Consider new alternative solutions, criteria, or methods if the proposed alternatives do not test well; repeat the 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 the alternatives based on the evaluation criteria.

Selecting solutions involves weighing the results from the evaluation of alternatives. Risks associated with implementation of the solutions must be assessed.

**Typical 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 managing 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 may require re-analysis later. Identified risks should be monitored.

2. Document 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.

**Generic Practices by Goal**

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<tr>
<th>Continuous Only</th>
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<tr>
<td><strong>GG 1</strong></td>
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### Continuous Only

<table>
<thead>
<tr>
<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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<tbody>
<tr>
<td><strong>Perform the specific practices of the decision analysis and resolution process to develop work products and provide services to achieve the specific goals of the process area.</strong></td>
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<table>
<thead>
<tr>
<th>GG 2</th>
<th>Institutionalize a Managed Process</th>
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<td><strong>The process is institutionalized as a managed process.</strong></td>
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### Staged Only

<table>
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<th>GG 3</th>
<th>Institutionalize a Defined Process</th>
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<td><strong>The process is institutionalized as a defined process.</strong></td>
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This generic goal’s appearance here reflects its location in the staged representation.

<table>
<thead>
<tr>
<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<tbody>
<tr>
<td><strong>Establish and maintain an organizational policy for planning and performing the decision analysis and resolution process.</strong></td>
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</table>

**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.

<table>
<thead>
<tr>
<th>GP 2.2</th>
<th>Plan the Process</th>
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<tr>
<td><strong>Establish and maintain the plan for performing the decision analysis and resolution process.</strong></td>
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**Elaboration:**

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

<table>
<thead>
<tr>
<th>GP 2.3</th>
<th>Provide Resources</th>
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<tr>
<td><strong>Provide adequate resources for performing the decision analysis and resolution process, developing the work products, and providing the services of the process.</strong></td>
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</table>
Elaboration:

Examples of resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the decision analysis and resolution process as needed.

Elaboration:

Examples of training topics include the following:

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

GP 2.6 Manage Configurations

Place designated work products of the decision analysis and resolution process under appropriate levels of control.

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

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the decision analysis and resolution process as planned.
Elaboration:

Examples of activities for stakeholder involvement include the following:

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

GP 2.8 Monitor and Control the Process

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

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

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the decision analysis and resolution process against its process description, standards, and procedures, and address noncompliance.

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

GP 2.10 Review Status with Higher Level Management

Review the activities, status, and results of the decision analysis and resolution process with higher level management and resolve issues.
Continuous Only

**GG 3** Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1** Establish a Defined Process

Establish and maintain the description of a defined decision analysis and resolution process.

**GP 3.2** Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the decision analysis and resolution process to support the future use and improvement of the organization's processes and process assets.

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

**GG 4** Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

**GP 4.1** Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the decision analysis and resolution process, which address quality and process performance, based on customer needs and business objectives.

**GP 4.2** Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the decision analysis and resolution process to achieve the established quantitative quality and process-performance objectives.
Continuous Only

GG 5 Institutionalize an Optimizing Process

*The process is institutionalized as an optimizing process.*

GP 5.1 Ensure Continuous Process Improvement

*Ensure continuous improvement of the decision analysis and resolution process in fulfilling the relevant business objectives of the organization.*

GP 5.2 Correct Root Causes of Problems

*Identify and correct the root causes of defects and other problems in the decision analysis and resolution process.*
INTEGRATED PROJECT MANAGEMENT

A Project Management Process Area at Maturity Level 3

Purpose

The purpose of Integrated Project Management (IPM) is to establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.

Introductory Notes

Integrated Project Management involves the following:

- Establishing the project's defined process at project startup by tailoring the organization's set of standard processes
- Managing the project using the project's defined process
- Establishing the work environment for the project based on the organization's work environment standards
- Using and contributing to the organizational process assets
- Enabling relevant stakeholders' concerns to be identified, considered, and, when appropriate, addressed during the development of the product
- Ensuring that the relevant stakeholders perform their tasks in a coordinated and timely manner (1) to address product and product component requirements, plans, objectives, problems, and risks; (2) to fulfill their commitments; and (3) to 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 project's defined process.

Managing the project's effort, cost, schedule, staffing, risks, and other factors is tied to the tasks of the project's defined process. The implementation and management of the project's defined process are typically described in the project plan. Certain activities may be covered in other plans that affect the project, such as the quality assurance plan, risk management strategy, and the configuration management plan.
Since the defined process for each project is tailored from the organization’s set of standard processes, variability among projects is typically reduced and projects can more easily share process assets, data, and lessons learned.

This process area also addresses the coordination of all activities associated with the project such as the following:

- Development activities (e.g., requirements development, design, and verification)
- Service activities (e.g., delivery, help desk, operations, and customer contact)
- Acquisition activities (e.g., solicitation, contract monitoring, and transition to operation)
- Support activities (e.g., configuration management, documentation, marketing, and training)

The working interfaces and interactions among relevant stakeholders internal and external to the project are planned and managed to ensure the quality and integrity of the entire product. Relevant stakeholders participate, as appropriate, in defining the project’s defined process and the project plan. Reviews and exchanges are regularly conducted with the relevant stakeholders to ensure that coordination issues receive appropriate attention and everyone involved with the project is appropriately aware of the status, plans, and activities. (See the definition of “relevant stakeholder” in the glossary.) In defining the project’s defined process, formal interfaces are created as necessary to ensure that appropriate coordination and collaboration occurs.

This process area applies in any organizational structure, including projects that are structured as line organizations, matrix organizations, or integrated teams. The terminology should be appropriately interpreted for the organizational structure in place.

Related Process Areas

Refer to the Project Planning process area for more information about planning the project, which includes identifying relevant stakeholders and their appropriate involvement in the project.

Refer to the Project Monitoring and Control process area for more information about monitoring and controlling the project.

Refer to the Verification process area for more information about peer reviews.
Refer to the Organizational Process Definition process area for more information about organizational process assets and work environment standards.

Refer to the Measurement and Analysis process area for more information about defining a process for measuring and analyzing processes.

**Specific Goal and Practice Summary**

**SG 1 Use the Project’s Defined Process**

- **SP 1.1** Establish the Project’s Defined Process
- **SP 1.2** Use Organizational Process Assets for Planning Project Activities
- **SP 1.3** Establish the Project’s Work Environment
- **SP 1.4** Integrate Plans
- **SP 1.5** Manage the Project Using the Integrated Plans
- **SP 1.6** Contribute to the 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 Project’s Defined Process**

*The project is conducted using a defined process that is tailored from the organization’s set of standard processes.*

The project’s defined process must include those processes from the organization’s set of standard processes that address all processes necessary to acquire or develop and maintain the product. The product-related lifecycle processes, such as the manufacturing and support processes, are developed concurrently with the product.

**SP 1.1 Establish the Project’s Defined Process**

*Establish and maintain the project’s defined process from project startup through the life of the project.*

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

Refer to the Organizational Process Focus process area for more information about organizational process needs and objectives and deploying the organization’s set of standard processes on projects.

The project’s defined process consists of defined processes that form an integrated, coherent lifecycle for the project.
The project's defined process should satisfy the project's contractual and operational needs, opportunities, and constraints. It is designed to provide a best fit for the project's needs. A project's defined process is based on the following factors:

- Customer requirements
- Product and product component requirements
- Commitments
- Organizational process needs and objectives
- Organization’s set of standard processes and tailoring guidelines
- Operational environment
- Business environment

Establishing the project's defined process at project startup helps to ensure that project staff and stakeholders implement a set of activities needed to efficiently establish an initial set of requirements and plans for the project. As the project progresses, the description of the project's defined process is elaborated and revised to better meet the project's requirements and the organization's process needs and objectives. Also, as the organization's set of standard processes change, the project's defined process may need to be revised.

**Typical Work Products**

1. The project's defined process

**Subpractices**

1. Select a lifecycle model from those available from the organizational process assets.

   Examples of project characteristics that could affect the selection of lifecycle models include the following:
   - Size of the project
   - Experience and familiarity of staff in implementing the process
   - Constraints such as cycle time and acceptable defect levels

2. Select the standard processes from the organization's set of standard processes that best fit the needs of the project.

3. Tailor the organization’s set of standard processes and other organizational process assets according to the tailoring guidelines to produce the project’s defined process.
Sometimes the available lifecycle models and standard processes are inadequate to meet a specific project’s needs. Sometimes the project will be unable to produce required work products or measures. In such circumstances, the project will need to seek approval to deviate from what is required by the organization. Waivers are provided for this purpose.

4. Use other artifacts from the organization's process asset library as appropriate.

Other artifacts may include the following:

- Lessons-learned documents
- Templates
- Example documents
- Estimating models

5. Document the project's defined process.

The project's defined process covers all of the activities for the project and its interfaces to relevant stakeholders.

Examples of project activities include the following:

- Project planning
- Project monitoring
- Requirements development
- Requirements management
- Supplier management
- Configuration management
- Quality assurance
- Risk management
- Decision analysis and resolution
- Product development and support
- Solicitation

6. Conduct peer reviews of the project's defined process.

Refer to the Verification process area for more information about conducting peer reviews.

7. Revise the project's defined process as necessary.

**SP 1.2 Use Organizational Process Assets for Planning Project Activities**

*Use the organizational process assets and measurement repository for estimating and planning the project's activities.*
Refer to the Organizational Process Definition process area for more information about organizational process assets and the organization’s measurement repository.

**Typical Work Products**
1. Project estimates
2. Project plans

**Subpractices**
1. Use the tasks and work products of the project's defined process as a basis for estimating and planning the project's activities.

   An understanding of the relationships among the various tasks and work products of the project's defined process, and of the roles to be performed by the relevant stakeholders, is a basis for developing a realistic plan.

2. Use the organization's measurement repository in estimating the project’s planning parameters.

   This estimate typically includes the following:
   - Using appropriate historical data from this project or similar projects
   - Accounting for and recording similarities and differences between the current project and those projects whose historical data will be used
   - Independently validating the historical data
   - Recording the 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
   - Design approach
   - Operational 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
- Defects
- Response time
- Service capacity
- Supplier performance

SP 1.3 Establish the Project's Work Environment

**Establish and maintain the project's work environment based on the organization's work environment standards.**

An appropriate work environment for a project comprises an infrastructure of facilities, tools, and equipment that people need to perform their jobs effectively in support of business and project objectives. The work environment and its components are maintained at a level of performance and reliability indicated by the organizational work environment standards. As required, the project’s work environment or some of its components can be developed internally or acquired from external sources.

The project’s work environment might encompass environments for product integration, verification, and validation or they might be separate environments.

Refer to the Establish Work Environment Standards specific practice in the Organizational Process Definition process area for more information about work environment standards.

Refer to the Establish the Product Integration Environment specific practice of the Product Integration process area for more information about establishing and maintaining the product integration environment for the project.

Refer to the Establish the Verification Environment specific practice of the Verification process area for more information about establishing and maintaining the verification environment for the project.

Refer to the Establish the Validation Environment specific practice of the Validation process area for more information about establishing and maintaining the validation environment for the project.
Typical Work Products
1. Equipment and tools for the project
2. Installation, operation, and maintenance manuals for the project work environment
3. User surveys and results
4. Usage, performance, and maintenance records
5. Support services for the project’s work environment

Subpractices
1. Plan, design, and install a work environment for the project.

   The critical aspects of the project work environment are, like any other product, requirements driven. Work environment functionality and operations are explored with the same rigor as is done for any other product development.

   It may be necessary to make tradeoffs among performance, costs, and risks. The following are examples of each:

   • Performance considerations may include timely interoperable communications, safety, security, and maintainability.
   • Costs may include capital outlays, training, support structure, disassembly and disposal of existing environments, and operation and maintenance of the environment.
   • Risks may include workflow and project disruptions.

   Examples of equipment and tools include the following:

   • Office software
   • Decision support software
   • Project management tools
   • Requirements management tools, design tools
   • Configuration management tools
   • Evaluation tools
   • Test and/or evaluation equipment

2. Provide ongoing maintenance and operational support for the project’s 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 the maintenance and support
- Training people to perform the maintenance and support
- Contracting the maintenance and support
- Developing expert users for selected tools

3. Maintain the qualification of the components of the project’s work environment.

Components include software, databases, hardware, tools, test equipment, and appropriate documentation. 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 the project’s 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 project plan and the other plans that affect the project to describe the project’s defined process.

Refer to the Project Planning process area for more information about establishing and maintaining a project plan.

Refer to the Organizational Process Definition process area for more information about organizational process assets and, in particular, the organization’s measurement repository.

Refer to the Measurement and Analysis process area for more information about defining measures and measurement activities and using analytic techniques.

Refer to the Risk Management process area for more information about identifying and analyzing risks.

Refer to the Organizational Process Focus process area for more information about organizational process needs and objectives.
This specific practice extends the specific practices for establishing and maintaining a project plan to address additional planning activities such as incorporating the project’s defined process, coordinating with relevant stakeholders, using organizational process assets, incorporating plans for peer reviews, and establishing objective entry and exit criteria for tasks.

The development of the project plan should account for current and projected needs, objectives, and requirements of the organization, customer, suppliers, and end users, as appropriate.

Typical Work Products
1. Integrated plans

Subpractices
1. Integrate other plans that affect the project with the project plan.

Other plans that affect the project may include the following:
   - Quality assurance plans
   - Configuration management plans
   - Risk management strategy
   - Documentation plans

2. Incorporate into the project plan the definitions of measures and measurement activities for managing the project.

   Examples of measures that would be incorporated include the following:
   - Organization’s common set of measures
   - Additional project-specific measures

3. Identify and analyze product and project interface risks.

   Examples of product and project interface risks include the following:
   - Incomplete interface descriptions
   - Unavailability of tools or test equipment
   - Availability of COTS components
   - Inadequate or ineffective team interfaces

4. Schedule the tasks in a sequence that accounts for critical development factors and project risks.
Examples of factors considered in scheduling include the following:

- Size and complexity of the tasks
- Integration and test issues
- Needs of the customer and end users
- Availability of critical resources
- Availability of key personnel

5. Incorporate the plans for performing peer reviews on the work products of the project's defined process.

Refer to the Verification process area for more information about peer reviews.

6. Incorporate the training needed to perform the project's defined process in the project's training plans.

This task typically involves negotiating with the organizational training group the support they will provide.

7. Establish objective entry and exit criteria to authorize the initiation and completion of the tasks described in the work breakdown structure (WBS).

Refer to the Project Planning process area for more information about the WBS.

8. Ensure that the project 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 Project Using the Integrated Plans

Manage the project using the project plan, the other plans that affect the project, and the project's defined process.

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

Refer to the Organizational Process Focus process area for more information about organizational process needs and objectives and coordinating process improvement activities with the rest of the organization.

Refer to the Risk Management process area for more information about managing risks.
Refer to the Project Monitoring and Control process area for more information about monitoring and controlling the project.

**Typical Work Products**
1. Work products created by performing the project's defined process
2. Collected measures ("actuals") and progress records or reports
3. Revised requirements, plans, and commitments
4. Integrated plans

**Subpractices**
1. Implement the project’s defined process using the organization's process asset library.

   This task typically includes the following:
   - Incorporating artifacts from the organization’s process asset library into the project as appropriate
   - Using lessons learned from the organization’s process asset library to manage the project

2. Monitor and control the project’s activities and work products using the project’s defined process, project plan, and other plans that affect the project.

   This task typically includes the following:
   - Using the defined entry and exit criteria to authorize the initiation and determine the completion of the tasks
   - Monitoring the activities that could significantly affect the actual values of the project’s planning parameters
   - Tracking the project’s planning parameters using measurable thresholds that will trigger investigation and appropriate actions
   - Monitoring product and project interface risks
   - Managing external and internal commitments based on the plans for the tasks and work products of the project’s defined process

   An understanding of the relationships among the various tasks and work products of the project’s defined process, and of the roles to be performed by the relevant stakeholders, along with well-defined control mechanisms (e.g., peer reviews) achieves better visibility into the project’s performance and better control of the project.

3. Obtain and analyze the selected measures to manage the project and support the organization’s needs.

   Refer to the Measurement and Analysis process area for more information about defining a process for obtaining and analyzing measures.
4. Periodically review and align the project’s performance with the current and anticipated needs, objectives, and requirements of the organization, customer, and end users, as appropriate.

This review includes alignment with the organizational process needs and objectives.

Examples of actions that achieve alignment include the following:

- Accelerating the schedule, with appropriate adjustments to other planning parameters and the project risks
- Changing the requirements in response to a change in market opportunities or customer and end-user needs
- Terminating the project

SP 1.6 Contribute to the Organizational Process Assets

Contribute work products, measures, and documented experiences to the organizational process assets.

Refer to the Organizational Process Focus process area for more information about process improvement proposals.

Refer to the Organizational Process Definition process area for more information about the organizational process assets, the organization’s measurement repository, and the organization’s process asset library.

This specific practice addresses collecting information from processes in the project’s defined process.

Typical Work Products

1. Proposed improvements to the organizational process assets
2. Actual process and product measures collected from the project
3. Documentation (e.g., exemplary process descriptions, plans, training modules, checklists, and lessons learned)
4. Process artifacts associated with tailoring and implementing the organization’s set of standard processes on the project

Subpractices

1. Propose improvements to the organizational process assets.
2. Store process and product measures in the organization’s measurement repository.

Refer to the Project Planning process area for more information about recording planning and replanning data.
Refer to the Project Monitoring and Control process area for more information about recording measures.

This typically includes the following:

- Planning data
- Replanning data
- Measures

Examples of data recorded by the project 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

4. Document lessons learned from the project 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 Implementation specific practice of the Organization 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 projects.
SG 2 Coordinate and Collaborate with Relevant Stakeholders

**Coordination and collaboration of the project with relevant stakeholders is conducted.**

SP 2.1 Manage Stakeholder Involvement

*Manage the involvement of the relevant stakeholders in the project.*

Stakeholder involvement is managed according to the project’s integrated and defined process.

Refer to the Project Planning process area for more information about identifying stakeholders and their appropriate involvement and about establishing and maintaining commitments.

**Typical Work Products**

1. Agendas and schedules for collaborative activities
2. Documented issues (e.g., issues with customer requirements, product and product component requirements, product architecture, and product design)
3. Recommendations for resolving relevant stakeholder issues

**Subpractices**

1. Coordinate with the relevant stakeholders who should participate in the project’s activities.
   
The relevant stakeholders should already be identified in the project plan.

2. Ensure that work products that are produced to satisfy commitments meet the requirements of the recipient projects.
   
Refer to the Verification process area for more information about verifying work products against their requirements.

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 project for other projects with representatives of the projects receiving the work product
- Resolving issues related to the acceptance of the work products

3. Develop recommendations and coordinate the actions to resolve misunderstandings and problems with the product and product component requirements, product and product component architecture, and product and product component design.
SP 2.2 Manage Dependencies

*Participate with relevant stakeholders to identify, negotiate, and track critical dependencies.*

Refer to the Project Planning process area for more information about identifying stakeholders and their appropriate involvement and about establishing and maintaining commitments.

Typical 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 project schedule.
4. Review and get agreement on the commitments to address each critical dependency with the people responsible for providing the work product and the people receiving the work product.
5. Document the 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 Project Monitoring and Control process area for more information about tracking commitments.
Tracking the 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 the responsible people whenever possible
- Escalating to the appropriate managers the actual and potential problems not resolvable with the responsible people

**SP 2.3 Resolve Coordination Issues**

*Resolve issues with relevant stakeholders.*

Examples of coordination issues include the following:

- Late critical dependencies and commitments
- Product and product component requirements and design defects
- Product-level problems
- Unavailability of critical resources or personnel

**Typical Work Products**

1. Relevant stakeholder coordination issues
2. Status of relevant stakeholder coordination issues

**Subpractices**

1. Identify and document issues.
2. Communicate issues to the relevant stakeholders.
3. Resolve issues with the relevant stakeholders.
4. Escalate to the appropriate managers those issues not resolvable with the relevant stakeholders.
5. Track the issues to closure.
6. Communicate with the relevant stakeholders on the status and resolution of the issues.
### Generic Practices by Goal

#### Continuous Only

<table>
<thead>
<tr>
<th>GG 1</th>
<th>Achieve Specific Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</strong></td>
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<tr>
<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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<tr>
<td><strong>Perform the specific practices of the integrated project management process to develop work products and provide services to achieve the specific goals of the process area.</strong></td>
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This generic goal’s appearance here reflects its location in the staged representation.

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**GP 2.1 Establish an Organizational Policy**

**Establish and maintain an organizational policy for planning and performing the integrated project management process.**

Elaboration:

This policy establishes organizational expectations for establishing and maintaining the project’s defined process from project startup through the life of the project, using the project’s defined process in managing the project, and coordinating and collaborating with relevant stakeholders.

**GP 2.2 Plan the Process**

**Establish and maintain the plan for performing the integrated project management process.**
Elaboration:

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

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices\(^7\) for more information about the relationship between generic practice 2.2 and project planning processes.

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<table>
<thead>
<tr>
<th>GP 2.3 Provide Resources</th>
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<tbody>
<tr>
<td>Provide adequate resources for performing the integrated project management process, developing the work products, and providing the services of the process.</td>
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</table>

Elaboration:

Examples of resources provided include the following tools:

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

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</table>

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\(^7\) Retained for consistency with CMMI product suite. This draft document does not have this table or section.
Elaboration:

Examples of training topics include the following:

- Tailoring the organization’s set of standard processes to meet the needs of the project
- Procedures for managing the project based on the project’s defined process
- Using the organization’s measurement repository
- Using the organizational process assets
- Integrated management
- Intergroup coordination
- Group problem solving

GP 2.6 Manage Configurations

Place designated work products of the integrated project management process under appropriate levels of control.

Elaboration:

Examples of work products placed under control include the following:

- The project’s defined process
- Project plans
- Other plans that affect the project
- Integrated plans
- Actual process and product measures collected from the project

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the integrated project management process as planned.

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices for more information about the relationship between generic practice 2.7 and the Manage Stakeholder Involvement practice in this process area.
Examples of activities for stakeholder involvement include the following:

- Resolving issues about the tailoring of the organizational process assets
- Resolving issues among the project plan and the other plans that affect the project
- Reviewing project performance to align with current and projected needs, objectives, and requirements

**GP 2.8  Monitor and Control the Process**

*Monitor and control the integrated project management process against the plan for performing the process and take appropriate corrective action.*

Elaboration:

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

- Number of changes to the project’s defined process
- 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 project tailoring activities

**GP 2.9  Objectively Evaluate Adherence**

*Objectively evaluate adherence of the integrated project management process against its process description, standards, and procedures, and address noncompliance.*

Elaboration:

Examples of activities reviewed include the following:

- Establishing, maintaining, and using the project's defined process
- Coordinating and collaborating with relevant stakeholders

Examples of work products reviewed include the following:

- Project's defined process
- Project plans
- Other plans that affect the project

**GP 2.10  Review Status with Higher Level Management**

*Review the activities, status, and results of the integrated project management process with higher level management and resolve issues.*
Continuous Only

GG 3  Institutionalize a Defined Process

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the continuous representation.

GP 3.1  Establish a Defined Process

*Establish and maintain the description of a defined integrated project management process.*

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices for more information about the relationship between generic practice 3.1 and the Integrated Project Management process area.

GP 3.2  Collect Improvement Information

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the integrated project management process to support the future use and improvement of the organization’s processes and process assets.*

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices for more information about the relationship between generic practice 3.2 and the Integrated Project Management process area.

Examples of work products, measures, measurement results, and improvement information include the following:

- Project’s defined process
- Number of tailoring options exercised by the project to create its defined process
- Interface coordination issue trends (i.e., number identified and number closed)
- Number of times the PAL is accessed for assets related to project planning by project personnel
- Records of expenses related to holding face-to-face meetings versus holding meetings using collaborative equipment such as teleconferencing and videoconferencing

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8 Retained for consistency with CMMI product suite. This draft document does not have this table or section.
## Continuous Only

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INCIDENT AND REQUEST MANAGEMENT

A Service Establishment and Delivery Process Area at Maturity Level 2

Purpose

The purpose of Incident and Request Management (IRM) is to ensure the timely resolution of requests for service and incidents that occur during service delivery.

Introductory Notes

The Incident and Request Management process area involves the following:

- Identifying and analyzing service requests and incidents
- Initiating specific actions to deliver the service requested or resolve the incident
- Monitoring the status of service requests and incidents; tracking progress of actions initiated to deliver the service requested or to resolve the incident and escalating if necessary
- Communicating status of service requests and incidents to the relevant stakeholders
- Validating the correct delivery of requested services and complete resolution of incidents with relevant stakeholders

Both service requests and incidents are events that—if not resolved—eventually will cause the service provider to break its service commitments. Hence, the service provider needs to address both service requests and incidents in a timely manner.

Service requests are requests from customers to deliver (part of) a previously agreed-upon service. Usually, the service delivered in response to a service request is part of a larger service that is delivered by the service provider. Examples include running a custom-made query on a database as part of a systems management service, installing an extra software package for a specific user as part of a workplace management service, repairing a broken component of a maintained system as part of a maintenance service, and performing a health check as part of a health program.
Incidents are interruptions or potential interruptions to the agreed level of service. Examples of interruptions to the agreed level of service include a software application that is down during normal operating hours, an elevator that is stuck, a hotel room that is doubly booked, and lost baggage in an airport. Examples of potential interruptions to the agreed-upon level of 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 interruptions in the sense that the complaint indicates that the customer has perceived the service to not be in accordance with the agreed-upon level of service. Therefore, complaints should be handled in a similar vein as incidents and are within the scope of the Incident and Request Management process area.

See the definitions of "service incident," "service request," and "complaint" in the glossary.

**Related Process Areas**

All incidents have an underlying cause that triggers their occurrence. Removing the underlying or root cause of incidents may reduce the workload on the service provider and improve the level of service. It might also be worthwhile for some categories of service requests to investigate underlying causes of service requests as a means of reducing the workload on the service provider or improving the level of service. For example, providing end users with the possibility to reset passwords themselves may significantly lower the number of service requests for resetting passwords.

Typically, the amount of time needed to fulfill a service request or resolve an incident is agreed before the start of service delivery and documented in a service level agreement.

*Refer to the Requirements Management process area for more information about establishing and maintaining service level agreements.*

Capacity, performance, or availability issues often signal potential incidents.

*Refer to the Capacity and Availability Management process area for more information about managing capacity and availability.*

Often, incident and requests will concern work products that are under configuration management.

*Refer to the Configuration Management process area for more information about controlling changes to work products.*
Specific Goal and Practice Summary

SG 1 Prepare for Incident and Request Management
   SP 1.1 Establish an Incident and Request Management Strategy
   SP 1.2 Establish an Incident and Request Management System

SG 2 Manage Incidents and Requests
   SP 2.1 Identify Incidents and Requests
   SP 2.2 Manage Incidents and Requests
   SP 2.3 Monitor the Resolution of Incidents and Requests
   SP 2.4 Communicate and Validate Resolution of Incidents and Requests

Specific Practices by Goal

SG 1 Prepare for Incident and Request Management

Preparation for incident and request management is conducted

Preparation is conducted by establishing and maintaining a strategy for ensuring the timely resolution of requests and incidents. This strategy is typically documented in an incident and request management plan. The incident and request management strategy addresses the organizational functions involved in the incident and request management, the procedures employed, the support tools used, and the assignment of responsibility for the lifecycle of requests and incidents.

SP 1.1 Establish an Incident and Request Management Strategy

Establish and maintain the strategy to be used for incident and request management.

A comprehensive incident and request management strategy addresses items such as the following:

- How responsibility for resolving incidents and requests is assigned and transferred
- How responsibility for monitoring the status of incidents and requests and for tracking the progress of actions related to incidents and requests is assigned and transferred
- How the customer and end users can report incidents and submit requests
- Methods and tools to be used for incident and request management

Typical Work Products
1. Incident and request management strategy.

SP 1.2 Establish an Incident and Request Management System

Establish and maintain an incident and request management system for recording incident and request information.
An incident and request management system includes the storage media, the procedures, and the tools for accessing the incident and request management system.

**Typical Work Products**
1. An incident and request management system with controlled work products
2. Incident and request management system access control procedures

**Subpractices**
1. Establish a mechanism to transfer incident and requests between groups and departments.

   Service requests and incidents may need to be transferred between different groups and departments because the group or department that entered the service request or incident may not be best suited for resolving the service request or incident.

2. Store and retrieve service incident and request information in the incident and request management system

   Examples of incident and request management systems include the following:
   - Bug or issue tracking software
   - Help desk software

3. Share and transfer incident and request records between groups or departments within the incident and request management system.

4. Store and recover the change history of incident and request records.

5. Store, update, and retrieve incident and request records.

6. Create incident and request management reports from the incident and request management system.

7. Preserve the contents of the incident and request management system.

   Examples of preservation functions of the incident and request management system include the following:
   - Backups and restoration of incident and request management files
   - Archiving of incident and request management files
   - Recovery from incident and request management errors

8. Revise the incident and request management structure as necessary.
Incidents and requests are identified and managed.

Incidents and requests may have different characteristics and may be categorized and resolved in different ways.

SP 2.1 Identify Incidents and Requests

Identify and record incidents and requests.

Typical Work Products

1. Incident or request database record.

Subpractices

1. Identify incident and requests
   
   Examples of identifying incident and requests include:
   - Incidents reported by the customer to a help desk by phone
   - Service requests submitted by the customer by use of a web form
   - Incidents detected by automated detection systems (e.g., Big Brother)

2. Record incident and request information

   When recording incident and request information, record sufficient information to properly support incident and request analysis and resolution.

   Examples of incident and request information to record:
   - Name and contact information of the person who submitted the service request or incident
   - Description of the service request or incident
   - Date and time of occurrence
   - The configuration items concerned
   - Relevant characteristics of the situation in which the service request or incident occurred

SP 2.2 Manage Incidents and Requests

Analyze, review, and manage incidents and requests

The purpose of this analysis is to determine the best course of action for resolving the incident or request.

Typical Work Products

1. Action proposal

2. Major Incident report
Subpractices

1. Conduct service request or incident analysis.

The analysis is typically performed by front-line service personnel. For standard service requests and incidents, the analysis may be done by merely selecting the type of service request or incident. For major incidents, the analysis may involve assembling a separate incident resolution team to analyze the incident.

Examples of when to perform incident and request analysis include the following:

- When resolving a service request will take considerable time or effort
- When the impact of the incident on the customer is large

2. Determine which department or group is best suited to resolve the service request or incident.

Which department or group is best suited may depend on the type of service request or incident, locations involved, and severity.

Examples of groups and departments that deal with different types of incidents include the following:

- A network support group handles network connectivity incidents
- A help desk deals with service requests for password resets

3. Determine actions that need to be taken to resolve the service request or incident.

Examples of actions include the following:

- Replacing a broken component
- Training a customer

When analyzing standard service requests and incidents, the actions for resolving that standard service request or incident may be documented as standard action plan.

4. Plan the actions.

5. Manage the incidents and requests until they are resolved to the customer’s satisfaction.

6. Review the actions.

Typically, the result of the actions is reviewed with the person that submitted the service request or incident to verify that the actions indeed resolved the service request or incident to the satisfaction of the submitter.

7. Record the actions and result
The actions performed to resolve the service request or incident and the result of performing the actions are recorded in the incident and request management system to support resolving similar service requests and incidents in future situations.

SP 2.3 Monitor the Resolution of Incidents and Requests

**Monitor the resolution of incidents and requests and escalate if necessary.**

SP 2.4 Communicate and Validate Resolution of Incidents and Requests

**Communicate the status of incidents and requests and validate the resolution of incidents and requests with the submitters of incidents and requests.**

**Generic Practices by Goal**

**Continuous Only**

GG 1 Achieve Specific Goals

*The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.*

GP 1.1 Perform Specific Practices

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

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 Incident and Request Management process.*

GP 2.2 Plan the Process

*Establish and maintain the plan for performing the Incident and Request Management process.*

**Elaboration:**

This plan for performing the Incident and Request Management process area can be included in (or referenced by) the service delivery plan, which is described in the Project Planning process area. This plan typically is based on an estimation of the volume of service requests and incidents, divided by types where appropriate.
GP 2.3 Provide Resources

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

Elaboration:

Examples of resources provided include the following tools:

- Help desk tools
- Remote analysis tools
- Monitoring tools

GP 2.4 Assign Responsibility

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

Elaboration:

Responsibility is assigned for both first-tier incident and request handling, e.g. by a help desk, and for second-tier handling, e.g. by support groups organized by product or platform.

GP 2.5 Train People

Train the people performing or supporting the Incident and Request Management process as needed.

Elaboration:

Examples of training topics include the following:

- Roles, responsibilities, and authority of the incident and request management staff
- Incident and request management standards, procedures, and methods
- Incident and request management system

GP 2.6 Manage Configurations

Place designated work products of the Incident and Request Management process under appropriate levels of control.
Elaboration:

Examples of work products placed under control include the following:

- Incident and request management records
- Incident and request management reports
- Incident and request database

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the Incident and Request Management process as planned.

Elaboration:

Examples of activities for stakeholder involvement include the following:

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

GP 2.8 Monitor and Control the Process

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

Elaboration:

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

- Number of service requests and incidents
- Lead time of resolving service requests and incidents compared to the agreed lead times in the service level agreement
- Number of transfers between support groups before a service request or incident is resolved

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the Incident and Request Management process against its process description, standards, and procedures, and address noncompliance.

Examples of work products reviewed include the following:

- Incident and request records
**GP 2.10 Review Status with Higher Level Management**

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

**Staged Only**

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

**Continuous/Maturity Levels 3 - 5 Only**

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**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

- Data currency status
- Results of data integrity tests
- Data analysis reports

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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 that is used to support management information needs.

Introductory Notes

The Measurement and Analysis process area involves the following:

- Specifying the objectives of measurement and analysis such that they are aligned with identified information needs and objectives
- Specifying the measures, analysis techniques, and mechanism for data collection, data storage, reporting, and feedback
- Implementing the collection, storage, analysis, and reporting of the data
- Providing objective results that can be used in making informed decisions, and taking appropriate corrective actions

The integration of measurement and analysis activities into the processes of the project supports the following:

- Objective planning and estimating
- Tracking actual 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 projects or other organizational functions (e.g., quality assurance).

The initial focus for measurement activities is at the project level. However, a measurement capability may prove useful for addressing organization-and/or enterprise-wide information needs. To support this capability, the measurement activities should support information needs at multiple levels including the business, organizational unit, and project to minimize re-work as the organization matures.
Projects may choose to store project-specific data and results in a project-specific repository. When data are shared more widely across projects, the data may reside in the organization’s measurement repository.

Measurement and analysis of the product components provided by suppliers is essential for effective management of the quality and costs of the project. It is possible, with careful management of supplier agreements, to provide insight into the data that support supplier-performance analysis.

**Related Process Areas**

Refer to the Project Planning process area for more information about estimating project attributes and other planning information needs.

Refer to the Project Monitoring and Control process area for more information about monitoring project performance information needs.

Refer to the Configuration Management process area for more information about managing measurement work products.

Refer to the Requirements Development process area for more information about meeting customer requirements and related information needs.

Refer to the Requirements Management process area for more information about maintaining requirements traceability and related information needs.

Refer to the Organizational Process Definition process area for more information about establishing the organization’s measurement repository.

Refer to the Quantitative Project Management process area for more information about understanding variation and the appropriate use of statistical analysis techniques.

**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 Collect 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 covered under this specific goal may 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.
- It often is important to specify the essential analyses that will be conducted before attending to details of measurement specification, data collection, or storage.

SP 1.1  Establish Measurement Objectives

Establish and maintain measurement objectives that are 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 may be taken based on the results of data analyses.

The sources for measurement objectives may be management, technical, project, product, or process implementation needs.

The 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 results will be commensurate with the resources devoted to doing the work.

Modifications to identified information needs and objectives may, in turn, be indicated as a consequence of the process and results of measurement and analysis.

Sources of information needs and objectives may include the following:

- Project plans
- Monitoring of project performance
- 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 projects or organizational entities
• External industry benchmarks
• Process improvement plans

Example measurement objectives include the following:

• Reduce time to delivery
• Reduce total lifecycle cost
• Deliver specified functionality completely
• Improve prior levels of quality
• Improve prior customer satisfaction ratings
• Maintain and improve the acquirer/supplier relationships

Refer to the Project Planning process area for more information about estimating project attributes and other planning information needs.

Refer to the Project Monitoring and Control process area for more information about project performance information needs.

Refer to the Requirements Development process area for more information about meeting customer requirements and related information needs.

Refer to the Requirements Management process area for more information about maintaining requirements traceability and related information needs.

Typical Work Products
1. Measurement objectives

Subpractices
1. Document information needs and objectives.

   Information needs and objectives are documented to allow traceability to subsequent measurement and analysis activities.

2. Prioritize information needs and objectives.

   It may 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.

   It is important to 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 ensure that the 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 may need to be refined and clarified as a result of setting measurement objectives. Initial descriptions of information needs may be unclear or ambiguous. Conflicts may arise between existing needs and objectives. Precise targets on an already existing measure may be unrealistic.

5. **Maintain traceability of the measurement objectives to the identified information needs and objectives.**

There must always be a good answer to the question, “Why are we measuring this?”

Of course, the measurement objectives may also change to reflect evolving information needs and objectives.

**SP 1.2 Specify Measures**

Specify measures to address the measurement objectives.

Measurement objectives are refined into precise, quantifiable measures.

Measures may 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)
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)

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.

Typical Work Products
1. Specifications of base and derived measures

Subpractices
1. Identify candidate measures based on documented measurement objectives.

   The measurement objectives are refined into specific measures. The identified candidate measures are categorized and specified by name and unit of measure.

2. Identify existing measures that already address the measurement objectives.

   Specifications for measures may already exist, perhaps established for other purposes earlier or elsewhere in the organization.

3. Specify operational definitions for the measures.

   Operational definitions are stated in precise and unambiguous terms. They address two important criteria as follows:
   - 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?

4. Prioritize, review, and update measures.

   Proposed specifications of the measures are reviewed for their appropriateness with potential end users and other relevant stakeholders. Priorities are set or changed, and specifications of the measures are updated as necessary.
SP 1.3 Specify Data Collection and Storage Procedures

Specify how measurement data will be obtained and stored.

Explicit specification of collection methods helps ensure that the right data are collected properly. It may also aid in further clarifying information needs and measurement objectives.

Proper attention to storage and retrieval procedures helps ensure that data are available and accessible for future use.

Typical 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 already 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 how, where, and when the data will be collected. Procedures for collecting valid data are specified. The data are stored in an accessible manner for analysis, and it is determined whether they will be saved for possible reanalysis or 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 the points of collection to repositories, other databases, or end users been established?
- Who is responsible for obtaining the 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 may include manual or automated forms and templates. Clear, concise guidance on correct procedures is available to those responsible for doing the work. Training is provided as necessary to clarify the processes necessary for collection of complete and accurate data and to minimize the burden on those who must provide and record the data.

5. Support automatic collection of the data where appropriate and feasible.

Automated support can aid in collecting more complete and accurate data.

Examples of such automated support include the following:

- Time stamped activity logs
- Static or dynamic analyses of artifacts

However, some data cannot be collected without human intervention (e.g., customer satisfaction or other human judgments), and setting up the necessary infrastructure for other automation may be costly.

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 the data. They also may have useful insights about how to improve existing processes, or be able to suggest other useful measures or analyses.

7. Update measures and measurement objectives as necessary.

Priorities may need to be reset based on the following:

- The importance of the measures
- The amount of effort required to obtain the data

Considerations include whether new forms, tools, or training would be required to obtain the data.

---

**SP 1.4 Specify Analysis Procedures**

Specify how measurement data will be analyzed and reported.

Specifying the analysis procedures in advance ensures that appropriate analyses will be conducted and reported to address the documented measurement objectives (and thereby the information needs and objectives on which they are based). This approach also provides a check that the necessary data will in fact be collected.

**Typical Work Products**

1. Analysis specifications and procedures
2. Data analysis tools

Subpractices

1. Specify and prioritize the analyses that will be conducted and the reports that will be prepared.

Early attention should be paid to the analyses that will be conducted and to the manner in which the results will be reported. These should meet the following criteria:

- The analyses explicitly address the documented measurement objectives
- Presentation of the results is clearly understandable by the audiences to whom the results are addressed

Priorities may have to be set within available resources.

2. Select appropriate data analysis methods and tools.

*Refer to the Select Measures and Analytic Techniques and Apply Statistical Methods to Understand Variation specific practices of the Quantitative Project Management process area for more information about the appropriate use of statistical analysis techniques and understanding variation, respectively.*

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, or tables)
- Choice of appropriate descriptive statistics (e.g., arithmetic mean, median, or 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 on the specified measures (e.g., central tendency, extent of variation, or data points exhibiting unusual variation)
- Examine the interrelationships among the specified measures (e.g., comparisons of defects by phase of the product’s lifecycle or by product component)
- Display changes over time

3. Specify administrative procedures for analyzing the data and communicating the 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, or staff meetings)

4. Review and update the proposed content and format of the 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. The relevant stakeholders consulted should include intended 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 the specifications established for data analysis procedures. Other measures may prove to be unnecessary, or a need for additional measures may be recognized.

The exercise of specifying how measures will be analyzed and reported may also suggest the need for refining the measurement objectives themselves.

6. Specify criteria for evaluating the utility of the analysis results and for evaluating the conduct of the measurement and analysis activities.

Criteria for evaluating the utility of the analysis might address the extent to which the following apply:

- The results are (1) provided on a timely basis, (2) understandable, and (3) used for decision making.
- The work does not cost more to perform than is justified by the benefits that 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, or only unsuccessful projects are evaluated to determine overall productivity).
- The measurement data are repeatable (e.g., statistically reliable).
- Statistical assumptions have been satisfied (e.g., about the distribution of data or about appropriate measurement scales).
SG 2  Provide Measurement Results

Measurement results, which address identified information needs and objectives, are provided.

The primary reason for doing measurement and analysis is to address identified information needs and objectives. Measurement results based on objective evidence can help to monitor performance, fulfill contractual obligations, make informed management and technical decisions, and enable corrective actions to be taken.

SP 2.1  Collect Measurement Data

Obtain specified measurement data.

The data necessary for analysis are obtained and checked for completeness and integrity.

Typical Work Products
1. Base and derived measurement data sets
2. Results of data integrity tests

Subpractices
1. Obtain the data for base measures.

   Data are collected as necessary for previously used as well as for newly specified base measures. Existing data are gathered from project records or from elsewhere in the organization.

   Note that data that were collected earlier may no longer be available for reuse in existing databases, paper records, or formal repositories.

2. Generate the data for derived measures.

   Values are newly calculated for all derived measures.

3. Perform data integrity checks as close to the source of the data as possible.

   All measurements are subject to error in specifying or recording data. It is always better to identify such errors and to identify 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 the measures that are used to calculate additional derived measures. Doing so can ensure that important distinctions are not overlooked and that the derived measures convey their intended meanings (otherwise known as “criterion validity”).

### SP 2.2 Analyze Measurement Data

**Analyze and interpret measurement data.**

The 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.

#### Typical Work Products

1. Analysis results and draft reports

#### Subpractices

1. Conduct initial analyses, interpret the results, and draw preliminary conclusions.

   The results of data analyses are rarely self-evident. Criteria for interpreting the results and drawing conclusions should be stated explicitly.

2. Conduct additional measurement and analysis as necessary, and prepare results for presentation.

   The results of planned analyses may suggest (or require) additional, unanticipated analyses. In addition, they may 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 the initial results for presentation may identify the need for additional, unanticipated analyses.

3. Review the initial results with relevant stakeholders.

   It may be appropriate to review initial interpretations of the results and the way in which they are presented before disseminating and communicating them more widely.

   Reviewing the initial results before their release may 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 and sponsors, as well as data analysts and data providers.

4. Refine criteria for future analyses.

Valuable 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 may become apparent, as may 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 the timely and cost-effective future use of historical data and results. The information also is needed to provide sufficient context for interpretation of the data, measurement criteria, and analysis results.

Information stored typically includes the following:

- Measurement plans
- Specifications of measures
- Sets of data that have been collected
- Analysis reports and presentations

The stored information contains or references the information needed to understand and interpret the measures and to assess them for reasonableness and applicability (e.g., measurement specifications used on different projects when comparing across projects).

Data sets for derived measures typically 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, or report prose).

Interim analysis results need not be stored separately if they can be efficiently reconstructed.

Projects may choose to store project-specific data and results in a project-specific repository. When data are shared more widely across projects, the data may reside in the organization’s measurement repository.

*Refer to the Establish the Organization’s Measurement Repository specific practice of the Organizational Process Definition process area for more information about establishing the organization’s measurement repository.*
Refer to the Configuration Management process area for information about managing measurement work products.

**Typical Work Products**
1. Stored data inventory

**Subpractices**
1. Review the data to ensure their completeness, integrity, accuracy, and currency.
2. Store the data according to the data storage procedures.
3. Make the stored contents available for use only by appropriate groups and personnel.
4. Prevent the stored information from being used inappropriately.

Examples of ways to prevent inappropriate use of the data and related information include controlling access to data and educating people on the appropriate use of data.

Examples of inappropriate use include the following:
- Disclosure of information that was 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 projects
- Impugning the integrity of specific individuals

**SP 2.4 Communicate Results**

*Report 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 users, sponsors, data analysts, and data providers.

**Typical Work Products**
1. Delivered reports and related analysis results
2. Contextual information or guidance to aid in the interpretation of analysis results
Subpractices

1. Keep relevant stakeholders apprised of measurement results on a timely basis.

Measurement results are communicated in time to be used for their intended purposes. Reports are unlikely to be used if they are distributed with little effort to follow up with those who need to know the results.

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. The users are regularly kept apprised of progress and interim results.

Refer to the Project Monitoring and Control process area for more information about the use of measurement results.

2. Assist relevant stakeholders in understanding the results.

Results are reported in a clear and concise manner appropriate to the methodological sophistication of the relevant stakeholders. They are understandable, easily interpretable, and clearly tied to identified information needs and objectives.

The data are often not self-evident to practitioners who are not measurement experts. Measurement choices should be explicitly clear about the following:

- How and why the base and derived measures were specified
- How the data were obtained
- How to interpret the results based on the data analysis methods that were used
- How the results address information needs

Examples of actions to assist in understanding of results include the following:

- Discussing the results with the relevant stakeholders
- Providing a transmittal memo that provides background and explanation
- Briefing users on the results
- Providing training on the appropriate use and understanding of measurement results
## Generic Practices by Goal

### Continuous Only

<table>
<thead>
<tr>
<th>GG 1</th>
<th>Achieve Specific Goals</th>
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</thead>
<tbody>
<tr>
<td>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</td>
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<table>
<thead>
<tr>
<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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<tbody>
<tr>
<td>Perform the specific practices of the measurement and analysis process to develop work products and provide services to achieve the specific goals of the process area.</td>
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### GG 2 | Institutionalize a Managed Process |
<table>
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<tr>
<td>The process is institutionalized as a managed process.</td>
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<thead>
<tr>
<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<tr>
<td>Establish and maintain an organizational policy for planning and performing the measurement and analysis process.</td>
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</table>

Elaboration:

This policy establishes organizational expectations for aligning measurement objectives and activities with identified information needs and objectives and for providing measurement results.

<table>
<thead>
<tr>
<th>GP 2.2</th>
<th>Plan the Process</th>
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<tbody>
<tr>
<td>Establish and maintain the plan for performing the measurement and analysis process.</td>
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</table>

Elaboration:

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

<table>
<thead>
<tr>
<th>GP 2.3</th>
<th>Provide Resources</th>
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<tr>
<td>Provide adequate resources for performing the measurement and analysis process, developing the work products, and providing the services of the process.</td>
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</table>
Elaboration:

Measurement personnel may be employed full time or part time. A measurement group may or may not exist to support measurement activities across multiple projects.

Examples of other resources provided include the following tools:

- Statistical packages
- Packages that support data collection over networks

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

*Train the people performing or supporting the measurement and analysis process as needed.*

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)

GP 2.6 Manage Configurations

*Place designated work products of the measurement and analysis process under appropriate levels of control.*

Elaboration:

Examples of work products placed under control include the following:

- 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
### GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the measurement and analysis process as planned.*

**Elaboration:**

Examples of activities for stakeholder involvement include the following:

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

### GP 2.8 Monitor and Control the Process

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

**Elaboration:**

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

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

### GP 2.9 Objectively Evaluate Adherence

*Objectively evaluate adherence of the measurement and analysis process against its process description, standards, and procedures, and address noncompliance.*

**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
<table>
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<tr>
<th>GP 2.10</th>
<th>Review Status with Higher Level Management</th>
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<tr>
<td><strong>GP 2.10</strong></td>
<td><strong>Review Status with Higher Level Management</strong></td>
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<tr>
<td><strong>Review the activities, status, and results of the measurement and analysis process with higher level management and resolve issues.</strong></td>
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### Staged Only

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

### Continuous/Maturity Levels 3 - 5 Only

<table>
<thead>
<tr>
<th>GG 3</th>
<th>Institutionalize a Defined Process</th>
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<th>GP 3.1</th>
<th>Establish a Defined Process</th>
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<td><strong>Establish a Defined Process</strong></td>
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<tr>
<td><strong>Establish and maintain the description of a defined measurement and analysis process.</strong></td>
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<tr>
<th>GP 3.2</th>
<th>Collect Improvement Information</th>
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<tr>
<td><strong>Collect Improvement Information</strong></td>
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<tr>
<td><strong>Collect work products, measures, measurement results, and improvement information derived from planning and performing the measurement and analysis process to support the future use and improvement of the organization’s processes and process assets.</strong></td>
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</tbody>
</table>

**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

- Data currency status
- Results of data integrity tests
- Data analysis reports

### Continuous Only

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<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
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<tr>
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<tr>
<th>GP 4.1</th>
<th>Establish Quantitative Objectives for the Process</th>
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<tr>
<td><strong>Establish Quantitative Objectives for the Process</strong></td>
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<tr>
<td><strong>Establish and maintain quantitative objectives for the measurement and analysis process, which address quality and process performance, based on customer needs and business objectives.</strong></td>
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### Continuous Only

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<th>GP 4.2</th>
<th>Stabilize Subprocess Performance</th>
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<tbody>
<tr>
<td></td>
<td>Stabilize the performance of one or more subprocesses to determine the ability of the measurement and analysis process to achieve the established quantitative quality and process-performance objectives.</td>
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<tr>
<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
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<th>GP 5.1</th>
<th>Ensure Continuous Process Improvement</th>
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<td>Ensure continuous improvement of the measurement and analysis process in fulfilling the relevant business objectives of the organization.</td>
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<tr>
<th>GP 5.2</th>
<th>Correct Root Causes of Problems</th>
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<td>Identify and correct the root causes of defects and other problems in the measurement and analysis process.</td>
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ORGANIZATIONAL INNOVATION AND DEPLOYMENT

A Process Management Process Area at Maturity Level 5

Purpose

The purpose of Organizational Innovation and Deployment (OID) is to select and deploy incremental and innovative improvements that measurably improve the organization’s processes and technologies. The improvements support the organization’s quality and process-performance objectives as derived from the organization’s business objectives.

Introductory Notes

The Organizational Innovation and Deployment process area enables the selection and deployment of improvements that can enhance the organization’s ability to meet its quality and process-performance objectives. (See the definition of “quality and process-performance objectives” in the glossary.) The term “improvement,” as used in this process area, refers to all of the ideas (proven and unproven) that would change the organization’s processes and technologies to better meet the organization’s quality and process-performance objectives.

Quality and process-performance objectives that this process area might address include the following:

- Improved product quality (e.g., functionality, performance)
- Increased productivity
- Decreased cycle time
- Greater customer and end-user satisfaction
- Shorter development or production time to change functionality or add new features, or adapt to new technologies
- Reduce delivery time
- Reduce time to adapt to new technologies and business needs
Achievement of these objectives depends on the successful establishment of an infrastructure that enables and encourages all people in the organization to propose potential improvements to the organization’s processes and technologies. Achievement of these objectives also depends on being able to effectively evaluate and deploy proposed improvements to the organization’s processes and technologies. All members of the organization can participate in the organization’s process- and technology-improvement activities. Their proposals are systematically gathered and addressed.

Pilots are conducted to evaluate significant changes involving untried, high-risk, or innovative improvements before they are broadly deployed.

Process and technology improvements that will be deployed across the organization are selected from process- and technology-improvement proposals based on the following criteria:

- A quantitative understanding of the organization's current quality and process performance
- The organization's quality and process-performance objectives
- Estimates of the improvement in quality and process performance resulting from deploying the process and technology improvements
- Estimated costs of deploying process and technology improvements, and the resources and funding available for such deployment

The expected benefits added by the process and technology improvements are weighed against the cost and impact to the organization. Change and stability must be balanced carefully. Change that is too great or too rapid can overwhelm the organization, destroying its investment in organizational learning represented by organizational process assets. Rigid stability can result in stagnation, allowing the changing business environment to erode the organization’s business position.

Improvements are deployed, as appropriate, to new and ongoing projects.

In this process area, the term “process and technology improvements” refers to incremental and innovative improvements to processes and also to process or product technologies (including project work environments).

The informative material in this process area is written with the assumption that the specific practices are applied to a quantitatively managed process. The specific practices of this process area may be applicable, but with reduced value, if the assumption is not met.
The specific practices in this process area complement and extend those found in the Organizational Process Focus process area. The focus of this process area is process improvement that is based on a quantitative knowledge of the organization’s set of standard processes and technologies and their expected quality and performance in predictable situations. In the Organizational Process Focus process area, no assumptions are made about the quantitative basis of improvement.

**Related Process Areas**

Refer to the Organizational Process Definition process area for more information about incorporating the deployed process improvements into organizational process assets.

Refer to the Organizational Process Focus process area for more information about soliciting, collecting, and handling process improvement proposals and coordinating the deployment of process improvement into the project’s defined processes.

Refer to the Organizational Training process area for more information about providing updated training to support deployment of process and technology improvements.

Refer to the Organizational Process Performance process area for more information about quality and process-performance objectives and process-performance models. Quality and process-performance objectives are used to analyze and select process- and technology-improvement proposals for deployment. Process-performance models are used to quantify the impact and benefits of innovations.

Refer to the Measurement and Analysis process area for more information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.

Refer to the Integrated Project Management process area for more information about coordinating the deployment of process and technology improvements into the project’s defined process and project work environment.

Refer to the Decision Analysis and Resolution process area for more information about formal evaluations related to improvement proposals and innovations.
Specific Goal and Practice Summary

SG 1 Select Improvements
   SP 1.1 Collect and Analyze Improvement Proposals
   SP 1.2 Identify and Analyze Innovations
   SP 1.3 Pilot Improvements
   SP 1.4 Select Improvements for Deployment

SG 2 Deploy Improvements
   SP 2.1 Plan the Deployment
   SP 2.2 Manage the Deployment
   SP 2.3 Measure Improvement Effects

Specific Practices by Goal

SG 1 Select Improvements

**Process and technology improvements, which contribute to meeting quality and process-performance objectives, are selected.**

SP 1.1 Collect and Analyze Improvement Proposals

**Collect and analyze process- and technology-improvement proposals.**

Each process- and technology-improvement proposal must be analyzed.

Simple process and technology improvements, with well-understood benefits and effects, will not usually undergo detailed evaluations.

Examples of simple process and technology improvements include the following:

- Add an item to a peer review checklist.
- Combine the technical review and management review for suppliers into a single technical/management review.

Typical Work Products

1. Analyzed process- and technology-improvement proposals

Subpractices


A process- and technology-improvement proposal documents proposed incremental and innovative improvements to specific processes and technologies. Managers and staff in the organization, as well as customers, end users, and suppliers can submit process- and technology-improvement proposals. Process and technology improvements may be implemented at the local level before being proposed for the organization.
Examples of sources for process- and technology-improvement proposals include the following:

- Findings and recommendations from process appraisals
- The organization’s quality and process-performance objectives
- Analysis of data about customer and end-user problems as well as customer and end-user satisfaction
- Analysis of data about project performance compared to quality and productivity objectives
- Analysis of technical performance measures
- Results of process and product benchmarking efforts
- Analysis of data on defect causes
- Measured effectiveness of process activities
- Measured effectiveness of project work environments
- Examples of process- and technology-improvement proposals that were successfully adopted elsewhere
- Feedback on previously submitted process- and technology-improvement proposals
- Spontaneous ideas from managers and staff

Refer to the Organizational Process Focus process area for more information about process- and technology-improvement proposals.

2. Analyze the costs and benefits of process- and technology-improvement proposals as appropriate.

Process- and technology-improvement proposals that have a large cost-to-benefit ratio are 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 project and organizational risks
- Ability to respond quickly to changes in project requirements, market situations, and the business environment
- Effect on related processes and associated assets
- Cost of defining and collecting data that supports the measurement and analysis of the process- and technology-improvement proposal
- Expected life span of the proposal

Process- and technology-improvement proposals that would not improve the organization's processes are rejected.
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 process-performance models.

3. Identify the process- and technology-improvement proposals that are innovative.

Innovative improvements are also identified and analyzed in the Identify and Analyze Innovations specific practice.

Whereas this specific practice analyzes proposals that have been passively collected, the purpose of the Identify and Analyze Innovations specific practice is to actively search for and locate innovative improvements. The search primarily involves looking outside the organization.

Innovative improvements are typically identified by reviewing process- and technology-improvement proposals or by actively investigating and monitoring innovations that are in use in other organizations or are documented in research literature. Innovation may be inspired by internal improvement objectives or by the external business environment.

Innovative improvements are typically major changes to the process that represent a break from the old way of doing things (e.g., changing the lifecycle model). Innovative improvements may also include changes in the products that support, enhance, or automate the process (e.g., using off-the-shelf products to support the process).

Examples of innovative improvements include the following:

- Advances in computer and related hardware products
- New support tools
- New techniques, methodologies, processes, or lifecycle models
- New interface standards
- New reusable components
- New management techniques
- New quality-improvement techniques
- New process development and deployment support tools

4. Identify potential barriers and risks to deploying each process- and technology-improvement proposal.
Examples of barriers to deploying process and technology 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 of relevant stakeholders

Examples of risk factors that affect the deployment of process and technology 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

5. Estimate the cost, effort, and schedule required for deploying each process- and technology-improvement proposal.

6. Select the process- and technology-improvement proposals to be piloted before broad-scale deployment.
   
   Since innovations, by definition, usually represent a major change, most innovative improvements will be piloted.

7. Document the results of the evaluation of each process- and technology-improvement proposal.

8. Monitor the status of each process- and technology-improvement proposal.

SP 1.2 Identify and Analyze Innovations

Identify and analyze innovative improvements that could increase the organization’s quality and process performance.

The specific practice, Collect and Analyze Improvement Proposals, analyzes proposals that are passively collected. The purpose of this specific practice is to actively search for, locate, and analyze innovative improvements. This search primarily involves looking outside the organization.
Typical Work Products
1. Candidate innovative improvements
2. Analysis of proposed innovative improvements

Subpractices
1. Analyze the organization's set of standard processes to determine areas where innovative improvements would be most helpful.

These analyses are performed to determine which subprocesses are critical to achieving the organization’s quality and process-performance objectives and which ones are good candidates to be improved.

2. Investigate innovative improvements that may improve the organization’s set of standard processes.

Investigating innovative improvements involves the following:

• Systematically maintaining awareness of leading relevant technical work and technology trends
• Periodically searching for commercially available innovative improvements
• Collecting proposals for innovative improvements from the projects and the organization
• Systematically reviewing processes and technologies used externally and comparing them to those used within 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 project work environments

3. Analyze potential innovative improvements to understand their effects on process elements and predict their influence on the process.

Process-performance models can provide a basis for analyzing possible effects of changes to process elements.

Refer to the Organizational Process Performance process area for more information about process-performance models.

4. Analyze the costs and benefits of potential innovative improvements.

Innovative improvements that have a very large cost-to-benefit ratio are rejected.

5. Create process- and technology-improvement proposals for those innovative improvements that would result in improving the organization’s processes or technologies.

6. Select the innovative improvements to be piloted before broadscale deployment.
Since innovations, by definition, usually represent a major change, most innovative improvements will be piloted.

7. Document the results of the evaluations of innovative improvements.

**SP 1.3 Pilot Improvements**

*Pilot process and technology improvements to select which ones to implement.*

Pilots are performed to assess new and unproven major changes before they are broadly deployed, as appropriate.

The implementation of this specific practice may overlap with the implementation of the Implement the Action Proposals specific practice in the Causal Analysis and Resolution process area (e.g., when causal analysis and resolution is implemented organizationally or across multiple projects).

**Typical Work Products**

1. Pilot evaluation reports
2. Documented lessons learned from pilots

**Subpractices**

1. Plan the pilots.
   
   When planning pilots, it is critical to define quantitative criteria to be used for evaluating pilot results.

2. Review and get relevant stakeholder agreement on the plans for the pilots.

3. Consult with and assist the people performing the pilots.

4. Perform each pilot in an environment that is characteristic of the environment present in a broadscale deployment.

5. Track the pilots against their plans.

6. Review and document the results of pilots.
Pilot results are evaluated using the quantitative criteria defined during pilot planning. Reviewing and documenting the results of pilots usually involves the following:

- Deciding whether to terminate the pilot, replan and continue the pilot, or proceed with deploying the process and technology improvement
- Updating the disposition of process- and technology-improvement proposals associated with the pilot
- Identifying and documenting new process- and technology-improvement proposals as appropriate
- Identifying and documenting lessons learned and problems encountered during the pilot

**SP 1.4 Select Improvements for Deployment**

*Select process and technology improvements for deployment across the organization.*

Selection of process and technology improvements for deployment across the organization is based on quantifiable criteria derived from the organization’s quality and process-performance objectives.

**Typical Work Products**

1. Process and technology improvements selected for deployment

**Subpractices**

1. Prioritize the candidate process and technology improvements for deployment.

   Priority is based on an evaluation of the estimated cost-to-benefit ratio with regard to the quality and process-performance objectives.

   *Refer to the Organizational Process Performance process area for more information about quality and process-performance objectives.*

2. Select the process and technology improvements to be deployed.

   The selection of the process improvements is based on their priorities and the available resources.

3. Determine how each process and technology improvement will be deployed.
Examples of where the process and technology improvements may be deployed include the following:

- Organizational process assets
- Project-specific or common work environments
- Organization’s product families
- Organization’s capabilities
- Organization’s projects
- Organizational groups

4. Document the results of the selection process.

The results of the selection process usually include the following:

- The selection criteria for candidate improvements
- The disposition of each improvement proposal
- The rationale for the disposition of each improvement proposal
- The assets to be changed for each selected improvement

SG 2 Deploy Improvements

Measurable improvements to the organization’s processes and technologies are continually and systematically deployed.

SP 2.1 Plan the Deployment

Establish and maintain the plans for deploying the selected process and technology improvements.

The plans for deploying each process and technology improvement may be included in the organization’s plan for organizational innovation and deployment or they may be documented separately.

The implementation of 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 the improvements with respect to quality and process-performance objectives.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets.

This specific practice plans the deployment of individual process and technology improvements. The Plan the Process generic practice addresses comprehensive planning that covers the specific practices in this process area.
Typical Work Products
1. Deployment plan for selected process and technology improvements

Subpractices
1. Determine how each process and technology improvement must be adjusted for organization-wide deployment.

Process and technology improvements proposed within a limited context (e.g., for a single project) might have to be modified to work across the organization.

2. Determine the changes necessary to deploy each process and technology improvement.

Examples of changes needed to deploy a process and technology 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

3. Identify strategies to address potential barriers to deploying each process and technology improvement.

4. Establish measures and objectives for determining the value of each process and technology improvement with respect to the organization’s quality and process-performance objectives.

Examples of measures for determining the value of a process and technology improvement include the following:

- Return on investment
- Time to recover the cost of the process or technology improvement
- Measured improvement in the project’s or organization’s process performance
- Number and types of project and organizational risks mitigated by the process or technology improvement
- Average time required to respond to changes in project requirements, market situations, and the business environment
Refer to the Measurement and Analysis process area for more information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.

5. Document the plan for deploying each process and technology improvement.

6. Review and get agreement with relevant stakeholders on the plan for deploying each process and technology improvement.

7. Revise the plan for deploying each process and technology improvement as necessary.

SP 2.2 Manage the Deployment

Manage the deployment of the selected process and technology improvements.

The implementation of this specific practice may overlap with the implementation of the Implement the Action Proposals specific practice in the Causal Analysis and Resolution process area (e.g., when causal analysis and resolution is implemented organizationally or across multiple projects). The primary difference is that in the Causal Analysis and Resolution process area, planning is done to manage the removal of the root causes of defects or problems from the project’s defined processes. In the Organizational Innovation and Deployment process area, planning is done to manage the deployment of improvements to the organization’s processes and technologies that can be quantified against the organization’s business objectives.

Typical Work Products
1. Updated training materials (to reflect deployed process and technology improvements)
2. Documented results of process- and technology-improvement deployment activities
3. Revised process- and technology-improvement measures, objectives, priorities, and deployment plans

Subpractices
1. Monitor the deployment of the process and technology improvements using the deployment plan.
2. Coordinate the deployment of process and technology improvements across the organization.
Coordinating deployment includes the following activities:

- Coordinating the activities of projects, support groups, and organizational groups for each process and technology improvement
- Coordinating the activities for deploying related process and technology improvements

3. Quickly deploy process and technology improvements in a controlled and disciplined manner, as appropriate.

Examples of methods for quickly deploying process and technology improvements include the following:

- Using red-lines, process change notices, or other controlled process documentation as interim process descriptions
- Deploying process and technology improvements incrementally, rather than as a single deployment
- Providing comprehensive consulting to early adopters of the process and technology improvement in lieu of revised formal training

4. Incorporate the process and technology improvements into organizational process assets, as appropriate.

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

5. Coordinate the deployment of the process and technology improvements into the projects’ defined processes as appropriate.

Refer to the Organizational Process Focus process area for more information about deploying organizational process assets.

6. Provide consulting, as appropriate, to support deployment of the process and technology improvements.

7. Provide updated training materials to reflect the improvements to the organizational process assets.

Refer to the Organizational Training process area for more information about training materials.

8. Confirm that the deployment of all process and technology improvements is completed.

9. Determine whether the ability of the defined process to meet quality and process-performance objectives is adversely affected by the process and technology improvement, and take corrective action as necessary.
Refer to the Quantitative Project Management process area for more information about quantitatively managing the project’s defined process to achieve the project’s established quality and process-performance objectives.

10. Document and review the results of process- and technology-improvement deployment.

Documenting and reviewing the results includes the following:

- Identifying and documenting lessons learned
- Identifying and documenting new process- and technology-improvement proposals
- Revising process- and technology-improvement measures, objectives, priorities, and deployment plans

**SP 2.3 Measure Improvement Effects**

*Measure the effects of the deployed process and technology improvements.*

Refer to the Measurement and Analysis process area for more information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.

The implementation of this specific practice may overlap with the implementation of the Evaluate the Effect of Changes specific practice in the Causal Analysis and Resolution process area (e.g., when causal analysis and resolution is implemented organizationally or across multiple projects).

**Typical Work Products**

1. Documented measures of the effects resulting from the deployed process and technology improvements

**Subpractices**

1. Measure the actual cost, effort, and schedule for deploying each process and technology improvement.

2. Measure the value of each process and technology improvement.

3. Measure the progress toward achieving the organization’s quality and process-performance objectives.

4. Analyze the progress toward achieving the organization's quality and process-performance objectives and take corrective action as needed.

Refer to the Organizational Process Performance process area for more information about process-performance analyses.
5. Store the measures in the organization’s measurement repository.

**Generic Practices by Goal**

<table>
<thead>
<tr>
<th>Continuous Only</th>
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<tbody>
<tr>
<td>GG 1</td>
<td>Achieve Specific Goals</td>
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<tr>
<td>GP 1.1</td>
<td>Perform Specific Practices</td>
</tr>
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</table>

The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.

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<tr>
<th>Staged Only</th>
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<tbody>
<tr>
<td>GG 3</td>
<td>Institutionalize a Defined Process</td>
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</table>

The process is institutionalized as a defined process.

This generic goal’s appearance here reflects its location in the staged representation.

<table>
<thead>
<tr>
<th>GP 2.1 Establish an Organizational Policy</th>
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</table>

Establish and maintain an organizational policy for planning and performing the organizational innovation and deployment process.

Elaboration:

This policy establishes organizational expectations for identifying and deploying process and technology improvements that contribute to meeting quality and process-performance objectives.

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<tr>
<th>GP 2.2 Plan the Process</th>
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</table>

Establish and maintain the plan for performing the organizational innovation and deployment process.
Elaboration:

This plan for performing the organizational innovation and deployment process differs from the deployment plans described in a specific practice in this process area. The plan called for in this generic practice would address the comprehensive planning for all of the specific practices in this process area, from collecting and analyzing improvement proposals all the way through to the measurement of improvement effects. In contrast, the deployment plans called for in the specific practice would address the planning needed for the deployment of individual process and technology improvements.

GP 2.3 Provide Resources

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

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the organizational innovation and deployment process as needed.
Elaboration:

Examples of training topics include the following:

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

GP 2.6 Manage Configurations

*Place designated work products of the organizational innovation and deployment process under appropriate levels of control.*

Elaboration:

Examples of work products placed under control include the following:

- Documented lessons learned from pilots
- Revised process- and technology-improvement measures, objectives, priorities, and deployment plans
- Updated training material

GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the organizational innovation and deployment process as planned.*

Elaboration:

Examples of activities for stakeholder involvement include the following:

- Reviewing process- and technology-improvement proposals that may have major impacts on process performance or on customer and end-user satisfaction
- Providing feedback to the organization on the status and results of the process- and technology-improvement deployment activities

The feedback typically involves:

- Informing the people who submit process- and technology-improvement proposals about the disposition of their proposals
- Regularly informing relevant stakeholders about the plans and status for selecting and deploying process and technology improvements
- Preparing and distributing a summary of process- and technology-improvement selection and deployment activities
GP 2.8 Monitor and Control the Process

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

Elaboration:

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

- Change in quality
- Change in process performance
- Schedule for activities to deploy a selected improvement

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the organizational innovation and deployment process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Selecting improvements
- Deploying improvements

Examples of work products reviewed include the following:

- Deployment plans
- Revised process- and technology-improvement measures, objectives, priorities, and deployment plans
- Updated training material

GP 2.10 Review Status with Higher Level Management

Review the activities, status, and results of the organizational innovation and deployment process with higher level management and resolve issues.
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<td><strong>GG 3</strong></td>
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| GP 3.1 | Establish a Defined Process |
|        | *Establish and maintain the description of a defined organizational innovation and deployment process.* |

| GP 3.2 | Collect Improvement Information |
|        | *Collect work products, measures, measurement results, and improvement information derived from planning and performing the organizational innovation and deployment process to support the future use and improvement of the organization’s processes and process assets.* |

**Elaboration:**

- Examples of work products, measures, measurement results, and improvement information include the following:
  - Lessons learned captured from relevant stakeholders that identify barriers to deployment from previous technology insertions
  - Documented measures of the costs and benefits resulting from deploying innovations
  - Report of a comparison of similar development processes to identify the potential for improving efficiency
### Continuous Only

<table>
<thead>
<tr>
<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
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<tbody>
<tr>
<td></td>
<td>The process is institutionalized as a quantitatively managed process.</td>
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<tr>
<td>GP 4.1</td>
<td>Establish Quantitative Objectives for the Process</td>
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<td>Establish and maintain quantitative objectives for the organizational innovation and deployment process, which address quality and process performance, based on customer needs and business objectives.</td>
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<tr>
<td>GP 4.2</td>
<td>Stabilize Subprocess Performance</td>
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<td>Stabilize the performance of one or more subprocesses to determine the ability of the organizational innovation and deployment process to achieve the established quantitative quality and process-performance objectives.</td>
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<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
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<tr>
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<td>The process is institutionalized as an optimizing process.</td>
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<tr>
<td>GP 5.1</td>
<td>Ensure Continuous Process Improvement</td>
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<td>Ensure continuous improvement of the organizational innovation and deployment process in fulfilling the relevant business objectives of the organization.</td>
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<tr>
<td>GP 5.2</td>
<td>Correct Root Causes of Problems</td>
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<td>Identify and correct the root causes of defects and other problems in the organizational innovation and deployment process.</td>
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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 and work environment standards.

Introductory Notes

Organizational process assets enable consistent process performance 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 is a collection of items maintained by the organization for use by the people and projects of the organization. This collection of items includes descriptions of processes and process elements, descriptions of lifecycle models, process tailoring guidelines, process-related documentation, and data. 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.

The organization’s set of standard processes is tailored by projects to create their defined processes. The other organizational process assets are used to support tailoring as well as the implementation of the defined processes. The work environment standards are used to guide creation of project work environments.

A standard process is composed of other processes (i.e., subprocesses) or process elements. A process element is the fundamental (e.g., atomic) unit of process definition and describes the activities and tasks to consistently perform work. Process architecture provides rules for connecting the process elements of a standard process. The organization’s set of standard processes may include multiple process architectures.

(See the definitions of “standard process,” “process architecture,” “subprocess,” and “process element” in the glossary.)
The organizational process assets may be organized in many ways, depending on the implementation of the Organizational Process Definition process area. Examples include the following:

- Descriptions of lifecycle models may be documented as part of the organization’s set of standard processes, or they may be documented separately.
- The organization’s set of standard processes may be stored in the organization’s process asset library, or they may be stored separately.
- A single repository may contain both the measurements and the process-related documentation, or they may be stored separately.

### Related Process Areas

Refer to the Organizational Process Focus process area for more information about organizational process-related matters.

### 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**

### 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 may be defined at multiple levels in an enterprise and they may be related in a hierarchical manner. For example, an enterprise may have a set of standard processes that is tailored by individual organizations (e.g., a division or site) in the enterprise to establish their set of standard processes. The set of standard processes may also be tailored for each of the organization’s business areas or product lines. 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 only have a single 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 the relationships among these 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 projects, including those processes addressed by the process areas at Maturity Level 2.

**Typical 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 bounded and closely related set of activities. The descriptions of the process elements may be templates to be filled in, fragments to be completed, abstractions to be refined, or complete descriptions to be tailored or used unmodified. These elements are described in sufficient detail such that the process, when fully defined, can be consistently performed by appropriately trained and skilled people.

Examples of process elements include the following:
- Template for generating work product size estimates
- Description of work product design methodology
- Tailorable peer review methodology
- Template for conduct of management reviews

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
- Product and process measures to be collected and used
- Verification points (e.g., peer reviews)
- Outputs
- Interfaces
- Exit criteria

3. Specify the relationships of the process elements.

Examples of relationships include the following:

- Ordering of the process elements
- Interfaces among the process elements
- Interfaces with external processes
- Interdependencies among the process elements

The rules for describing the relationships among process elements are referred to as "process architecture." The process architecture covers the essential requirements and guidelines. The detailed specifications of these relationships are covered in the descriptions of the 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 the relevant process standards and models. In addition, this mapping will be a useful input to future appraisals.

5. Ensure that the organization’s set of standard processes satisfies the process needs and objectives of the organization.

Refer to the Organizational Process Focus process area for more information about establishing and maintaining the organization’s process needs and objectives.

6. Ensure that there is appropriate integration among the processes that are included in the organization’s set of standard processes.

8. Conduct peer reviews on the organization's set of standard processes.

Refer to the Verification process area for more information about peer review.

9. Revise the organization's set of standard processes as necessary.

---

**SP 1.2 Establish Lifecycle Model Descriptions**

*Establish and maintain descriptions of the lifecycle models approved for use in the organization.*

Lifecycle models may 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 the phases of the project. Also, the organization may define different lifecycle models for each type of product and service it delivers.

**Typical Work Products**

1. Descriptions of lifecycle models

**Subpractices**

1. Select lifecycle models based on the needs of projects and the organization.

   For example, project lifecycle models include the following:

   - Waterfall
   - Spiral
   - Evolutionary
   - Incremental
   - Iterative

2. Document the descriptions of the lifecycle models.

   The lifecycle models may be documented as part of the organization's standard process descriptions or they may be documented separately.

3. Conduct peer reviews on the lifecycle models.

   Refer to the Verification process area for more information about conducting peer reviews.

4. Revise the descriptions of the lifecycle models as necessary.
SP 1.3 Establish Tailoring Criteria and Guidelines

Establish and maintain the tailoring criteria and guidelines for the organization’s set of standard processes.

The tailoring criteria and guidelines describe the following:

- How the organization’s set of standard processes and organizational process assets are used to create the defined processes
- Mandatory requirements that must be satisfied by the defined processes (e.g., the subset of the organizational process assets that are essential for any defined process)
- Options that can be exercised and criteria for selecting among the options
- Procedures that must be followed in performing and documenting process tailoring

Examples of reasons for tailoring include the following:

- Adapting the process for a new product line or work environment
- Customizing the process for a specific application or class of similar applications
- Elaborating the process description so that the resulting defined process can be performed

Flexibility in tailoring and defining processes is balanced with ensuring appropriate consistency in the processes across the organization. Flexibility is needed to address contextual variables such as the domain; nature of the customer; cost, schedule, and quality tradeoffs; technical difficulty of the work; and 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 criteria and guidelines may allow for using a standard process “as is,” with no tailoring.

Typical Work Products
1. Tailoring guidelines for the organization’s set of standard processes

Subpractices
1. Specify the 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 those approved by the organization
- Criteria for selecting process elements from the organization’s set of standard processes
- Procedures for tailoring the selected lifecycle models and process elements to accommodate specific process characteristics and needs

Examples of tailoring actions 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 for documenting the defined processes.
3. Specify the procedures for submitting and obtaining approval of waivers from the requirements of the organization’s set of standard processes.
4. Document the tailoring guidelines for the organization’s set of standard processes.
5. Conduct peer reviews on the tailoring guidelines.
   
   Refer to the Verification process area for more information about conducting peer reviews.
6. Revise the 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 Project Activities specific practice of the Integrated Project Management process area for more information about the use of the organization’s measurement repository in planning project 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 the information needed to understand and interpret the measures and assess them for reasonableness and applicability. For example, the definitions of the measures are used to compare similar measures from different processes.
Typical 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 (that is, the repository structure and 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.

The measures in the common set are selected based on the organization’s set of standard processes. They are selected for their ability to provide visibility into process performance to support expected business objectives. The common set of measures may vary for different standard processes.

Operational definitions for the measures specify the procedures for collecting valid data and the point in the process where the data will be collected.

Examples of classes of commonly used measures include the following:
- Estimates of work product size (e.g., pages)
- Estimates of effort and cost (e.g., person hours)
- Actual measures of size, effort, and cost
- Quality measures (e.g., number of defects found or severity of defects)
- Peer review coverage
- Test coverage
- Reliability measures (e.g., mean time to failure)

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

3. Design and implement the measurement repository.
4. Specify the procedures for storing, updating, and retrieving measures.
5. Conduct peer reviews on the definitions of the common set of measures and the procedures for storing and retrieving measures.

Refer to the Verification process area for more information about conducting peer reviews.
6. Enter the specified measures into the repository.

   *Refer to the Measurement and Analysis process area for more information about collecting and analyzing data.*

7. Make the contents of the measurement repository available for use by the organization and projects as appropriate.

8. Revise the measurement repository, 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
- Defined process descriptions
- Procedures (e.g., estimating procedure)
- Development plans
- Acquisition plans
- Quality assurance plans
- Training materials
- Process aids (e.g., checklists)
- Lessons-learned reports

**Typical Work Products**

1. Design of the organization’s process asset library
2. Organization’s process asset library
3. Selected items to be included in the organization’s process asset library
4. 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 the criteria for including items in the library.

   The items are selected based primarily on their relationship to the organization’s set of standard processes.

3. Specify the procedures for storing and retrieving items.

4. Enter the selected items into the library and catalog them for easy reference and retrieval.

5. Make the items available for use by the projects.

6. Periodically review the use of each item and use the results to maintain the library contents.

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 projects 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/or the use of waivers that allow adaptation of the project’s work environment to meet specific needs.

   Examples of work environment standards include
   - Procedures for 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
Typical 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.

Generic Practices by Goal

<table>
<thead>
<tr>
<th>Continuous Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GG 1</strong></td>
</tr>
<tr>
<td>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</td>
</tr>
<tr>
<td><strong>GP 1.1</strong></td>
</tr>
<tr>
<td>Perform the specific practices of the organizational process definition process to develop work products and provide services to achieve the specific goals of the process area.</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Staged Only</th>
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<tbody>
<tr>
<td><strong>GG 3</strong></td>
</tr>
<tr>
<td>The process is institutionalized as a defined process.</td>
</tr>
<tr>
<td>Elaboration:</td>
</tr>
<tr>
<td>This generic goal's appearance here reflects its location in the staged representation.</td>
</tr>
<tr>
<td><strong>GP 2.1</strong></td>
</tr>
<tr>
<td>Establish and maintain an organizational policy for planning and performing the organizational process definition process.</td>
</tr>
<tr>
<td>Elaboration:</td>
</tr>
<tr>
<td>This policy establishes organizational expectations for establishing and maintaining a set of standard processes for use by the organization and making organizational process assets available across the organization.</td>
</tr>
</tbody>
</table>
GP 2.2 Plan the Process

*Establish and maintain the plan for performing the organizational process definition process.*

Elaboration:

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

GP 2.3 Provide Resources

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

Elaboration:

A process group typically manages the 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
- The appropriate engineering disciplines
- Configuration management
- Quality assurance

Examples of other resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

*Train the people performing or supporting the organizational process definition process as needed.*
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

GP 2.6 Manage Configurations

Place designated work products of the organizational process definition process under appropriate levels of control.

Elaboration:

Examples of work products placed under control include the following:

- Organization’s set of standard processes
- Descriptions of the 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

GP 2.7 Identify and Involve Relevant Stakeholders

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

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 on the tailoring guidelines
- Assessing the definitions of the common set of process and product measures
- Reviewing the work environment standards
GP 2.8 Monitor and Control the Process

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

Elaboration:

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

- Percentage of projects 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
- Number of worker's compensation claims due to ergonomic problems
- Schedule for development of a process or process change

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the organizational process definition process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Establishing organizational process assets

Examples of work products reviewed include the following:

- Organization’s set of standard processes
- Descriptions of the lifecycle models
- Tailoring guidelines for the organization’s set of standard processes
- Organization’s measurement data

GP 2.10 Review Status with Higher Level Management

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

GG 3  Institutionalize a Defined Process

_The process is institutionalized as a defined process._

This generic goal's appearance here reflects its location in the continuous representation.

GP 3.1 Establish a Defined Process

_Establish and maintain the description of a defined organizational process definition process._

GP 3.2 Collect Improvement Information

_Collect work products, measures, measurement results, and improvement information derived from planning and performing the organizational process definition process to support the future use and improvement of the organization's processes and process assets._

Elaboration:

Examples of work products, measures, measurement results, and improvement information 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
<table>
<thead>
<tr>
<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The process is institutionalized as a quantitatively managed process.</strong></td>
<td></td>
</tr>
<tr>
<td>GP 4.1</td>
<td>Establish Quantitative Objectives for the Process</td>
</tr>
<tr>
<td><em>Establish and maintain quantitative objectives for the organizational process definition process, which address quality and process performance, based on customer needs and business objectives.</em></td>
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<tr>
<td>GP 4.2</td>
<td>Stabilize Subprocess Performance</td>
</tr>
<tr>
<td><em>Stabilize the performance of one or more subprocesses to determine the ability of the organizational process definition process to achieve the established quantitative quality and process-performance objectives.</em></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
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</thead>
<tbody>
<tr>
<td><strong>The process is institutionalized as an optimizing process.</strong></td>
<td></td>
</tr>
<tr>
<td>GP 5.1</td>
<td>Ensure Continuous Process Improvement</td>
</tr>
<tr>
<td><em>Ensure continuous improvement of the organizational process definition process in fulfilling the relevant business objectives of the organization.</em></td>
<td></td>
</tr>
<tr>
<td>GP 5.2</td>
<td>Correct Root Causes of Problems</td>
</tr>
<tr>
<td><em>Identify and correct the root causes of defects and other problems in the organizational process definition process.</em></td>
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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 the current strengths and weaknesses of the organization's processes and process assets.

**Introductory Notes**

The organization's processes include all the processes used by the organization and its projects. Candidate improvements to the organization's processes and process assets are obtained from various sources, including measurement of the processes, lessons learned in implementing the processes, results of process appraisals, results of product evaluation activities, results of benchmarking against other organizations’ processes, and recommendations from other improvement initiatives in the organization.

Process improvement occurs within 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 will 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 the improvements.

Careful planning is required to ensure that process improvement efforts across the organization are adequately managed and implemented. The organization’s planning for process improvement results in a process improvement plan.

The organization’s process improvement plan will address appraisal planning, process action planning, pilot planning, and deployment planning. Appraisal plans describe the appraisal timeline and schedule, the scope of the appraisal, the resources required to perform the appraisal, the reference model against which the appraisal will be performed, and the logistics for the appraisal.
Process action plans usually result from appraisals and document how specific improvements targeting the weaknesses uncovered by an appraisal will be implemented. In cases in which it is determined that the improvement described in the process action plan should be tested on a small group before deploying it across the organization, a pilot plan is generated.

Finally, when the improvement is to be deployed, a deployment plan is used. 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 the 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 Improvements**

- **SP 2.1** Establish Process Action Plans
- **SP 2.2** Implement Process Action Plans

**SG 3 Deploy Organizational Process Assets and Incorporate Lessons Learned**

- **SP 3.1** Deploy Organizational Process Assets
- **SP 3.2** Deploy Standard Processes
- **SP 3.3** Monitor Implementation
- **SP 3.4** Incorporate Process-Related Experiences into the 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 may be determined relative to a process standard or model such as a CMMI model or International Organization for Standardization (ISO) standard. The process improvements should be selected specifically to address the organization’s needs.
**SP 1.1 Establish Organizational Process Needs**

*Establish and maintain the description of the process needs and objectives for the organization.*

The organization's processes operate in a business context that must be understood. The organization's business objectives, needs, and constraints determine the needs and objectives for the organization's processes. Typically, the issues related to 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 the processes
- Process-performance objectives, such as time-to-market and delivered quality
- Process effectiveness

**Typical Work Products**

1. Organization’s process needs and objectives

**Subpractices**

1. Identify the policies, standards, and business objectives that are applicable to the organization's processes.

2. Examine relevant process standards and models for best practices.

3. Determine the organization’s process-performance objectives.

   Process-performance objectives may be expressed in quantitative or qualitative terms.

   *Refer to the Measurement and Analysis process area for more information about establishing measurement objectives.*

   - Examples of process-performance objectives include the following:
     - Cycle time
     - Defect removal rates
     - Productivity

4. Define the essential characteristics of the organization’s processes.

   The 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 used to describe the processes
- Process notation used
- Granularity of the processes

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 may be performed for the following reasons:

- To identify processes that should 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.

**Typical 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 the resources and funding to analyze and communicate the findings of the appraisal.

2. Define the scope of the process appraisal.

   Process appraisals may be performed on the entire organization or may be performed on a smaller part of an organization such as a single project or business area.
The scope of the process appraisal addresses the following:

- Definition of the organization (e.g., sites or business areas) that will be covered by the appraisal
- Identification of the project and support functions that will represent the organization in the appraisal
- Processes that will be appraised

3. Determine the method and criteria for process appraisal.

Process appraisals can occur in many forms. Process appraisals should address the needs and objectives of the organization, which may change over time. For example, the appraisal may be based on a process model, such as a CMMI model, or on a national or international standard, such as ISO 9001 [ISO 2000]. The appraisals may also be based on a benchmark comparison with other organizations. The appraisal method may assume a variety of characteristics in terms of time and effort expended, 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.**

Typical 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:

- Measure the processes and analyze the measurement results
- Review the processes for effectiveness and suitability
- Review the lessons learned from tailoring the organization’s set of standard processes
- Review the lessons learned from implementing the processes
- Review process improvement proposals submitted by the organization’s managers, staff, and other relevant stakeholders
- Solicit inputs on process improvements from senior management and leaders in the organization
- Examine the results of process appraisals and other process-related reviews
• Review results of other organizational improvement initiatives

2. Prioritize the candidate process improvements.

Criteria for prioritization are as follows:

• Consider the estimated cost and effort to implement the process improvements
• Appraise 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 the possible improvements to be implemented include the following:

• 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 that will be implemented.

4. Revise the list of planned process improvements to keep it current.

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**SG 2 Plan and Implement Process Improvements**

*Process actions that address improvements to the organization’s processes and process assets are planned and implemented.*

Successful implementation of improvements requires participation in process action planning and implementation by process owners, those performing 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 to set strategies and oversee process improvement activities
- Process group staff to facilitate and manage process improvement activities
- Process action teams to define and implement process actions
- Process owners to manage deployment
- Practitioners to perform the process

This involvement helps to obtain buy-in on the 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 in that they are plans targeting specific improvements that have been defined to address weaknesses usually uncovered by appraisals.

**Typical Work Products**

1. Organization’s approved process action plans

**Subpractices**

1. Identify strategies, approaches, and actions to address the identified process improvements.

   New, unproven, and major changes are piloted before they are incorporated into normal use.

2. Establish process action teams to implement the 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.


   Process action plans typically cover the following:
   - Process improvement infrastructure
   - Process improvement objectives
   - Process improvements that will be addressed
   - Procedures for planning and tracking process actions
   - Strategies for piloting and implementing the process actions
   - Responsibility and authority for implementing the process actions
   - Resources, schedules, and assignments for implementing the process actions
   - Methods for determining the effectiveness of the process actions
• Risks associated with process action plans

4. Review and negotiate process action plans with relevant stakeholders.

5. Review process action plans as necessary.

SP 2.2 Implement Process Action Plans

**Implement process action plans.**

**Typical Work Products**

1. Commitments among the various 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 the 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 the process action teams and relevant stakeholders to monitor the progress and results of the 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 in implementing process action plans.
8. Ensure that the results of implementing process action plans satisfy the organization’s process improvement objectives.

SG 3 Deploy Organizational Process Assets and Incorporate Lessons Learned

*The organizational process assets are deployed across the organization and process-related experiences are incorporated into the organizational process assets.*

The specific practices within this specific goal describe ongoing activities. New opportunities to benefit from the organizational process assets and changes to them may arise throughout the life of each project. Deployment of the standard processes and other organizational process assets must be continually supported within the organization, particularly for new projects at startup.
SP 3.1 Deploy Organizational Process Assets

**Deploy organizational process assets across the organization.**

Deploying organizational process assets or changes to organizational process assets should be performed in an orderly manner. Some organizational process assets or changes to organizational process assets may not be appropriate for use in some parts of the organization (because of customer requirements or the current lifecycle phase being implemented, for example). It is therefore important that those that are or will be executing the process, as well as other organization functions (such as training and quality assurance), be involved in the deployment as necessary.

*Refer to the Organizational Process Definition process area for more information about how the deployment of organizational process assets is supported and enabled by the organization’s process asset library.*

**Typical 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 this deployment include the following:

   - Identifying the organizational process assets that should be adopted by those who perform the process
   - Determining how the organizational process assets are made available (e.g., via Web site)
   - Identifying how changes to the organizational process assets are communicated
   - Identifying the resources (e.g., methods and tools) needed to support the use of the organizational process assets
   - Planning the deployment
   - Assisting those who use the organizational process assets
   - Ensuring that training is available for those who use the organizational process assets

   *Refer to the Organizational Training process area for more information about coordination of training.*
2. Document the changes to the organizational process assets.

Documenting changes to the organizational process assets serves two main purposes:

- To enable communication of the changes
- To understand the relationship of changes in the organizational process assets to changes in process performance and results

3. Deploy the changes that were made to the 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 associated support needed to successfully transition the changes

4. Provide guidance and consultation on the use of the organizational process assets.

SP 3.2 Deploy Standard Processes

*Deploy the organization’s set of standard processes to projects at their startup and deploy changes to them as appropriate throughout the life of each project.*

It is important that new projects use proven and effective processes to perform critical early activities (e.g., project planning, receiving requirements, and obtaining resources).

Projects 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 updating helps to ensure that all project activities derive the full benefit of what other projects have learned.

*Refer to the Organizational Process Definition process area for more information about the organization’s set of standard processes and tailoring guidelines.*

**Typical Work Products**

1. Organization’s list of projects and status of process deployment on each project (i.e., existing and planned projects)

2. Guidelines for deploying the organization’s set of standard processes on new projects

3. Records of tailoring the organization’s set of standard processes and implementing them on identified projects
Subpractices

1. Identify projects within the organization that are starting up.

2. Identify active projects 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 projects.

4. Assist projects in tailoring the organization’s set of standard processes to meet project needs.
   
   Refer to the Integrated Project Management process area for more information about tailoring the organization’s set of standard processes to meet the unique needs and objectives of the project.

5. Maintain records of tailoring and implementing processes on the identified projects.

6. Ensure that the defined processes resulting from process tailoring are incorporated into the plans for process-compliance audits.
   
   Process-compliance audits address objective evaluations of project activities against the project’s defined processes.

7. As the organization’s set of standard processes are updated, identify which projects should implement the changes.

SP 3.3 Monitor Implementation

Monitor the implementation of the organization’s set of standard processes and use of process assets on all projects.

By monitoring implementation, the organization ensures that the organization’s set of standard processes and other process assets are appropriately deployed to all projects. Monitoring implementation also helps the organization develop an understanding of the organizational process assets being used and where they are used within 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 projects.

Typical Work Products

1. Results of monitoring process implementation on projects

2. Status and results of process-compliance evaluations

3. Results of reviewing selected process artifacts created as part of process tailoring and implementation
Subpractices

1. Monitor projects for their use of the organization’s process assets and changes to them.

2. Review selected process artifacts created during the life of each project.

   Reviewing selected process artifacts created during the life of a project ensures that all projects are making appropriate use of the organization’s set of standard processes.

3. Review the results of process-compliance evaluations 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 against applicable process descriptions, standards, and procedures.

4. Identify, document, and track to closure issues related to implementing the organization’s set of standard processes.

---

**SP 3.4 Incorporate Process-Related Experiences into the Organizational Process Assets**

Incorporate process-related work products, measures, and improvement information derived from planning and performing the process into the organizational process assets.

Typical Work Products

1. Process improvement proposals
2. Process lessons learned
3. Measurements on the organizational process assets
4. Improvement recommendations for the organizational process assets
5. Records of the organization's process improvement activities
6. Information on the 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 organization’s business objectives.

2. Obtain feedback about the use of the organizational process assets.
3. Derive lessons learned from defining, piloting, implementing, and deploying the organizational process assets.

4. Make available lessons learned to the people in the organization as appropriate.

   Actions may have to be taken to ensure that lessons learned are used appropriately.

   Examples of inappropriate use of lessons learned include the following:
   - Evaluating the performance of people
   - Judging process performance or results

   Examples of ways to prevent inappropriate use of lessons learned include the following:
   - Controlling access to the lessons learned
   - Educating people about the appropriate use of lessons learned

5. Analyze the organization’s common set of measures.

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

   Refer to the Organizational Process Definition process area for more information about establishing an organizational measurement repository, including common measures.

6. Appraise the processes, methods, and tools in use in the organization and develop recommendations for improving the organizational process assets.

   This appraisal typically includes the following:
   - Determining which of the processes, methods, and tools are of potential use to other parts of the organization
   - Appraising the quality and effectiveness of the organizational process assets
   - Identifying candidate improvements to the 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 the 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 that will 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 may be incorporated into the organization’s process action plans.

9. Establish and maintain records of the organization's process improvement activities.

**Generic Practices by Goal**

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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.

**GP 2.2 Plan the Process**

*Establish and maintain the plan for performing the organizational process focus process.*

Elsoration:

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 the establishment of organizational process needs all the way through to the incorporation of process-related experiences into the organizational process assets.

**GP 2.3 Provide Resources**

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

Elsoration:

Examples of resources provided include the following tools:

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

**GP 2.4 Assign Responsibility**

*Assign responsibility and authority for performing the process, developing the work products, and providing the services of the organizational process focus process.*
Elaboration:

Two groups are typically established and assigned responsibility for process improvement: (1) a management steering committee for process improvement to provide senior management sponsorship, and (2) a process group to facilitate and manage the process improvement activities.

**GP 2.5 Train People**

*Train the people performing or supporting the organizational process focus process as needed.*

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

**GP 2.6 Manage Configurations**

*Place designated work products of the organizational process focus process under appropriate levels of control.*

Elaboration:

Examples of work products placed under control include the following:

- Process improvement proposals
- Organization’s approved process action plans
- Training materials for deploying organizational process assets
- Guidelines for deploying the organization’s set of standard processes on new projects
- Plans for the organization’s process appraisals

**GP 2.7 Identify and Involve Relevant Stakeholders**

*Identify and involve the relevant stakeholders of the organizational process focus process as planned.*
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 and 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

GP 2.8 Monitor and Control the Process

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

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
- Schedule for deployment of an organizational process asset
- Percentage of projects using the current organization’s set of standard processes (or tailored version of same)
- Issue trends associated with implementing the organization’s set of standard processes (i.e., number of issues identified and number closed)

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the organizational process focus process against its process description, standards, and procedures, and address noncompliance.
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 on projects 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

GP 2.10  Review Status with Higher Level Management

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

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, or progress toward achieving a targeted organizational maturity level or capability level profile)
Continuous Only

**GG 3**  Institutionalize a Defined Process

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1**  Establish a Defined Process

*Establish and maintain the description of a defined organizational process focus process.*

**GP 3.2**  Collect Improvement Information

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the organizational process focus process to support the future use and improvement of the organization’s processes and process assets.*

**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

- Criteria used for prioritizing 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 projects
### Continuous Only

**GG 4** Institutionalize a Quantitatively Managed Process

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<td><em>Stabilize the performance of one or more subprocesses to determine the ability of the organizational process focus process to achieve the established quantitative quality and process-performance objectives.</em></td>
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**GG 5** Institutionalize an Optimizing Process

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<td><em>Identify and correct the root causes of defects and other problems in the organizational process focus process.</em></td>
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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 the organization’s set of standard processes in support of quality and process-performance objectives, and to provide the process-performance data, baselines, and models to quantitatively manage the organization’s projects.

Introductory Notes

Process performance is a measure of the actual results achieved by following a process. Process performance is characterized by process measures (e.g., effort, cycle time, and defect removal effectiveness) and product measures (e.g., reliability, defect density, capacity, response time, and cost).

The common measures for the organization are composed of process and product measures that can be used to summarize the actual performance of processes in individual projects in the organization. The organizational data for these measures are analyzed to establish a distribution and range of results, which characterize the expected performance of the process when used on any individual project in the organization.

In this process area, the phrase “quality and process-performance objectives” covers objectives and requirements for product quality, service quality, and process performance. As indicated above, the term “process performance” includes quality; however, to emphasize the importance of quality, the phrase “quality and process-performance objectives” is used rather than just “process-performance objectives.”

The expected process performance can be used in establishing the project’s quality and process-performance objectives and can be used as a baseline against which actual project performance can be compared. This information is used to quantitatively manage the project. Each quantitatively managed project, in turn, provides actual performance results that become a part of the baseline data for the organizational process assets.
The associated 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 defects identified during product verification activities.

When the organization has 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 where the performance is within natural bounds that are consistent across process implementation teams
- Establish criteria for identifying whether a process or subprocess should be statistically managed, and determine pertinent measures and analytical techniques to be used in such management
- Identify processes that show unusual (e.g., sporadic or unpredictable) behavior
- Identify any aspects of the processes that can be improved in the organization’s set of standard processes
- Identify the implementation of a process which performs best

**Related Process Areas**

*Refer to the Quantitative Project Management process area for more information about the use of process-performance baselines and models.*

*Refer to the Measurement and Analysis process area for more information about specifying measures and collecting and analyzing data.*

**Specific Goal and Practice Summary**

SG 1 Establish Performance Baselines and Models
- SP 1.1 Select Processes
- SP 1.2 Establish Process-Performance Measures
- SP 1.3 Establish Quality and Process-Performance Objectives
- SP 1.4 Establish Process-Performance Baselines
- SP 1.5 Establish Process-Performance Models
Specific Practices by Goal

SG 1  Establish Performance Baselines and Models

Baseline 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 which processes are suitable to be measured (the Select Processes specific practice), which measures are useful for determining process performance (the Establish Process Performance Measures specific practice), and the quality and process-performance objectives for those processes (the Establish Quality and Process-Performance Objectives specific practice). These specific practices are often interrelated and may need to be performed concurrently to select the appropriate processes, measures, and quality and process-performance objectives. Often, the selection of one process, measure, or objective will constrain the selection of the others. For example, if a certain process is selected, the measures and objectives for that process may be constrained by the process itself.

SP 1.1  Select Processes

Select the processes or subprocesses in the organization’s set of standard processes that are to be included in the organization’s process-performance analyses.

Refer to the Organizational Process Definition process area for more information about the structure of the 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 will not be 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 the processes and/or subprocesses is based on the needs and objectives of both the organization and projects.

Examples of criteria which may be used for the selection of a process or subprocess for organizational analysis include the following:

- The relationship of the subprocess to key business objectives
- Current availability of valid historical data relevant to the subprocess
- The current degree of variability of this data
- Subprocess stability (e.g. stable performance in comparable instances)
- The availability of corporate or commercial information that can be used to build predictive models
The existence of project data that indicates the process or subprocess has been or can be stabilized is a useful criterion for selection of a process or subprocess.

Typical Work Products
1. List of processes or subprocesses identified for process-performance analyses

SP 1.2 Establish Process-Performance Measures

| Establish and maintain definitions of the measures that are to be included in the organization’s process-performance analyses. |

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

Typical Work Products
1. Definitions for the selected measures of process performance

Subpractices
1. Determine which of the organization’s business objectives for quality and process performance need to be addressed by the measures.

2. Select measures that provide appropriate insight into the organization’s quality and process performance.

The Goal Question Metric paradigm is an approach that can be used to select measures that provide insight into the organization’s business objectives.

Examples of criteria used to select measures include the following:

- Relationship of the measures to the organization’s business objectives
- Coverage that the measures provide over the entire life of the product or service
- Visibility that the measures provide into the process performance
- Availability of the measures
- Extent to which the measures are objective
- Frequency at which the observations of the measure can be collected
- Extent to which the measures are controllable by changes to the process or subprocess
- Extent to which the measures represent the users’ view of effective process performance

3. Incorporate the 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.

**SP 1.3 Establish Quality and Process-Performance Objectives**

*Establish and maintain quantitative objectives for quality and process performance for the organization.*

The organization’s quality and process-performance objectives should have the following attributes:

- Based on the organization’s business objectives
- Based on the past performance of projects
- Defined to gauge process performance in areas such as product quality, productivity, cycle time, or response time
- Constrained by the inherent variability or natural bounds of the selected process or subprocess

**Typical 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:

   - Achieve a development cycle of a specified duration for a specified release of a product
   - Achieve an average response time less than a specified duration for a specified version of a service
   - Deliver functionality of the product to a target percentage of estimated cost
   - Decrease the cost of maintenance of the products by a specified percent

2. Define the organization’s quantitative objectives for quality and process performance.

   Objectives may be established for process or subprocess measurements (e.g., effort, cycle time, and defect removal effectiveness) as well as for product measurements (e.g., reliability and defect density) and service measurements (e.g., capacity and response times) where appropriate.
Examples of quality and process-performance objectives include the following:

- Achieve a specified productivity
- Deliver work products with no more than a specified number of latent defects
- Shorten time to delivery to a specified percentage of the process-performance baseline
- Reduce the total lifecycle cost of new and existing products by a percentage
- Deliver a percentage of the specified product functionality

3. Define the priorities of the organization’s objectives for quality and process performance.

4. Review, negotiate, and obtain commitment for the organization’s quality and process-performance objectives and their priorities from the 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 processes change
- When actual quality and process performance differs significantly from the objectives

**SP 1.4 Establish Process-Performance Baselines**

*Establish and maintain the organization’s process-performance baselines.*

The organization’s process-performance baselines are a measurement of performance for the organization’s set of standard processes at various levels of detail, as appropriate. The processes include the following:

- Sequence of connected processes
- Processes that cover the entire life of the project
- Processes for developing individual work products

There may 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
- Line of business
- Application domain
- Complexity
- Team size
- Work product size
- Process elements from the organization’s set of standard processes

Allowable tailoring of the organization’s set of standard processes may significantly affect the comparability of the data for inclusion in process-performance baselines. The 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 Project Management process area for more information about the use of process-performance baselines.*

**Typical Work Products**

1. Baseline data on the organization’s process performance

**Subpractices**

1. Collect measurements from the organization’s projects.

   The process or subprocess in use when the measurement was taken is recorded to enable appropriate use later.

   *Refer to the Measurement and Analysis process area for information about collecting and analyzing data.*

2. Establish and maintain the organization’s process-performance baselines from the collected measurements and analyses.

   *Refer to the Measurement and Analysis process area for information about establishing objectives for measurement and analysis, specifying the measures and analyses to be performed, obtaining and analyzing measures, and reporting results.*

   Process-performance baselines are derived by analyzing the collected measures to establish a distribution and range of results that characterize the expected performance for selected processes or subprocesses when used on any individual project in the organization.

   The measurements from stable subprocesses from projects should be used; other data may not be reliable.
3. Review and get agreement with relevant stakeholders about the organization’s process-performance baselines.

4. Make the organization's process-performance information available across the organization in the organization's measurement repository.

   The organization’s process-performance baselines are used by the projects to estimate the natural bounds for process performance.

   Refer to the Organizational Process Definition process area for more information about establishing the organization’s measurement repository.

5. Compare the organization’s process-performance baselines to the associated objectives.

6. Revise the organization’s process-performance baselines as necessary.

Examples of when the organization’s process-performance baselines may need to be revised include the following:

- When the processes change
- When the organization’s results change
- When the organization’s needs change

---

SP 1.5 Establish Process-Performance Models

*Establish and maintain the process-performance models for the organization’s set of standard processes.*

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 life of the project to estimate progress toward achieving objectives that cannot be measured until later in the project’s life.

The process-performance models are used as follows:

- The organization uses them for estimating, analyzing, and predicting the process performance associated with the processes in the organization's set of standard processes.
- The organization uses them to assess the (potential) return on investment for process improvement activities.
- Projects use them for estimating, analyzing, and predicting the process performance for their defined processes.
- Projects use them for selecting processes or subprocesses for use.
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 business value.

Examples of areas of concern to projects in which models may be useful include the following:

- Schedule and cost
- Reliability
- Defect identification and removal rates
- Defect removal effectiveness
- Latent defect estimation
- Response time
- Project progress
- Combinations of these areas

Examples of process-performance models include the following:

- System dynamics models
- Reliability growth models
- Complexity models

Refer to the Quantitative Project Management process area for more information about the use of process-performance models.

Typical Work Products

1. Process-performance models

Subpractices

1. Establish the process-performance models based on the organization’s set of standard processes and the organization’s process-performance baselines.

2. Calibrate the process-performance models based on the organization’s past results and current needs.

3. Review the process-performance models and get agreement with relevant stakeholders.

4. Support the projects’ use of the process-performance models.

5. Revise the process-performance models as necessary.
Examples of when the process-performance models may need to be revised include the following:

- When the processes change
- When the organization’s results change
- When the organization’s needs change

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**Elaboration:**

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

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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.

GP 2.3 Provide Resources

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

Elaboration:

Special expertise in statistics and statistical process control may be needed to establish the process-performance baselines for the organization’s set of standard processes.

Examples of other resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the organizational process performance process as needed.

Elaboration:

Examples of training topics include the following:

- Process and process improvement modeling
- Quantitative and statistical methods (e.g., estimating models, Pareto analysis, and control charts)
GP 2.6 Manage Configurations

Place designated work products of the organizational process performance process under appropriate levels of control.

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

GP 2.7 Identify and Involve Relevant Stakeholders

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

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

GP 2.8 Monitor and Control the Process

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

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, and quality)
• Schedule for collecting and reviewing measures to be used for establishing a process-performance baseline

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the organizational process performance process against its process description, standards, and procedures, and address noncompliance.
Elaboration:

Examples of activities reviewed include the following:

- Establishing process-performance baselines and models

Examples of work products reviewed include the following:

- Process-performance plans
- Organization’s quality and process-performance objectives
- Definitions of the selected measures of process performance

**GP 2.10 Review Status with Higher Level Management**

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

**Continuous Only**

**GG 3 Institutionalize a Defined Process**

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1 Establish a Defined Process**

*Establish and maintain the description of a defined organizational process performance process.*

**GP 3.2 Collect Improvement Information**

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the organizational process performance process to support the future use and improvement of the organization’s processes and process assets.*

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

- Process-performance baselines
- Percent of measurement data that is rejected because of inconsistencies with the process-performance measurement definitions
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<thead>
<tr>
<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
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<td><em>The process is institutionalized as a quantitatively managed process.</em></td>
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<tr>
<td>GP 4.1</td>
<td>Establish Quantitative Objectives for the Process</td>
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<td><em>Establish and maintain quantitative objectives for the organizational process performance process, which address quality and process performance, based on customer needs and business objectives.</em></td>
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<td>GP 4.2</td>
<td>Stabilize Subprocess Performance</td>
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<td><em>Stabilize the performance of one or more subprocesses to determine the ability of the organizational process performance process to achieve the established quantitative quality and process-performance objectives.</em></td>
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<th>GG 5</th>
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<td><em>The process is institutionalized as an optimizing process.</em></td>
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<tr>
<td>GP 5.1</td>
<td>Ensure Continuous Process Improvement</td>
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<td><em>Ensure continuous improvement of the organizational process performance process in fulfilling the relevant business objectives of the organization.</em></td>
</tr>
<tr>
<td>GP 5.2</td>
<td>Correct Root Causes of Problems</td>
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<td><em>Identify and correct the root causes of defects and other problems in the organizational process performance process.</em></td>
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ORGANIZATIONAL SERVICE MANAGEMENT

A Process Management Process Area at Maturity Level 3

Purpose

The purpose of Organizational Service Management (OSM) is to establish and maintain standard services that ensure the satisfaction of the organization’s customer base.

Introductory Notes

The Organizational Service Management process area involves the following:

• gathering and analyzing data on customer satisfaction
• establishing and maintaining standard services and service levels

Organizational service management improves alignment between a service organization and its customer base. Within this process area, the customer includes the end user. Active engagement with customers yields information that the organization uses to ensure current customer satisfaction and anticipate future customer needs for services. The organization may also identify requirements for new service systems or changes to existing systems; these systems may support single or multiple customers.

Standard services enable consistent service performance across the organization and provide a basis for improving the fit of services to customer needs. They may also improve service quality, business capture, and customer satisfaction 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.

The standard services are typically described in a service catalog oriented to the information needs of customers. In addition, the service organization may maintain standard service descriptions oriented to the needs of its own personnel.

Regular attention to customer satisfaction with current services allows the organization to adjust or correct those services and may also contribute to planning for future services.
Related Process Areas

Refer to the Requirements Management process area for more information about defining a customer’s needs for a specific service and service agreement.

Refer to Service System Development for translating customer needs and standard services into new service systems for delivering services to customers.

Refer to Service Delivery for more information about delivering the services.

Refer to Project Monitoring and Control and Incident and Request Management for more information about processes for monitoring customer needs that could be included in the standard services.

Refer to the Organizational Process Definition process area for more information about establishing and maintaining standard processes to deliver standard services.

Specific Goal and Practice Summary

SG 1 Address Long-Term Customer Satisfaction
- SP 1.1 Gather Customer Satisfaction Data
- SP 1.2 Analyze Customer Satisfaction Data
- SP 1.3 Address Needs for Future Services

SG 2 Establish Standard Services
- SP 2.1 Establish Standard Services and Service Levels
- SP 2.2 Establish Standard Service Descriptions
- SP 2.3 Establish Tailoring Criteria and Guidelines
- SP 2.4 Establish the Organization’s Standard Service Repository

Specific Practices by Goal

SG 1 Address Long-Term Customer Satisfaction

*Long-term customer satisfaction data is gathered and analyzed.*

**SP 1.1 Gather Customer Satisfaction Data**

*Gather data about customer satisfaction that informs the organization about alignment between customer needs and standard services.*

The organization identifies relevant relationships or representatives of customer types and consistently engages with them to offer and receive information to ensure present and future alignment between customer needs and services. The objective of this activity is not to manage individual agreements, but to fuel organizational deliberations about standard services.
Examples of techniques and settings to capture customer satisfaction data include the following:

- Surveys
- Interviews and focus groups
- Scenarios and use cases
- User group settings
- Service reviews
- Customer presentations

**Typical Work Products**

1. Database of customer information
2. Records and notes of customer interactions

**Subpractices**

1. Determine and prioritize customer categories.
2. Identify relevant customers.
3. Interact with identified customers.
4. Collect data on customer satisfaction.
5. Capture and relay information that is important to customer satisfaction to relevant stakeholders.

**SP 1.2 Analyze Customer Satisfaction Data**

*Analyze customer satisfaction data to identify opportunities to improve, delete, or add standard services.*

**Typical Work Products**

1. Analysis of periodic customer and end-user satisfaction surveys
2. Analysis of collective incidents and service requests
3. Analysis of collective account manager notes
4. Action item lists
5. Improvement proposals
6. Future use cases or scenarios
7. Descriptions of market forces
8. Competitive and market analysis
Subpractices
1. Analyze data
2. Identify needed actions and improvements.

   Needed actions and improvements may include identifying services to revise or retire.

### SP 1.3 Address Customer Needs for Future Services

*Translate the needs of the organization’s set of customers into decisions about services to be developed.*

**Typical Work Products**
1. Descriptions of customer needs
2. Prospective service descriptions
3. Analysis of service system needs
4. Decision or approval packages for selected services

Subpractices
1. Describe current and future customer needs for services.
2. Select services to be developed.
3. Review and get agreement from relevant stakeholders on the services to be developed.

### SG 2 Establish Standard Services

*A set of organizational services is established and maintained.*

### SP 2.1 Establish Standard Services and Service Levels

*Establish and maintain the organization’s set of standard services and service levels.*

Multiple standard services and service levels may be needed to address the needs of different customers, units of the organization, markets, or application domains. In addition to establishing standard services, the services may 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 Project Monitoring and Control for more information about monitoring service levels.*

*Refer to Capacity and Availability Management for more information about capacity for delivering services against defined levels.*
Refer to Organizational Process Definition for more information about establishing and maintaining standard processes.

Typical Work Products
1. Organization’s set of standard services, often expressed in a service catalog
2. Organization’s set of standard service levels
3. Templates for service level agreements (SLAs)

Subpractices
1. Collect information on existing or potential services.

Examples of information sources on services include the following:

- Strategic planning work products
- Business plans
- Industry, market, and competitive analysis
- Customer requests

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 the standard services.

Variable parts of the standard service may be assigned categories and parameters. Standard service levels may 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. Select services and organize services into lines as needed.

5. Ensure that the organization's set of standard services adheres to applicable policies, standards, and models.

6. Ensure that there is appropriate integration among the services that are included in the organization's set of standard services.

7. Ensure that standard processes are available for delivering the standard services.

8. Define service levels.

   Defined service levels make levels of service offered specific and measurable. Services levels may help to balance cost and demand for service, and make roles and responsibilities between service provider and user clear.

   Service level information includes the following:
   - Provider and user responsibilities
   - Availability of service
   - Agreed service hours and exceptions
   - Anticipated service volume
   - Response times for service requests, incidents, and problems
   - Performance or quality targets
   - Key metrics to monitor
   - Reporting and escalation procedures
   - Consequences of failure
   - Variations available (such as “gold” service)

9. Document the organization's set of standard services and service levels.

   Standard service levels may be reflected in standard SLAs.

10. Conduct peer reviews on the organization's set of standard services and service levels.

11. Revise the organization's set of standard services and service levels as necessary.

12. Refresh the set of standard services and service levels on a periodic basis.

### SP 2.2 Establish Descriptions of the Standard Services

*Establish and maintain descriptions of the services that are approved for use in the organization.*
In addition to a set of descriptions for use 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 an organization, but not described in a manner that is effective and appropriate for all the intended users of the standard services. For successful use of standard services, they must be appropriately described for the full range of intended users.

Also, the descriptions for staff use must refer to the standard processes that are used to deliver the services.

**Typical Work Products**
1. Descriptions of services, often recorded in a service catalog or menu.

**Subpractices**
1. Develop the descriptions of the services for all relevant users.
2. Conduct peer reviews on the descriptions.

   Customer representatives may be included in these peer reviews to ensure that the descriptions meet the information needs of customers.
3. Revise the descriptions as necessary.

---

**SP 2.3 Establish Tailoring Criteria and Guidelines**

*Establish and maintain the tailoring criteria and guidelines for the organization's set of standard services.*

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  
  
  *Refer to the Service System Development process area for more information.*

- 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 reasons for tailoring include the following:

- Adapting the service for a new customer need or work environment
- Customizing the service for a specific application or class of similar applications
The organization uses knowledge of customer needs to develop sets of tailoring options that limit risk and improve customer satisfaction and time to market, while maintaining consistency across the organization.

**Typical Work Products**
1. Tailoring guidelines for the organization's set of standard services

**Subpractices**
1. Specify the selection criteria and procedures for tailoring the organization's set of standard services.

   **Examples of criteria and procedures include the following:**
   - Criteria for selecting services from those 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

2. Determine the standards for tailoring given the common and variable parts of the standard service.
3. Specify the standards for documenting the tailored services.
4. Ensure that the standards for tailoring standard services and the guidelines for tailoring standard processes are integrated.
5. Specify the procedures for submitting and obtaining approval of waivers from the requirements of the organization's set of standard services.
6. Document the tailoring guidelines for the organization's set of standard services.
7. Conduct peer reviews on the tailoring guidelines.
8. Revise the tailoring guidelines as necessary.

**SP 2.4 Establish the Standard Service Repository**

*Establish and maintain the organization's standard service repository.*
The organization's standard service repository is a collection of service descriptions maintained by the organization for use by the people and projects of the organization. This collection of items includes descriptions of services, descriptions of service levels, and service tailoring guidelines. The repository may house related information such as instructions for the sales force, proposal authors, and contract specialists.

Examples of sites for the standard service repository include the following:

- Configuration management database
- Web pages
- Document portfolio or library

**Typical Work Products**

1. Design of the organization’s standard service repository
2. Standard service repository
3. Selected items to be included in the organization’s standard service repository
4. Catalog of items in the organization’s standard service repository

**Subpractices**

1. Design and implement the organization’s standard service repository, including the repository structure and support environment.

   The organization’s standard service repository may be combined with the organization’s process asset library.

2. Specify the criteria for including items in the repository.
3. Specify the procedures for storing and retrieving items.
4. Enter the selected items into the repository and label them for easy reference and retrieval.
5. Make the items available for use.
6. Periodically review the use of each item and use the results to maintain the repository contents.
7. Revise the organization’s standard service repository as necessary.
Examples of when the repository may need to be revised include the following:

- New items are added
- Items are retired
- Current versions of items are changed

### Generic Practices by Goal

#### Continuous Only

<table>
<thead>
<tr>
<th>GG 1</th>
<th>Achieve Specific Goals</th>
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<tbody>
<tr>
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<td>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</td>
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<tr>
<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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<td>Perform the specific practices of the configuration management process to develop work products and provide services to achieve the specific goals of the process area.</td>
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<th>GG 2</th>
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<td>The process is institutionalized as a managed process.</td>
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#### Staged Only

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<table>
<thead>
<tr>
<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<td>Establish and maintain an organizational policy for planning and performing the Organizational Service Management process.</td>
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</table>

**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 across the organization.
GP 2.2  Plan the Process

*Establish and maintain the plan for performing the Organizational Service Management process.*

GP 2.3  Provide Resources

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

GP 2.4  Assign Responsibility

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

GP 2.5  Train People

*Train the people performing or supporting the Organizational Service Management process as needed.*

GP 2.6  Manage Configurations

*Place designated work products of the Organizational Service Management process under appropriate levels of control.*

Elaboration:

- Examples of work products placed under control include the following:
  - Organization’s set of standard service descriptions
  - Descriptions of the service levels
  - Tailoring guidelines for the organization’s set of standard services

GP 2.7  Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the Organizational Service Management process as planned.*

Elaboration:

- Examples of activities for stakeholder involvement include the following:
  - Reviewing the organization’s set of standard services
  - Reviewing the organization’s service levels
  - Resolving issues on the tailoring guidelines
GP 2.8  Monitor and Control the Process

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

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 violating defined service levels
- Frequency of use of particular services
- Schedule for development of a service description change

GP 2.9  Objectively Evaluate Adherence

Objectively evaluate adherence of the Organizational Service Management process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Establishing organizational standard services

Examples of work products reviewed include the following:

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

GP 2.10  Review Status with Higher Level Management

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

Continuous Only

GG 3  Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the continuous representation.
GP 3.2 Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the Organizational Service Management process to support the future use and improvement of the organization’s standard services.

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

GG 4 Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

GP 4.1 Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the decision analysis and resolution process, which address quality and process performance, based on customer needs and business objectives.

GP 4.2 Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the decision analysis and resolution process to achieve the established quantitative quality and process-performance objectives.

GG 5 Institutionalize an Optimizing Process

The process is institutionalized as an optimizing process.

GP 5.1 Ensure Continuous Process Improvement

Ensure continuous improvement of the decision analysis and resolution process in fulfilling the relevant business objectives of the organization.
### Continuous Only

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<th>GP 5.2 Correct Root Causes of Problems</th>
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<td><strong>Identify and correct the root causes of defects and other problems in the decision analysis and resolution process.</strong></td>
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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 the skills and knowledge of people so they can perform their roles effectively and efficiently.

Introductory Notes

Organizational Training includes training to support the organization’s strategic business objectives and to meet the tactical training needs that are common across projects and support groups. Specific training needs identified by individual projects and support groups are handled at the project and support group level and are outside the scope of Organizational Training. Project and support groups are responsible for identifying and addressing their specific training needs.

Refer to the Project Planning process area for more information about the specific training needs identified by projects.

An organizational training program involves the following:

• Identifying the training needed by the organization
• Obtaining and providing training to address those needs
• Establishing and maintaining training capability
• Establishing and maintaining training records
• Assessing training effectiveness

Effective training requires assessment of needs, planning, instructional design, and appropriate training media (e.g., workbooks and 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, personnel with appropriate mastery of specific disciplines and other areas of knowledge, and mechanisms for measuring the effectiveness of the training program.

The identification of process training needs is primarily based on the skills that are required to perform the organization’s set of standard processes.
Refer to the Organizational Process Definition process area for more information about the organization’s set of standard processes.

Certain skills may be effectively and efficiently imparted through vehicles other than in-class 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 can be measured in terms of the availability of opportunities to acquire the skills and knowledge needed to perform new and ongoing enterprise activities.

Skills and knowledge may be technical, organizational, or contextual. Technical skills pertain to the ability to use the equipment, tools, materials, data, and processes required by a project or a process. Organizational skills pertain to behavior within and according to the employee’s 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 in the organizational and social context of the project and support groups.

The phrase “project and support groups” is used frequently in the text of the process area description to indicate an organization-level perspective.

Related Process Areas

Refer to the Organizational Process Definition process area for more information about the organization’s process assets.

Refer to the Project Planning process area for more information about the specific training needs identified by projects.

Refer to the Decision Analysis and Resolution process area for how to apply decision-making criteria when determining training approaches.
Specific Goal and Practice Summary

SG 1 Establish an Organizational Training Capability

SP 1.1 Establish the 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 Training Capability

SG 2 Provide Necessary 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 organization's management and technical roles, is established and maintained.

The organization identifies the training required to develop the skills and the knowledge necessary to perform enterprise activities. Once the needs are identified, a training program addressing those needs is developed.

SP 1.1 Establish the Strategic Training Needs

Establish and maintain the 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:

- Organization’s standard processes
- Organization’s strategic business plan
- Organization’s process improvement plan
- Enterprise-level initiatives
- Skill assessments
- Risk analyses

Typical Work Products

1. Training needs
2. Assessment analysis
Subpractices
1. Analyze the organization’s strategic business objectives and process improvement plan to identify potential future training needs.

2. Document the strategic training needs of the organization.

   Examples of categories of training needs include (but are not limited to) the following:
   - Process analysis and documentation
   - Engineering (e.g., requirements analysis, design, testing, configuration management, and quality assurance)
   - Service delivery
   - Selection and management of suppliers
   - Management (e.g., estimating, tracking, and risk management)
   - Disaster recovery and continuity of operations

3. Determine the roles and skills needed to perform the organization’s set of standard processes.

4. Document the training needed to perform the 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

*Determines which training needs are the responsibility of the organization and which will be left to the individual project or support group.*

Refers to the Project Planning process area for more information about project- and support-group-specific plans for training.
In addition to strategic training needs, organizational training addresses training requirements that are common across projects and support groups. Projects and support groups have the primary responsibility for identifying and addressing their specific training needs. The organization’s training staff is only responsible for addressing common cross-project and support group training needs (e.g., training in work environments common to multiple projects). In some cases, however, the organization’s training staff may address additional training needs of projects and support groups, as negotiated with them, within the context of the training resources available and the organization’s training priorities.

**Typical Work Products**

1. Common project and support group training needs
2. Training commitments

**Subpractices**

1. Analyze the training needs identified by the various projects and support groups.

   Analysis of project 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 project and support group level.

2. Negotiate with the various projects and support groups on how their specific 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 project or support group include the following:
   - Training in the application or service domain of the project
   - Training in the unique tools and methods used by the project or support group
   - Training in safety, security, and human factors

3. Document the commitments for providing training support to the projects 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 or resources) and to evaluations of effectiveness.

**Typical Work Products**
1. Organizational training tactical plan

**Subpractices**
1. Establish plan content.

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, and skills and knowledge

2. Establish commitments to the plan.

Documented commitments by those responsible for implementing and supporting the plan are essential for the plan to be effective.

3. Revise plan and commitments as necessary.

**SP 1.4 Establish Training Capability**

*Establish and maintain training capability to address organizational training needs.*

Refer to the Decision Analysis and Resolution process area for how to apply decision-making criteria when selecting training approaches and developing training materials.

**Typical Work Products**
1. Training materials and supporting artifacts

**Subpractices**
1. Select the appropriate approaches to satisfy specific organizational training needs.
Many factors may affect the selection of training approaches, including audience-specific knowledge, costs and schedule, work environment, and so on. Selection of 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 acquire them externally.

Determine the costs and benefits of internal training development or of obtaining training externally.

Example criteria that can be used to determine the most effective mode of knowledge or skill acquisition include the following:

- Performance objectives
- Time available to prepare for project execution
- 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 may be provided by the project, by support groups, by the organization, or by 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.

To ensure that internally provided training instructors have the necessary knowledge and training skills, criteria can be defined to identify, develop, and qualify them. In the case of externally provided training, the organization’s training staff can investigate how the training provider determines which instructors will deliver the training. This can also be a factor in selecting or continuing to use a specific training provider.

5. Describe the training in the organization's training curriculum.

Examples of the information provided in the 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 the training materials and supporting artifacts as necessary.

Examples of situations in which the 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, or instructor evaluation forms)

SG 2 Provide Necessary Training

Training necessary for individuals to perform their roles effectively is provided.

In selecting people to be trained, the following should be taken into consideration:

- 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 technical management training for all disciplines, including project management
• Need for managers to have training in appropriate organizational processes
• Need for training in the basic principles of all appropriate disciplines to support personnel in quality management, configuration management, and other related support functions
• Need to provide competency development for critical functional areas
• Need to maintain the competencies and qualifications of personnel to operate and maintain work environments common to multiple projects

### SP 2.1 Deliver Training

**Deliver the training following the organizational training tactical plan.**

**Typical Work Products**
1. Delivered training course

**Subpractices**
1. Select the people who will receive the training necessary to perform their roles effectively.

   Training is intended to impart knowledge and skills to people performing various roles within 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 and instructors).

   Training should be planned and scheduled. Training is provided that has a direct bearing on the expectations of work performance. Therefore, optimal training occurs in a timely manner with regard to imminent job-performance expectations. These expectations often include the following:
   - Training in the use of specialized tools
   - Training in procedures that are new to the individual who will perform them

3. Conduct the training.
Experienced instructors should perform training. When possible, training is conducted in settings that closely resemble actual performance conditions 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.

4. Track the delivery of training against the plan.

### SP 2.2 Establish Training Records

**Establish and maintain records of the organizational training.**

*Refer to the Project Monitoring and Control process area for information about how project or support group training records are maintained.*

The scope of this practice is for the training performed at the organizational level. Establishment and maintenance of training records for project- or support-group-sponsored training is the responsibility of each individual project or support group.

**Typical 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 have been waived from specific 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 for organizational training.

3. Keep records of all students who successfully complete their designated 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 the 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 managers’ satisfaction with post-training effects
- Assessment mechanisms embedded in courseware

Measures may be taken to assess the benefit of the training against both the project’s 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, performance objectives should be shared with course participants, and should be unambiguous, observable, and verifiable. The results of the training-effectiveness assessment should be used to revise training materials as described in the Establish Training Capability specific practice.

Typical 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 projects to determine whether staff knowledge is adequate for performing project tasks.
2. Provide a mechanism for assessing the effectiveness of each training course with respect to established organizational, project, or individual learning (or performance) objectives.
3. Obtain student evaluations of how well training activities met their needs.

Generic Practices by Goal

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<tr>
<td>GG 1 Achieve Specific Goals</td>
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Organizational Training (OT)
Continuous Only

GP 1.1 Perform Specific Practices

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

GG 2 Institutionalize a Managed Process

*The process is institutionalized as a managed process.*

Staged Only

GG 3 Institutionalize a Defined Process

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the staged representation.

GP 2.1 Establish an Organizational Policy

*Establish and maintain an organizational policy for planning and performing the organizational training process.*

Elaboration:

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

GP 2.2 Plan the Process

*Establish and maintain the plan for performing the organizational training process.*

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 would address the comprehensive planning for all of the specific practices in this process area, from the establishment of strategic training needs all the way through to the assessment of the effectiveness of the organizational training effort. In contrast, the organizational training tactical plan called for in the specific practice would address the periodic planning for the delivery of individual training offerings.
GP 2.3  Provide Resources

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

Elaboration:

Examples of people (full or part time, internal or external), and skills needed 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 other resources provided include the following tools:

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

GP 2.4  Assign Responsibility

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

GP 2.5  Train People

*Train the people performing or supporting the organizational training process as needed.*

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices for more information about the relationship between generic practice 2.5 and the Organizational Training process area.

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9 Retained for consistency with CMMI product suite. This draft document does not have this table or section.
Examples of training topics include the following:

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

GP 2.6 Manage Configurations

*Place designated work products of the organizational training process under appropriate levels of control.*

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

GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the organizational training process as planned.*

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

GP 2.8 Monitor and Control the Process

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

GP 2.9   Objectively Evaluate Adherence

Objectively evaluate adherence of the organizational training process against its process description, standards, and procedures, and address noncompliance.

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

GP 2.10   Review Status with Higher Level Management

Review the activities, status, and results of the organizational training process with higher level management and resolve issues.
### Continuous Only

**GG 3**  
**Institutionalize a Defined Process**

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1**  
**Establish a Defined Process**

*Establish and maintain the description of a defined organizational training process.*

**GP 3.2**  
**Collect Improvement Information**

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the organizational training process to support the future use and improvement of the organization's processes and process assets.*

**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

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

### Continuous Only

**GG 4**  
**Institutionalize a Quantitatively Managed Process**

*The process is institutionalized as a quantitatively managed process.*

**GP 4.1**  
**Establish Quantitative Objectives for the Process**

*Establish and maintain quantitative objectives for the organizational training process, which address quality and process performance, based on customer needs and business objectives.*

**GP 4.2**  
**Stabilize Subprocess Performance**

*Stabilize the performance of one or more subprocesses to determine the ability of the organizational training process to achieve the established quantitative quality and process...*
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<td><strong>performance objectives.</strong></td>
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<th>Institutionalize an Optimizing Process</th>
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<th>GP 5.1</th>
<th>Ensure Continuous Process Improvement</th>
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<td>Identify and correct the root causes of defects and other problems in the organizational training process.</td>
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PROJECT MONITORING AND CONTROL

A Project Management Process Area at Maturity Level 2

Purpose

The purpose of Project Monitoring and Control (PMC) is to provide an understanding of the project’s progress so that appropriate corrective actions can be taken when the project’s performance deviates significantly from the plan.

Introductory Notes

A project’s documented plan is the basis for monitoring activities, communicating status, and taking corrective action. Progress is primarily determined by comparing actual work product and task attributes, effort, cost, and schedule to the plan at prescribed milestones or control levels within the project schedule or work breakdown structure (WBS). Appropriate visibility 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 project from meeting its objectives.

The term “project plan” is used throughout these practices to refer to the overall plan for controlling the project.

When actual status deviates significantly from the expected values, corrective actions are taken as appropriate. These actions may require replanning, which may include revising the original plan, establishing new agreements, or including additional mitigation activities within the current plan.

Related Process Areas

Refer to the Project Planning process area for more information about the project plan, including how it specifies the appropriate level of project monitoring, the measures used to monitor progress, and known risks.

Refer to the Service Delivery process area for more information about monitoring service delivery for expected performance and customer satisfaction.
Refer to the Capacity and Availability Management process area for information about analyzing and monitoring resources to meet service requirements.

Refer to the Measurement and Analysis process area for information about the process of measuring, analyzing, and recording information.

Specific Goal and Practice Summary

SG 1 Monitor Project Against Plan
- SP 1.1 Monitor Project Planning Parameters
- SP 1.2 Monitor Commitments
- SP 1.3 Monitor Project 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 Action

Specific Practices by Goal

SG 1  Monitor Project Against Plan

*Actual performance and progress of the project are monitored against the project plan.*

SP 1.1  Monitor Project Planning Parameters

*Monitor the actual values of the project planning parameters against the project plan.*

Project planning parameters constitute typical indicators of project progress and performance and include attributes of work products and tasks, cost, effort, and schedule. Attributes of the work products and tasks include such items as size, complexity, weight, form, fit, or function.

Monitoring typically involves measuring the actual values of project planning parameters, comparing actual values to the estimates in the plan, and identifying significant deviations. Recording actual values of the project planning parameters includes recording associated contextual information to help understand the measures. An analysis of the impact that significant deviations have on determining what corrective actions to take is handled in the second specific goal and its specific practices in this process area.

Typical Work Products
1. Records of project performance
2. Records of significant deviations

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 schedule documented in the project plan
• Identifying significant deviations from the schedule estimates in the project plan

2. Monitor the project's cost and expended effort.

Effort and cost monitoring typically includes the following:

• Periodically measuring the actual effort and cost expended and staff assigned
• Comparing actual effort, costs, staffing, and training to the estimates and budget documented in the project plan
• Identifying significant deviations from the budget in the project plan

3. Monitor the attributes of the work products and tasks.

Refer to the Project Planning process area for information about the attributes of work products and tasks.

Monitoring the attributes of the work products and tasks typically includes the following:

• Periodically measuring the actual attributes of the work products and tasks, such as size or complexity (and the changes to the attributes)
• Comparing the actual attributes of the work products and tasks (and the changes to the attributes) to the estimates documented in the project plan
• Identifying significant deviations from the estimates in the project plan

4. Monitor resources provided and used.

This subpractice includes monitoring staff recruitment and turnover. SVC

Refer to the Project Planning process area for information about planned resources.

Refer to the Capacity and Availability Management process area for information about analyzing and monitoring resources to meet service requirements. SVC
Examples of resources include the following:

- Physical facilities
- Computers, peripherals, and software used in design, manufacturing, testing, and operation
- Networks
- Security environment
- Project staff
- Processes

5. Monitor the knowledge and skills of project personnel.

Refer to the Project Planning process area for information about planning for knowledge and skills needed to perform the project.

Monitoring the knowledge and skills of the project personnel typically includes the following:

- Periodically measuring the acquisition of knowledge and skills by project personnel
- Comparing actual training obtained to that documented in the project plan
- Identifying significant deviations from estimates in the project plan

6. Document the significant deviations in the project planning parameters.

SP 1.2 Monitor Commitments

Monitor commitments against those identified in the project plan.

Typical 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 that are at significant risk of not being satisfied.
3. Document the results of the commitment reviews.

SP 1.3 Monitor Project Risks

Monitor risks against those identified in the project plan.

Refer to the Project Planning process area for more information about identifying project risks.

Refer to the Risk Management process area for more information about risk management activities.
Typical Work Products
1. Records of project risk monitoring

Subpractices
1. Periodically review the documentation of the risks in the context of the project's current status and circumstances.
2. Revise the documentation of the risks, as additional information becomes available, to incorporate changes.
3. Communicate risk status to relevant stakeholders.

   Examples of risk status include the following:
   • A change in the probability that the risk occurs
   • A change in risk priority

SP 1.4 Monitor Data Management

Monitor the management of project data against the project plan.

Refer to the Plan for Data Management specific practice in the Project Planning process area for more information about identifying the types of data that should be managed and how to plan for their management.

Once the plans for the management of project data are made, the management of that data must be monitored to ensure that those plans are accomplished.

Typical Work Products
1. Records of data management

Subpractices
1. Periodically review data management activities against their description in the project plan.
2. Identify and document significant issues and their impacts.
3. Document the results of data management activity reviews.

SP 1.5 Monitor Stakeholder Involvement

Monitor stakeholder involvement against the project plan.

Refer to the Plan Stakeholder Involvement specific practice in the Project Planning process area for more information about identifying relevant stakeholders and planning the appropriate involvement with them.
Once the stakeholders are identified and the extent of their involvement within the project is specified in project planning, that involvement must be monitored to ensure that the appropriate interactions are occurring.

**Typical 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 the stakeholder involvement status reviews.

**SP 1.6 Conduct Progress Reviews**

*Periodically review the project's progress, performance, and issues.*

Progress reviews are reviews on the project to keep stakeholders informed. These project reviews can be informal reviews and may not be specified explicitly in the project plans.

**Typical Work Products**
1. Documented project review results

**Subpractices**
1. Regularly communicate status on assigned activities and work products to relevant stakeholders.

   Managers, staff members, customers, end users, suppliers, and other relevant stakeholders within the organization are included in the reviews as appropriate.

2. Review the results of collecting and analyzing measures for controlling the project.

   *Refer to the Measurement and Analysis process area for more information about the process for measuring and analyzing project performance data.*

3. Identify and document significant issues and deviations from the plan.

4. Document change requests and problems identified in any of the work products and processes.

   *Refer to the Configuration Management process area for more information about how changes are managed.*

5. Document the results of the reviews.
6. Track change requests and problem reports to closure.

SP 1.7 Conduct Milestone Reviews

Review the accomplishments and results of the project at selected project milestones.

Refer to the Project Planning process area for more information about milestone planning.

Milestone reviews are planned during project planning and are typically formal reviews.

Typical Work Products
1. Documented milestone review results

Subpractices
1. Conduct reviews at meaningful points in the project’s schedule, such as the completion of selected stages, with relevant stakeholders.

   Managers, staff members, customers, end users, suppliers, and other relevant stakeholders within the organization are included in the milestone reviews as appropriate.

2. Review the commitments, plan, status, and risks of the project.

3. Identify and document significant issues and their impacts.

4. Document the 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 project’s performance or results deviate significantly from the plan.

SP 2.1 Analyze Issues

Collect and analyze the issues and determine the corrective actions necessary to address the issues.

Typical Work Products
1. List of issues needing corrective actions

Subpractices
1. Gather issues for analysis.

   Issues are collected from reviews and the execution of other processes.
Examples of issues to be gathered include the following:

- Issues discovered through performing verification and validation activities
- Significant deviations in the project planning parameters from the estimates in the project 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

2. Analyze issues to determine need for corrective action.

Refer to the Project Planning process area for information about corrective action criteria.

Corrective action is required when the issue, if left unresolved, may prevent the project from meeting its objectives.

**SP 2.2 Take Corrective Action**

**Take corrective action on identified issues.**

**Typical Work Products**

1. Corrective action plan

**Subpractices**

1. Determine and document the appropriate actions needed to address the identified issues.

Refer to the Project Planning process area for more information about the project plan when replanning is needed.

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 project 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 Action

**Manage corrective actions to closure.**

**Typical Work Products**
1. Corrective action results

**Subpractices**
1. Monitor corrective actions for completion.
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 for corrective actions.

Lessons learned as a result of taking corrective action can be inputs to planning and risk management processes.

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**Generic Practices by Goal**

**Continuous Only**

**GG 1  Achieve Specific Goals**

*The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.*

**GP 1.1  Perform Specific Practices**

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

**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 project monitoring and control process.*

Elaboration:

This policy establishes organizational expectations for monitoring performance against the project plan and managing corrective action to closure when actual performance or results deviate significantly from the plan.
GP 2.2 Plan the Process

Establish and maintain the plan for performing the project monitoring and control process.

Elaboration:

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

GP 2.3 Provide Resources

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

Elaboration:

Examples of resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the project monitoring and control process as needed.

Elaboration:

Examples of training topics include the following:

- Monitoring and control of projects
- Risk management
- Data management

GP 2.6 Manage Configurations

Place designated work products of the project monitoring and control process under appropriate levels of control.
Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

**Identify and involve the relevant stakeholders of the project monitoring and control process as planned.**

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices\(^1\) for more information about the relationship between generic practice 2.7 and the Monitor Stakeholder Involvement practice in the Project Monitoring and Control process area.

Examples of activities for stakeholder involvement include the following:

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

GP 2.8 Monitor and Control the Process

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

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices (see footnote) for more information about the relationship between generic practice 2.8 and the Project Monitoring and Control process area.

\(^{10}\) Retained for consistency with CMMI product suite. This draft document does not have this table or section.
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

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the project monitoring and control process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Monitoring project performance against the project plan
- Managing corrective actions to closure

Examples of work products reviewed include the following:

- Records of project performance
- Project review results

GP 2.10 Review Status with Higher Level Management

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

Staged Only

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.
Continuous/Maturity Levels 3 - 5 Only

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 project monitoring and control process.

GP 3.2 Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the project monitoring and control process to support the future use and improvement of the organization’s processes and process assets.

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

GG 4  Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

GP 4.1 Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the project monitoring and control process, which address quality and process performance, based on customer needs and business objectives.

GP 4.2 Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the project monitoring and control process to achieve the established quantitative quality and process-performance objectives.

GG 5  Institutionalize an Optimizing Process

The process is institutionalized as an optimizing process.
| Continuous Only |
|-----------------|-------------------------------------------------|
| **GP 5.1**      | **Ensure Continuous Process Improvement**       |
|                 | *Ensure continuous improvement of the project monitoring and control process in fulfilling the relevant business objectives of the organization.* |
| **GP 5.2**      | **Correct Root Causes of Problems**             |
|                 | *Identify and correct the root causes of defects and other problems in the project monitoring and control process.* |
PROJECT PLANNING

A Project Management Process Area at Maturity Level 2

Purpose

The purpose of Project Planning (PP) is to establish and maintain plans that define project activities.

Introductory Notes

The Project Planning process area involves the following:

• Developing the project plan
• Interacting with stakeholders appropriately
• Getting commitment to the plan
• Maintaining the plan

Planning begins with requirements that define the product and project.

Planning includes estimating the attributes of the 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. The project plan provides the basis for performing and controlling the project’s activities that address the commitments with the project’s customer.

The project plan will usually need to be revised as the project 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 “project plan” is used throughout the generic and specific practices in this process area to refer to the overall plan for controlling the project.
Related Process Areas

Refer to the Requirements Development process area for more information about developing requirements that define the product and product components. Product and product component requirements and changes to those requirements serve as a basis for planning and replanning.

Refer to the Requirements Management process area for more information about managing requirements needed for planning and replanning.

Refer to the Risk Management process area for more information about identifying and managing risks.

Refer to the Technical Solution process area for more information about transforming requirements into product and product component solutions.

Refer to the Capacity and Availability Management process area for more information about the effective provision of resources to meet service requirements. SVC

Refer to the Service Delivery process area for more information about establishing and maintaining an operational plan for service delivery. SVC

Specific Goal and Practice Summary

SG 1 Establish Estimates
   SP 1.1 Estimate the Scope of the Project
   SP 1.2 Establish Estimates of Work Product and Task Attributes
   SP 1.3 Define Project Lifecycle
   SP 1.4 Determine Estimates of Effort and Cost

SG 2 Develop a Project Plan
   SP 2.1 Establish the Budget and Schedule
   SP 2.2 Identify Project Risks
   SP 2.3 Plan for Data Management
   SP 2.4 Plan for Project Resources
   SP 2.5 Plan for Needed Knowledge and Skills
   SP 2.6 Plan Stakeholder Involvement
   SP 2.7 Establish the Project Plan

SG 3 Obtain Commitment to the Plan
   SP 3.1 Review Plans That Affect the Project
   SP 3.2 Reconcile Work and Resource Levels
   SP 3.3 Obtain Plan Commitment
Specific Practices by Goal

SG 1 Establish Estimates

 Estimates of project planning parameters are established and maintained.

Project planning parameters include all information needed by the project to perform the necessary planning, organizing, staffing, directing, coordinating, reporting, and budgeting.

Estimates of planning parameters should have a sound basis to instill confidence that any plans based on these estimates are capable of supporting project objectives.

Factors that are typically considered when estimating these parameters include the following:

- Project requirements, including the product requirements, the requirements imposed by the organization, the requirements imposed by the customer, and other requirements that impact the project
- Scope of the project
- Identified tasks and work products
- Technical approach
- Selected project lifecycle model (e.g., waterfall, incremental, or spiral)
- Attributes of the work products and tasks (e.g., size or complexity)
- Schedule
- Models or historical data for converting the attributes of the work products and tasks into labor hours and cost
- Methodology (e.g., models, data, algorithms) used to determine needed material, skills, labor hours, and cost

Documentation of the estimating rationale and supporting data is needed for stakeholders’ review and commitment to the plan and for maintenance of the plan as the project progresses.

SP 1.1 Estimate the Scope of the Project

Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.
The WBS evolves with the project. Initially a top-level WBS can serve to structure the initial estimating. The development of a WBS divides the overall project into an interconnected set of manageable components. Typically, the WBS is a product 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 done on the project. Some projects use the term “contract WBS” to refer to the portion of the WBS placed under contract (possibly the entire WBS). Not all projects have a contract WBS (e.g., internally funded development).

Typical Work Products
1. Task descriptions
2. Work package descriptions
3. WBS

Subpractices
1. Develop a WBS based on the product architecture.

   The WBS provides a scheme for organizing the project’s work around the product and product components that the work supports. The WBS should permit the identification of the following items:
   - Identified risks and their mitigation tasks
   - Tasks for deliverables and supporting activities
   - Tasks for skill and knowledge acquisition
   - Tasks for development of needed support plans, such as configuration management, quality assurance, and verification plans
   - Tasks for integration and management of nondevelopmental items

2. Identify the work packages in sufficient detail to specify estimates of project tasks, responsibilities, and schedule.

   The top-level WBS is intended to help in gauging the project work effort in terms of tasks and organizational roles and responsibilities. The amount of detail in the WBS at this more detailed level helps in developing realistic schedules, thereby minimizing the need for management reserve.

3. Identify product or product components that will be externally acquired.

   Refer to the Supplier Agreement Management process area for more information about acquiring products from sources external to the project.

4. Identify work products that will be reused.
Establish Estimates of Work Product and Task Attributes

Establish and maintain estimates of the attributes of the work products and tasks.

Size is the primary input to many models used to estimate effort, cost, and schedule. The models can also be based on inputs such as connectivity, complexity, and structure.

Examples of types of work products for which size estimates are made include the following:
- Deliverable and nondeliverable work products
- Documents and files
- Operational and support hardware, firmware, and software

Examples of size measures include the following:
- Number of functions
- Function points
- Source lines of code
- Number of classes and objects
- Number of requirements
- Number and complexity of interfaces
- Number of pages
- Number of inputs and outputs
- Number of technical risk items
- Volume of data
- Number of logic gates for integrated circuits
- Number of parts (e.g., printed circuit boards, components, and mechanical parts)
- Physical constraints (e.g., weight and volume)

The estimates should be consistent with project requirements to determine the project’s effort, cost, and schedule. A relative level of difficulty or complexity should be assigned for each size attribute.

Typical Work Products
1. Technical approach
2. Size and complexity of tasks and work products
3. Estimating models
4. Attribute estimates
Subpractices

1. Determine the technical approach for the project.

   The service solution approach defines a top-level strategy for the development and delivery of the service and may include a technical approach when appropriate.

   The technical approach defines a top-level strategy for development of the product. It includes decisions on architectural features, such as distributed or client/server; state-of-the-art or established technologies to be applied, such as robotics, composite materials, or artificial intelligence; and breadth of the functionality expected in the final products, such as safety, security, and ergonomics.

2. Use appropriate methods to determine the attributes of the work products and tasks that will be used to estimate the resource requirements.

   Methods for determining size and complexity should be based on validated models or historical data.

   The methods for determining attributes evolve as our understanding of the relationship of product characteristics to attributes increases.

<table>
<thead>
<tr>
<th>Examples of current methods include the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Number of logic gates for integrated circuit design</td>
</tr>
<tr>
<td>• Lines of code or function points for software</td>
</tr>
<tr>
<td>• Number/complexity of requirements for systems engineering</td>
</tr>
<tr>
<td>• Number of square feet for standard-specified residential homes</td>
</tr>
</tbody>
</table>

3. Estimate the attributes of the work products and tasks.

   SP 1.3 Define Project Lifecycle

   Define the project lifecycle phases on which to scope the planning effort.

   The determination of a project's lifecycle phases provides for planned periods of evaluation and decision making. These are normally defined to support logical decision points at which significant commitments are made concerning resources and technical approach. Such points provide planned events at which project course corrections and determinations of future scope and cost can be made.
The project lifecycle phases need to be defined depending on the scope of requirements, the estimates for project resources, and the nature of the project. Larger projects may contain multiple phases, such as concept exploration, development, production, operations, and disposal. Within these phases, subphases may be needed. A development phase may include subphases such as requirements analysis, design, fabrication, integration, and verification. The determination of project phases typically includes selection and refinement of one or more development models to address interdependencies and appropriate sequencing of the activities in the phases.

Depending on the strategy for development, there may be intermediate phases for the creation of prototypes, increments of capability, or spiral model cycles.

Understanding the project lifecycle is crucial in determining the scope of the planning effort and the timing of the initial planning, as well as the timing and criteria (critical milestones) for replanning.

The selection of a strategy 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. SVC

Refer to Organizational Service Management for information on defining and tailoring standard services. SVC

Typical Work Products
1. Project lifecycle phases

SP 1.4 Determine Estimates of Effort and Cost

Estimate the project effort and cost for the work products and tasks based on estimation rationale.

Estimates of effort and cost are generally based on the results of analysis using models or historical data applied to size, activities, and other planning parameters. Confidence in these estimates is based on the rationale for the selected model and the nature of the data. There may be occasions when the available historical data does not apply, such as where efforts are unprecedented or where the type of task does not fit available models. An effort is unprecedented (to some degree) if a similar product or component has never been built. An effort may also be unprecedented if the development group has never built such a product or component.
Unprecedented efforts are more risky, require more research to develop reasonable bases of estimate, and require more management reserve. The uniqueness of the project must be documented when using these models to ensure a common understanding of any assumptions made in the initial planning stages.

**Typical Work Products**

1. Estimation rationale
2. Project effort estimates
3. Project cost estimates

**Subpractices**

1. Collect the models or historical data that will be used to transform the attributes of the work products and tasks into estimates of the labor hours and cost.

   Many parametric models have been developed to aid in estimating cost and schedule. The use of these models as the sole source of estimation is not recommended because these models are based on historical project data that may or may not be pertinent to your project. Multiple models and/or methods can be used to ensure a high level of confidence in the estimate.

   Historical data include the cost, effort, and schedule data from previously executed projects, plus 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 target environment, or any appropriate combination of these when estimating effort and cost.

   **Examples of infrastructure resources include the following:**

   - Critical computer resources (e.g., memory, disk and network capacity, peripherals, communication channels, and the capacities of these)
   - Engineering environments and tools (e.g., tools for prototyping, assembly, computer-aided design [CAD], and simulation)
   - Facilities, machinery, and equipment (e.g., test benches and recording devices)

3. Estimate effort and cost using models and/or historical data.
Effort and cost inputs used for estimating typically include the following:

- Judgmental 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
- Product and product component requirements
- Technical approach
- WBS
- Size estimates of work products and anticipated changes
- Cost of externally acquired products
- Selected project lifecycle model and processes
- Lifecycle cost estimates
- Capability of tools provided in engineering environment
- Skill levels of managers and staff needed to perform the work
- Knowledge, skill, and training needs
- Facilities needed (e.g., office and meeting space and workstations)
- Engineering facilities needed
- Capability of manufacturing process(es)
- Travel
- Level of security required for tasks, work products, hardware, software, personnel, and work environment
- Service level agreements for call centers and warranty work
- Direct labor and overhead

SG 2 Develop a Project Plan

*A project plan is established and maintained as the basis for managing the project.*

A project plan is a formal, approved document used to manage and control the execution of the project. It is based on the project requirements and the established estimates.

The project plan should consider all phases of the project lifecycle. Project planning should ensure that all plans affecting the project are consistent with the overall project plan.

SP 2.1 Establish the Budget and Schedule

*Establish and maintain the project’s budget and schedule.*

The project’s budget and schedule are based on the 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 project risk. Identifying accomplishments to be demonstrated before initiation of the 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 project, and a more accurate status of the project’s tasks.

**Typical Work Products**
1. Project schedules
2. Schedule dependencies
3. Project budget

**Subpractices**
1. Identify major milestones.

   Milestones are often imposed to ensure completion of certain deliverables by the milestone. Milestones can be event based or calendar based. If calendar based, once milestone dates have been agreed on, it is often very difficult to change them.

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 is available. Identifying these assumptions provides insight into the level of confidence (uncertainties) in the overall schedule.

3. Identify constraints.

   Factors that limit the flexibility of management options need to be identified as early as possible. The examination of the attributes of the work products and tasks often will bring these issues to the surface. Such attributes can include task duration, resources, inputs, and outputs.

4. Identify task dependencies.

   Typically, the tasks for a project can be accomplished in some ordered sequence that will minimize the duration of the project. This involves the identification of predecessor and successor tasks to determine the optimal ordering.

   Examples of tools that can help determine an optimal ordering of task activities include the following:
   - Critical Path Method (CPM)
   - Program Evaluation and Review Technique (PERT)
   - Resource-limited scheduling

5. Define the budget and schedule.
Establishing and maintaining the project’s budget and schedule typically includes the following:

- Defining the committed or expected availability of resources and facilities
- Determining time phasing of activities
- Determining a breakout of subordinate schedules
- Defining the dependencies between the activities (predecessor or successor relationships)
- Defining the schedule activities and milestones to support accuracy in progress measurement
- Identifying milestones for 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 project assumptions and rationale

6. Establish corrective action criteria.

Criteria are established for determining what constitutes a significant deviation from the project plan. A basis for gauging issues and problems is necessary to determine when a corrective action should be taken. The corrective actions may require replanning, which may include revising the original plan, establishing new agreements, or including mitigation activities within the current plan.

SP 2.2 Identify Project Risks

*Identify and analyze project risks.*

Refer to the Risk Management process area for more information about risk management activities.

Refer to the Monitor Project Risks specific practice in the Project Monitoring and Control process area for more information about risk monitoring activities.
Risks are identified or discovered and analyzed to support project planning. This specific practice should be extended to all the plans that affect the project to ensure that the appropriate interfacing is taking place between all relevant stakeholders on identified risks. Project planning risk identification and analysis typically include the following:

- Identifying risks
- Analyzing the risks to determine the impact, probability of occurrence, and time frame in which problems are likely to occur
- Prioritizing risks

**Typical 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 must be identified and described in an understandable way before they can be analyzed. 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
   - Performance models
   - Cost models
   - Network analysis
   - Quality factor analysis

2. Document the risks.

3. Review and obtain agreement with relevant stakeholders on the completeness and correctness of the documented risks.

4. Revise the 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 project circumstances change significantly

SP 2.3  Plan for Data Management

**Plan for the management of project data.**

Data are the various forms of documentation required to support a program in all of its areas (e.g., administration, engineering, configuration management, finance, logistics, quality, safety, manufacturing, and procurement). The data can take any form (e.g., reports, manuals, notebooks, charts, drawings, specifications, files, or correspondence). The data may exist in any medium (e.g., printed or drawn on various materials, photographs, electronic, or multimedia). Data may be deliverable (e.g., items identified by a program’s contract data requirements) or data may be nondeliverable (e.g., informal data, trade studies and analyses, internal meeting minutes, internal design review documentation, lessons learned, and action items). Distribution can take many forms, including electronic transmission.

The data requirements for the project should be established for both the 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 the data resources.

The reason for collecting each document should be clear. This task includes the analysis and verification of project deliverables and nondeliverables, contract and noncontract data requirements, and customer-supplied data. Often, data is collected with no clear understanding of how it will be used. Data is costly and should be collected only when needed.

**Typical Work Products**

1. Data management plan
2. Master list of managed data
3. Data content and format description
4. Data requirements lists for acquirers and for suppliers
5. Privacy requirements
6. Security requirements
7. Security procedures
8. Mechanism for data retrieval, reproduction, and distribution

9. Schedule for collection of project data

10. Listing of project data to be collected

**Subpractices**

1. Establish requirements and procedures to ensure privacy and security of the data.

   Not everyone will have the need or clearance necessary to access the project data. Procedures must be established to identify who has access to what data as well as when they have access to the data.

   **Requirements and procedures may cover service staff who will have responsibility for 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 project data to be identified, collected, and distributed.

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**SP 2.4 Plan for Project Resources**

**Plan for necessary resources to perform the project.**

Defining project resources (labor, machinery/equipment, materials, and methods) and quantities needed to perform project activities builds on the initial estimates and provides additional information that can be applied to expand the WBS used to manage the project.

The top-level WBS developed earlier as an estimation mechanism is typically expanded by decomposing these top levels into work packages that represent singular 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 or work product 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, 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.

**Typical Work Products**

1. WBS work packages

2. WBS task dictionary

3. Staffing requirements based on project size and scope
4. Critical facilities/equipment list
5. Process/workflow definitions and diagrams
6. Program administration requirements list

Subpractices
1. Determine process requirements.

The processes used to manage a project must be identified, defined, and coordinated with all the relevant stakeholders to ensure efficient operations during project execution.

2. Determine staffing requirements.

The staffing of a project depends on the decomposition of the project requirements into tasks, roles, and responsibilities for accomplishing the project requirements as laid out within the work packages of the WBS.

Staffing requirements must consider the knowledge and skills required for each of the identified positions, as defined in the Plan for Needed Knowledge and Skills specific practice.

Planning for staffing includes ensuring that:

- the service agreement evolution is planned to include recruiting appropriate staff and managing staff turnover
- the required skills are available
- the balance is made between skills and resources available internally and those needed from external organizations
- commitments to the project are maintained

Refer to the Capacity and Availability Management process area for more information about planning for the effective provision of resources to support service requirements.

3. Determine facilities, equipment, and component requirements.

Most projects are unique in some sense and require some set of unique assets to accomplish the objectives of the project. The determination and acquisition of these assets in a timely manner are crucial to project success.

Lead-time items need to be identified early to determine how they will be addressed. Even when the required assets are not unique, compiling a list of all of the facilities, equipment, and parts (e.g., number of computers for the personnel working on the project, software applications, and office space) provides insight into aspects of the scope of an effort that are often overlooked.

SP 2.5 Plan for Needed Knowledge and Skills

Plan for knowledge and skills needed to perform the project.
Refer to the Organizational Training process area for more information about knowledge and skills information to be incorporated into the project plan.

Knowledge delivery to projects involves both training of project personnel and acquisition of knowledge from outside sources.

Staffing requirements are dependent on the knowledge and skills available to support the execution of the project.

**Typical Work Products**
1. Inventory of skill needs
2. Staffing and new hire plans
3. Databases (e.g., skills and training)

**Subpractices**
1. Identify the knowledge and skills needed to perform the project.
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 project)
- External training
- Staffing and new hires
- External skill acquisition

The choice of in-house training or outsourced training for the needed knowledge and skills is determined by the availability of training expertise, the project’s schedule, and the business objectives.

4. Incorporate selected mechanisms into the project plan.

**SP 2.6 Plan Stakeholder Involvement**

*Plan the involvement of identified stakeholders.*

Stakeholders are identified from all phases of the project lifecycle by identifying the type of people and functions needing representation in the project and describing their relevance and the degree of interaction for specific project activities. A two-dimensional matrix with stakeholders along one axis and project activities along the other axis is a convenient format for accomplishing this identification. Relevance of the stakeholder to the activity in a particular project phase and the amount of interaction expected would be shown at the intersection of the project phase activity axis and the stakeholder axis.
For the inputs of stakeholders to be useful, careful selection of relevant stakeholders is necessary. For each major activity, identify the 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 project moves through the phases of the project 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.

In a service environment, both end users and customers of a service are typically identified as relevant stakeholders and the involvement of each is planned.

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
- Roles and responsibilities of the relevant stakeholders with respect to the project, by project lifecycle phase
- Relationships between stakeholders
- Relative importance of the stakeholder to success of the project, by project lifecycle phase
- Resources (e.g., training, materials, time, and funding) needed to ensure stakeholder interaction
- Schedule for phasing of stakeholder interaction

Conduct of this specific practice relies on shared or exchanged information with the previous Plan for Needed Knowledge and Skills specific practice.

**Typical Work Products**

1. Stakeholder involvement plan
Establish and maintain the overall project plan content.

A documented plan that addresses all relevant planning items is necessary to achieve the mutual understanding, commitment, and performance of individuals, groups, and organizations that must execute or support the plans. The plan generated for the project defines all aspects of the effort, tying together in a logical manner: project lifecycle considerations; technical and management tasks; budgets and schedules; milestones; data management, risk identification, resource and skill requirements; and stakeholder identification and interaction. Infrastructure descriptions include responsibility and authority relationships for project staff, management, and support organizations.

For Software Engineering

For software, the planning document is often referred to as one of the following:

- Software development plan
- Software project plan
- Software plan

For Hardware Engineering

For hardware, the planning document is often referred to as a hardware development plan. Development activities in preparation for production may be included in the hardware development plan or defined in a separate production plan.

Examples of plans that have been used in the U.S. Department of Defense community include the following:

- Integrated Master Plan—an event-driven plan that documents significant accomplishments with pass/fail criteria for both business and technical elements of the project and that ties each accomplishment to a key program event.
- Integrated Master Schedule—an integrated and networked multi-layered schedule of program tasks required to complete the work effort documented in a related Integrated Master Plan.
- Systems Engineering Management Plan—a plan that details the integrated technical effort across the project.
- Systems Engineering Master Schedule—an event-based schedule that contains a compilation of key technical accomplishments, each with measurable criteria, requiring successful completion to pass identified events.
- Systems Engineering Detailed Schedule—a detailed, time-dependent, task-oriented schedule that associates specific dates and milestones with the Systems Engineering Master Schedule.
Typical Work Products
1. Overall project plan

SG 3 Obtain Commitment to the Plan

*Commitments to the project plan are established and maintained.*

To be effective, plans require commitment by those responsible for implementing and supporting the plan.

**SP 3.1 Review Plans That Affect the Project**

*Review all plans that affect the project to understand project commitments.*

Plans developed within other process areas will typically contain information similar to that called for in the overall project plan. These plans may provide additional detailed guidance and should be compatible with and support the overall project plan to indicate who has the authority, responsibility, accountability, and control. All plans that affect the project should be reviewed to ensure a common understanding of the scope, objectives, roles, and relationships that are required for the project to be successful. Many of these plans are described by the Plan the Process generic practice in each of the process areas.

Typical Work Products
1. Record of the reviews of plans that affect the project

**SP 3.2 Reconcile Work and Resource Levels**

*Reconcile the project plan to reflect available and estimated resources.*

To establish a project that is feasible, obtain commitment from relevant stakeholders and reconcile any differences between the estimates and the available resources. Reconciliation is typically accomplished by lowering or deferring technical performance requirements, negotiating more resources, finding ways to increase productivity, outsourcing, adjusting the staff skill mix, or revising all plans that affect the project or schedules.

Typical Work Products
1. Revised methods and corresponding estimating parameters (e.g., better tools and 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 project. 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.

**Typical 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 appropriate level of signatories.

   Commitments must be documented to ensure a consistent mutual understanding as well as for tracking and maintenance. Provisional commitments should be accompanied by a description of the risks associated with the relationship.

3. Review internal commitments with senior management as appropriate.

4. Review external commitments with senior management as appropriate.

   Management may have the necessary insight and authority to reduce risks associated with external commitments.

5. Identify commitments on interfaces between elements in the project, and with other projects and organizational units so that they can be monitored.

   Well-defined interface specifications form the basis for commitments.
## Generic Practices by Goal

### Continuous Only

<table>
<thead>
<tr>
<th>Goal</th>
<th>GP</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG 1</td>
<td>GP 1.1</td>
<td>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</td>
</tr>
<tr>
<td>GG 2</td>
<td>GP 2.1</td>
<td>The process is institutionalized as a managed process.</td>
</tr>
<tr>
<td></td>
<td>GP 2.2</td>
<td>Establish and maintain an organizational policy for planning and performing the project planning process.</td>
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<tr>
<td></td>
<td>GP 2.3</td>
<td>Establish and maintain the plan for performing the project planning process.</td>
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<tr>
<td></td>
<td>GP 2.3</td>
<td>Provide adequate resources for performing the project planning process, developing the work products, and providing the services of the process.</td>
</tr>
</tbody>
</table>

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11 Retained for consistency with CMMI product suite. This draft document does not have this table or section.
Elaboration:

Special expertise, equipment, and facilities in project planning may be required. Special expertise in project planning may include the following:

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

Examples of other resources provided include the following tools:

- 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 project planning process.

GP 2.5 Train People

Train the people performing or supporting the project planning process as needed.

Elaboration:

Examples of training topics include the following:

- Estimating
- Budgeting
- Negotiating
- Risk identification and analysis
- Data management
- Planning
- Scheduling

GP 2.6 Manage Configurations

Place designated work products of the project planning process under appropriate levels of control.
Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the project planning process as planned.*

Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices\textsuperscript{12} for more information about the relationship between generic practice 2.7 and the Plan Stakeholder Involvement practice in the Project Planning process area.

Examples of activities for stakeholder involvement include the following:

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

GP 2.8 Monitor and Control the Process

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

\textsuperscript{12} Retained for consistency with CMMI product suite. This draft document does not have this table or section.
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 project planning process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

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

Examples of work products reviewed include the following:

- WBS
- Project plan
- Data management plan
- Stakeholder involvement plan

GP 2.10 Review Status with Higher Level Management

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

Staged Only

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

Continuous/Maturity Levels 3 - 5 Only

GG 3 Institutionalize a Defined Process

The process is institutionalized as a defined process.
Continuous/Maturity Levels 3 - 5 Only

<table>
<thead>
<tr>
<th>GP 3.1</th>
<th>Establish a Defined Process</th>
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<tbody>
<tr>
<td><strong>Establish and maintain the description of a defined project planning process.</strong></td>
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<tr>
<th>GP 3.2</th>
<th>Collect Improvement Information</th>
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<tr>
<td><strong>Collect work products, measures, measurement results, and improvement information derived from planning and performing the project planning process to support the future use and improvement of the organization’s processes and process assets.</strong></td>
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</table>

**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

<table>
<thead>
<tr>
<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
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<tr>
<td><strong>The process is institutionalized as a quantitatively managed process.</strong></td>
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<tr>
<th>GP 4.1</th>
<th>Establish Quantitative Objectives for the Process</th>
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<tr>
<td><strong>Establish and maintain quantitative objectives for the project planning process, which address quality and process performance, based on customer needs and business objectives.</strong></td>
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<tr>
<th>GP 4.2</th>
<th>Stabilize Subprocess Performance</th>
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<tbody>
<tr>
<td><strong>Stabilize the performance of one or more subprocesses to determine the ability of the project planning process to achieve the established quantitative quality and process-performance objectives.</strong></td>
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<tr>
<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
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<tr>
<th>GP 5.1</th>
<th>Ensure Continuous Process Improvement</th>
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<tr>
<td><strong>Ensure continuous improvement of the project planning process in fulfilling the relevant business objectives of the</strong></td>
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<tr>
<td>Continuous Only</td>
<td>GP 5.2 Correct Root Causes of Problems</td>
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<td>organization.</td>
<td>Identify and correct the root causes of defects and other problems in the project planning process.</td>
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PROCESS AND PRODUCT QUALITY ASSURANCE
A Support Process Area at Maturity Level 2

Purpose

The purpose of Process and Product Quality Assurance (PPQA) is to provide staff and management with objective insight into processes and associated work products.

Introductory Notes

The Process and Product Quality Assurance process area involves the following:

- Objectively evaluating performed processes, work products, and services against the applicable process descriptions, standards, and procedures
- Identifying and documenting noncompliance issues
- Providing feedback to project staff and managers on the results of quality assurance activities
- Ensuring that noncompliance issues are addressed

The Process and Product Quality Assurance process area supports the delivery of high-quality products and services by providing the project staff and managers at all levels with appropriate visibility into, and feedback on, processes and associated work products throughout the life of the project.

The practices in the Process and Product Quality Assurance process area ensure that planned processes are implemented, while the practices in the Verification process area ensure that the specified requirements are satisfied. These two process areas may on occasion address the same work product but from different perspectives. Projects should take advantage of the overlap in order to minimize duplication of effort while taking care to maintain the separate perspectives.

Objectivity in process and product quality assurance evaluations is critical to the success of the project. (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 not producing 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 may 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

Traditionally, a quality assurance group that is independent of the project provides this objectivity. It may be appropriate in some organizations, however, 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 may be performed, partially or completely, by peers; and the quality assurance function may be embedded in the process. For small organizations, this might be the most feasible approach.

If quality assurance is embedded in the process, several issues must be addressed to ensure objectivity. Everyone performing quality assurance activities should be trained in quality assurance. Those performing quality assurance activities for a work product should be separate from those directly involved in developing or maintaining the work product. An independent reporting channel to the appropriate level of organizational management must be available so that noncompliance issues can be escalated as necessary.

For example, in implementing peer reviews as an objective evaluation method:

- 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 role of QA.
- Checklists are available to support the QA activity.
- Defects are recorded as part of the peer review report and are tracked and escalated outside the project when necessary.

Quality assurance should begin in the early phases of a project to establish plans, processes, standards, and procedures that will add value to the project and satisfy the requirements of the project and the organizational policies. Those performing quality assurance participate in establishing the plans, processes, standards, and procedures to ensure that they fit the project’s needs and that they will be useable for performing quality assurance evaluations. In addition, the specific processes and associated work products that will be evaluated during the project are designated. This designation may be based on sampling or on objective criteria that are consistent with organizational policies and project requirements and needs.
When noncompliance issues are identified, they are first addressed within the project and resolved there if possible. Any noncompliance issues that cannot be resolved within the project are escalated to an appropriate level of management for resolution.

This process area applies primarily to evaluations of the activities and work products of a project, but it also applies to evaluations of nonproject activities and work products such as training activities. For these activities and work products, the term “project” should be appropriately interpreted.

Related Process Areas

Refer to the Project Planning process area for more information about identifying processes and associated work products that will be objectively evaluated.

Refer to the Verification process area for more information about satisfying specified requirements.

Specific Goal and Practice Summary

SG 1 Objectively Evaluate Processes and Work Products

SP 1.1 Objectively Evaluate Processes

Objectively evaluate the designated performed processes against the applicable process descriptions, standards, and procedures.

Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated.

Objectivity in quality assurance evaluations is critical to the success of the project. A description of the quality assurance reporting chain and how it ensures objectivity should be defined.

Typical Work Products

1. Evaluation reports
2. Noncompliance reports
3. Corrective actions

Subpractices
1. Promote an environment (created as part of project management) that encourages employee participation in identifying and reporting quality issues.

2. Establish and maintain clearly stated criteria for the 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 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 for future products and services.

---

SP 1.2 Objectively Evaluate Work Products and Services

Objectively evaluate the designated work products and services against the applicable process descriptions, standards, and procedures.

Typical 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.

2. Establish and maintain clearly stated criteria for the evaluation of 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 the evaluations of work products.

4. Evaluate work products before they are delivered to the customer.

5. Evaluate work products at selected milestones in their development.

6. Perform in-progress or incremental evaluations of work products and services against process descriptions, standards, and procedures.

7. Identify each case of noncompliance found during the evaluations.

8. Identify lessons learned that could improve processes for future products and services.

9. If delivering services, select services to be evaluated based on documented sampling criteria if sampling is used.\(^{\text{SVC}}\)

10. If delivering services, evaluate them when they are delivered to the customer.\(^{\text{SVC}}\)

11. If delivering services, evaluate them at selected times in their delivery.\(^{\text{SVC}}\)

SG 2  Provide Objective Insight

**Noncompliance issues are objectively tracked and communicated, and resolution is ensured.**

SP 2.1  Communicate and Ensure Resolution of Noncompliance Issues

*Communicate quality issues and ensure 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 results of trend analysis.

When local resolution of noncompliance issues cannot be obtained, use established escalation mechanisms to ensure that the appropriate level of management can resolve the issue. Track noncompliance issues to resolution.
Typical Work Products
1. Corrective action reports
2. Evaluation reports
3. Quality trends

Subpractices
1. Resolve each noncompliance with the appropriate members of the staff where possible.
2. Document noncompliance issues when they cannot be resolved within the project.
   
   Examples of ways to resolve noncompliance within the project include the following:
   - Fixing the noncompliance
   - Changing the process descriptions, standards, or procedures that were violated
   - Obtaining a waiver to cover the noncompliance issue

3. Escalate noncompliance issues that cannot be resolved within the project to the appropriate level of management designated to receive and act on noncompliance issues.
4. Analyze the noncompliance issues to see if there are any quality trends that can be identified and addressed.
5. Ensure that relevant stakeholders are aware of the results of evaluations and the 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 the quality assurance activities.

Typical 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 such that status and results are known.
2. Revise the status and history of the quality assurance activities as necessary.

### Generic Practices by Goal

<table>
<thead>
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<th>Continuous Only</th>
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<tr>
<td><strong>GG 1</strong> Achieve Specific Goals</td>
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<tr>
<td><strong>GP 1.1</strong> Perform Specific Practices</td>
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</table>

*The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.*

**Elaboration:**

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

| **GG 2** Institutionalize a Managed Process |
| **GG 2** Institutionalize a Managed Process |
| **GP 2.1** Establish an Organizational Policy |

*The process is institutionalized as a managed process.*

**Elaboration:**

Establish and maintain an organizational policy for planning and performing the process and product quality assurance process.

This policy establishes organizational expectations for objectively evaluating whether processes and associated work products adhere to the 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 projects. Process and product quality assurance must possess sufficient independence from project management to provide objectivity in identifying and reporting noncompliance issues.

**GP 2.2** Plan the Process

*Establish and maintain the plan for performing the process and product quality assurance process.*
Elaboration:

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

**GP 2.3 Provide Resources**

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

Elaboration:

Examples of resources provided include the following tools:

- Evaluation tools
- Noncompliance tracking tool

**GP 2.4 Assign Responsibility**

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

Elaboration:

To guard against subjectivity or bias, ensure that those people assigned responsibility and authority for process and product quality assurance can perform their evaluations with sufficient independence and objectivity.

**GP 2.5 Train People**

*Train the people performing or supporting the process and product quality assurance process as needed.*

Elaboration:

Examples of training topics include the following:

- Application domain
- Customer relations
- Process descriptions, standards, procedures, and methods for the project
- Quality assurance objectives, process descriptions, standards, procedures, methods, and tools
### GP 2.6 Manage Configurations

*Place designated work products of the process and product quality assurance process under appropriate levels of control.*

**Elaboration:**

Examples of work products placed under control include the following:

- Noncompliance reports
- Evaluation logs and reports

### GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the process and product quality assurance process as planned.*

**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

### GP 2.8 Monitor and Control the Process

*Monitor and control the process and product quality assurance process against the plan for performing the process and take appropriate corrective action.*

**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

### GP 2.9 Objectively Evaluate Adherence

*Objectively evaluate adherence of the process and product quality assurance process against its process description, standards, and procedures, and address noncompliance.*
Elaboration:

Refer to Table 6.2 on page 95 in Generic Goals and Generic Practices\(^{13}\) for more information about the relationship between generic practice 2.9 and the Process and Product Quality Assurance process area.

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

GP 2.10  Review Status with Higher Level Management

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

Staged Only

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

Continuous/Maturity Levels 3 - 5 Only

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 and product quality assurance process.

GP 3.2  Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the process and product quality assurance process to support the future use and improvement of the organization’s processes and process assets.

\(^{13}\) Retained for consistency with CMMI product suite. This draft document does not have this table or section.
## Continuous/Maturity Levels 3 - 5 Only

**Elaboration:**

Examples of work products, measures, measurement results, and improvement information include the following:

- Evaluation logs
- Quality trends
- Noncompliance report
- Status reports of corrective action
- Cost of quality reports for the project

## Continuous Only

### GG 4  Institutionalize a Quantitatively Managed Process

**The process is institutionalized as a quantitatively managed process.**

**GP 4.1** Establish Quantitative Objectives for the Process

*Establish and maintain quantitative objectives for the process and product quality assurance process, which address quality and process performance, based on customer needs and business objectives.*

**GP 4.2** Stabilize Subprocess Performance

*Stabilize the performance of one or more subprocesses to determine the ability of the process and product quality assurance process to achieve the established quantitative quality and process-performance objectives.*

### GG 5  Institutionalize an Optimizing Process

**The process is institutionalized as an optimizing process.**

**GP 5.1** Ensure Continuous Process Improvement

*Ensure continuous improvement of the process and product quality assurance process in fulfilling the relevant business objectives of the organization.*

**GP 5.2** Correct Root Causes of Problems

*Identify and correct the root causes of defects and other problems in the process and product quality assurance process.*
**PROBLEM MANAGEMENT**

A Support Process Area at Maturity Level 3

**Purpose**

The purpose of Problem Management (PRM) process area is to prevent incidents from recurring by identifying and addressing underlying causes of incidents.

**Introductory Notes**

The Problem Management process area involves the following:

- Identifying and analyzing the underlying cause of incidents
- Deciding on the best course of action for dealing with each problem
- Initiating specific actions to remove the underlying cause of incidents to prevent them from occurring
- Monitoring the status of problems; tracking progress of actions initiated to resolve the problem and escalating if necessary
- Communicating status of problems to the relevant stakeholders.

A problem is a situation in the service system that is the underlying cause of incidents. All incidents have one or more underlying causes, regardless 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. However, not all problems may cause incidents to occur immediately. For example, a defect in an unused part of a system may not cause any incidents for a long time.

Activities that identify problems from incidents are called reactive problem management activities. Activities that identify problems before they actually cause incidents by investigating and monitoring the service system are called proactive problem management activities. An example of reactive problem management is analyzing the cause of a system outage. An example of proactive problem management is monitoring software memory usage to detect memory leaks as soon as possible.
All incidents have an underlying cause that triggers their occurrence. Removing the underlying or root cause of incidents may reduce the workload on the service provider and improve the level of service. It might also be worthwhile for some categories of service requests to investigate underlying causes of service requests as a means of reducing the workload on the service provider or improving the level of service. For example, providing end users with the possibility to reset passwords themselves may significantly lower the number of service requests for resetting passwords.

See the definition of “problem” in the glossary.

**Related Process Areas**

The Problem Management process area deals with the underlying cause of incidents.

*Refer to the Incident and Request Management process area for more information about handling service requests and incidents.*

Often, removing problems will concern work products that are under configuration management.

*Refer to the Configuration Management process area for more information about controlling work products.*

Problem management addresses underlying causes of incidents in the service system. The root cause of incidents will often be different than the immediate underlying cause. For example, an incident may be caused by a faulty system component (the underlying cause), while the root cause of the incident is a suboptimal supplier selection process.

*Refer to the Causal Analysis and Resolution process area for more information about analyzing and resolving underlying and root causes of problems.*

Typically, the amount of time needed to fulfill a service request or resolve an incident is agreed before the start of service delivery in a service level agreement.

*Refer to the Requirements Management process area for more information about establishing and maintaining service level agreements.*
Specific Goal and Practice Summary

SG 1 Prepare for Problem Management
   SP 1.1 Establish a Problem Management Strategy
   SP 1.2 Establish a Problem Management System

SG 2 Address Problems
   SP 2.1 Identify Problems
   SP 2.2 Address Problems
   SP 2.3 Monitor the Resolution of Problems
   SP 2.4 Communicate and Validate Resolution of Problems

Specific Practices by Goal

SG 1 Prepare for Problem Management

Preparation for problem management is conducted.

Preparation is conducted by establishing and maintaining a strategy for ensuring the timely resolution of problems. This strategy is typically documented in a problem management plan. The problem management strategy addresses the organizational functions involved in the problem management, the procedures employed, the support tools used, and the assignment of responsibility for the lifecycle of problems.

SP 1.1 Establish a Problem Management Strategy

Establish and maintain the strategy to be used for problem management.

A comprehensive problem management strategy addresses items such as the following:

- How responsibility for resolving problem is assigned and transferred
- How responsibility for monitoring the status of problems and for tracking the progress of actions related to problems is assigned and transferred
- How groups and individuals can report problems
- Methods and tools to be used for problem management

Typical Work Products
1. Problem management strategy.

SP 1.2 Establish a Problem Management System

Establish and maintain a problem management system for recording problem information.

A problem management system includes the storage media, the procedures, and the tools for accessing the problem management system.
Typical Work Products
1. A problem management system with controlled work products
2. Problem management system access control procedures

Subpractices
1. Establish a mechanism to transfer problems between groups and departments.

Problems may need to be transferred between different groups and department because the group or department that entered the problem may not be best suited for resolving the problem.

2. Store and retrieve problem information in the problem management system

Examples of systems include the following:
- Bug or issue tracking software
- Help desk software

3. Share and transfer problem records between groups or departments within the problem management system.

4. Store and recover the change history of problem records.

5. Store, update, and retrieve problem records.

6. Create reports from the problem management system.

7. Preserve the contents of the problem management system.

Examples of preservation functions of the problem management system include the following:
- Backups and restoration of problem management files
- Archiving of problem management files
- Recovery from problem management errors

8. Revise the problem management structure as necessary.

SG 2 Address Problems

Problems are identified and addressed.

SP 2.1 Identify Problems

Identify and record problems.

Problems can be identified proactively on a periodic basis and reactively to respond to individual incidents or a group of incidents.
Typical Work Products
1. Problem database record.

Subpractices
1. Identify problems from incidents.

Examples of identifying problems include:
- Analyze incidents reported by customers to a help desk
- Monitor the service infrastructure for incidents

2. Identify problems from proactive analysis of the service system.

Examples of proactively identifying problems include:
- Analysis of trends in the use of resources
- A structural analysis of strength and weaknesses of the service infrastructure

3. Record problem information

When recording problem information, record sufficient information to properly support problem analysis and resolution.

Examples of problem information to record:
- Incidents caused by the problem
- The configuration items involved
- Relevant characteristics of the situation in which the incidents occurred
- Incidents potentially caused by the problem
- The configuration items involved
- Relevant characteristics of the situation in which the incidents could occur

SP 2.2 Address Problems

*Analyze, review, and address problems.*

The purpose of this analysis is to determine the best course of action for resolving the problem. Note that the possible courses of action may be not to resolve the problem at all and dealing with the incidents when they occur, or to provide a work-around.

Typical Work Products
1. Action proposal
2. Work-around
Subpractices

1. Conduct problem analysis with the people who are responsible for performing the task.

   The analysis is typically performed by second-tier service personnel. For problems that underlie major incidents, the analysis may involve assembling a separate problem resolution team to analyze the problem.

2. Determine which department or group is best suited to resolve the problem.

   Which department or group is best suited may depend on the type of problem, configuration items involved, and the severity.

   Examples of groups and departments that deal with different types problem include the following:
   - A network support group handles network problems
   - A Unix server support team deals with server configuration problems.

3. Determine actions that need to be taken to resolve the problem.

   Examples of actions include the following:
   - Replacing a broken component
   - Fixing a software defect
   - Not fixing the problem because it is cheaper or less risky to deal with the incidents than addressing the problem.

4. Plan the actions.

5. Manage the actions until the problem is addressed.

6. Review the resolution and results with relevant stakeholders.

7. Record the actions and result.

   The performed actions to resolve the problem and the result of performing the actions are recorded in the problem management system to support resolving similar problems in future situations.

---

**SP 2.3** Monitor the Resolution of Problems

*Monitor the resolution of problems and escalate if necessary.*

**SP 2.4** Communicate and Validate Resolution of Problems

*Communicate the status of problems and validate the resolution of problems.*
Generic Practices by Goal

Continuous Only

GG 1  Achieve Specific Goals

The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.

GP 1.1  Perform Specific Practices

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

GG 2  Institutionalize a Managed Process

The process is institutionalized as a managed process.

Staged Only

GG 3  Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the staged representation.

GP 2.1  Establish an Organizational Policy

Establish and maintain an organizational policy for planning and performing the problem management process.

GP 2.2  Plan the Process

Establish and maintain the plan for performing the problem management process.

Elaboration:

This plan for performing the problem management process can be included in (or referenced by) the service delivery plan, which is described in the Project Planning process area. This plan typically is based on an estimation of the volume of incidents and problems, divided by types where appropriate.

GP 2.3  Provide Resources

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

Examples of resources provided include the following tools:

- Help desk tools
- Remote analysis tools
- Monitoring tools

GP 2.4 Assign Responsibility

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

Elaboration:

Responsibility is assigned for both identifying problems, e.g. by a help desk, and for analyzing and resolving problems, e.g. by support groups organized by product or platform.

GP 2.5 Train People

*Train the people performing or supporting the problem management process as needed.*

Elaboration:

Examples of training topics include the following:

- Roles, responsibilities, and authority of the problem management staff
- Problem management standards, procedures, and methods
- Problem management system

GP 2.6 Manage Configurations

*Place designated work products of the problem management process under appropriate levels of control.*
Examples of work products placed under control include the following:

- Problem management records
- Problem management reports
- Problem database

GP 2.7 Identify and Involve Relevant Stakeholders

**Identify and involve the relevant stakeholders of the problem management process as planned.**

Examples of activities for stakeholder involvement include the following:

- Identifying problems
- Reviewing problem management reports and resolving issues
- Reviewing the result of actions for resolving problems

GP 2.8 Monitor and Control the Process

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

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

- Number of problems
- Lead time of resolving problems
- Number of transfers between support groups before a problem is resolved

GP 2.9 Objectively Evaluate Adherence

**Objectively evaluate adherence of the problem management process against its process description, standards, and procedures, and address noncompliance.**

Examples of work products reviewed include the following:

- Problem records
GP 2.10  Review Status with Higher Level Management

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

Continuous Only

GG 3  Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal’s appearance here reflects its location in the continuous representation.

GP 3.1  Establish a Defined Process

Establish and maintain the description of a defined decision analysis and resolution process.

GP 3.2  Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the decision analysis and resolution process to support the future use and improvement of the organization’s processes and process assets.

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

Continuous Only

GG 4  Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

GP 4.1  Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the decision analysis and resolution process, which address quality and process performance, based on customer needs and business objectives.
### Continuous Only

<table>
<thead>
<tr>
<th>GP 4.2</th>
<th>Stabilize Subprocess Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stabilize the performance of one or more subprocesses to determine the ability of the decision analysis and resolution process to achieve the established quantitative quality and process-performance objectives.</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The process is institutionalized as an optimizing process.</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GP 5.1</th>
<th>Ensure Continuous Process Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ensure continuous improvement of the decision analysis and resolution process in fulfilling the relevant business objectives of the organization.</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GP 5.2</th>
<th>Correct Root Causes of Problems</th>
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<tr>
<td><strong>Identify and correct the root causes of defects and other problems in the decision analysis and resolution process.</strong></td>
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QUANTITATIVE PROJECT MANAGEMENT

A Project Management Process Area at Maturity Level 4

Purpose

The purpose of Quantitative Project Management (QPM) is to quantitatively manage the project’s defined process to achieve the project’s established quality and process-performance objectives.

Introductory Notes

The Quantitative Project Management process area involves the following:

- Establishing and maintaining the project’s quality and process-performance objectives
- Identifying suitable subprocesses that compose the project’s defined process based on historical stability and capability data found in process-performance baselines or models
- Selecting the subprocesses of the project’s defined process to be statistically managed
- Monitoring the project to determine whether the project’s objectives for quality and process performance are being satisfied, and identifying appropriate corrective action
- Selecting the measures and analytic techniques to be used in statistically managing the selected subprocesses
- Establishing and maintaining an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques
- Monitoring the performance of the selected subprocesses to determine whether they are capable of satisfying their quality and process-performance objectives, and identifying corrective action
- Recording statistical and quality management data in the organization’s measurement repository

The quality and process-performance objectives, measures, and baselines identified here are developed as described in the Organizational Process Performance process area. Subsequently, the results of performing the processes associated with the Quantitative Project Management process area (e.g., measurement definitions and measurement data) become part of the organizational process assets referred to in the Organizational Process Performance process area.
To effectively address the specific practices in this process area, the organization should have already established a set of standard processes and related organizational process assets, such as the organization’s measurement repository and the organization’s process asset library for use by each project in establishing its defined process. The project’s defined process is a set of subprocesses that form an integrated and coherent lifecycle for the project. It is established, in part, through selecting and tailoring processes from the organization’s set of standard processes. (See the definition of “defined process” in the glossary.)

The project should also ensure that the measurements and progress of the supplier’s efforts are made available. Establishment of effective relationships with suppliers is necessary for the successful implementation of this process area’s specific practices.

Process performance is a measure of the actual process results achieved. Process performance is characterized by both process measures (e.g., effort, cycle time, and defect removal efficiency) and product measures (e.g., reliability, defect density, and response time).

Subprocesses are defined components of a larger defined process. For example, a typical organization’s development process may be defined in terms of subprocesses such as requirements development, design, build, test, and peer review. The subprocesses themselves may be further decomposed as necessary into other subprocesses and process elements.

One essential element of quantitative management is having confidence in estimates (i.e., being able to predict the extent to which the project can fulfill its quality and process-performance objectives). The subprocesses that will be statistically managed are chosen based on identified needs for predictable performance. (See the definitions of “statistically managed process,” “quality and process-performance objective,” and “quantitatively managed process” in the glossary.)

Another essential element of quantitative management is understanding the nature and extent of the variation experienced in process performance, and recognizing when the project’s actual performance may not be adequate to achieve the project’s quality and process-performance objectives.

Statistical management involves statistical thinking and the correct use of a variety of statistical techniques, such as run charts, control charts, confidence intervals, prediction intervals, and tests of hypotheses. Quantitative management uses data from statistical management to help the project predict whether it will be able to achieve its quality and process-performance objectives and identify what corrective action should be taken.
This process area applies to managing a project, but the concepts found here also apply to managing other groups and functions. Applying these concepts to managing other groups and functions may not necessarily contribute to achieving the organization’s business objectives, but may help these groups and functions control their own processes.

Examples of other groups and functions include the following:

- Quality assurance
- Process definition and improvement
- Effort reporting
- Customer complaint handling
- Problem tracking and reporting

**Related Process Areas**

Refer to the Project Monitoring and Control process area for more information about monitoring and controlling the project and taking corrective action.

Refer to the Measurement and Analysis process area for more information about establishing measurable objectives, specifying the measures and analyses to be performed, obtaining and analyzing measures, and providing results.

Refer to the Organizational Process Performance process area for more information about the organization’s quality and process-performance objectives, process-performance analyses, process-performance baselines, and process-performance models.

Refer to the Organizational Process Definition process area for more information about the organizational process assets, including the organization’s measurement repository.

Refer to the Integrated Project Management process area for more information about establishing and maintaining the project’s defined process.

Refer to the Causal Analysis and Resolution process area for more information about how to identify the causes of defects and other problems, and taking action to prevent them from occurring in the future.

Refer to the Organizational Innovation and Deployment process area for more information about selecting and deploying improvements that support the organization’s quality and process-performance objectives.
Specific Goal and Practice Summary

SG 1 Quantitatively Manage the Project
  SP 1.1 Establish the Project’s Objectives
  SP 1.2 Compose the Defined Process
  SP 1.3 Select the Subprocesses that Will Be Statistically Managed
  SP 1.4 Manage Project Performance

SG 2 Statistically Manage Subprocess Performance
  SP 2.1 Select Measures and Analytic Techniques
  SP 2.2 Apply Statistical Methods to Understand Variation
  SP 2.3 Monitor Performance of the Selected Subprocesses
  SP 2.4 Record Statistical Management Data

Specific Practices by Goal

SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

SP 1.1 Establish the Project’s Objectives

Establish and maintain the project’s quality and process-performance objectives.

When establishing the project’s quality and process-performance objectives, it is often useful to think ahead about which processes from the organization’s set of standard processes will be included in the project’s defined process, and what the historical data indicates regarding their process performance. These considerations will help in establishing realistic objectives for the project. Later, as the project’s actual performance becomes known and more predictable, the objectives may need to be revised.

Typical Work Products
1. The project’s quality and process-performance objectives

Subpractices
1. Review the organization’s objectives for quality and process performance.

   The intent of this review is to ensure that the project understands the broader business context in which the project will need to operate. The project’s objectives for quality and process performance are developed in the context of these overarching organizational objectives.

   Refer to the Organizational Process Performance process area for more information about the organization’s quality and process-performance objectives.
2. Identify the quality and process performance needs and priorities of the customer, suppliers, end users, and other relevant stakeholders.

Examples of quality and process-performance attributes for which needs and priorities might be identified include the following:

- Functionality
- Reliability
- Maintainability
- Usability
- Duration
- Predictability
- Timeliness
- Accuracy

3. Identify how process performance is to be measured.

Consider whether the measures established by the organization are adequate for assessing progress in fulfilling customer, end-user, and other stakeholder needs and priorities. It may be necessary to supplement these with additional measures.

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

4. Define and document measurable quality and process-performance objectives for the project.

Defining and documenting objectives for the project involve the following:

- Incorporating the organization’s quality and process-performance objectives
- Writing objectives that reflect the quality and process-performance needs and priorities of the customer, end users, and other stakeholders, and the way these objectives should be measured

Examples of quality attributes for which objectives might be written include the following:

- Mean time between failures
- Critical resource utilization
- Number and severity of defects in the released product
- Number and severity of customer complaints concerning the provided service
Examples of process-performance attributes for which objectives might be written include the following:

- Percentage of defects removed by product verification activities (perhaps by type of verification, such as peer reviews and testing)
- Defect escape rates
- Number and density of defects (by severity) found during the first year following product delivery (or start of service)
- Cycle time
- Percentage of rework time

5. Derive interim objectives for each lifecycle phase, as appropriate, to monitor progress toward achieving the project’s objectives.

An example of a method to predict future results of a process is the use of process-performance models to predict the latent defects in the delivered product using interim measures of defects identified during product verification activities (e.g., peer reviews and testing).

6. Resolve conflicts among the project’s quality and process-performance objectives (e.g., if one objective cannot be achieved without compromising another objective).

Resolving conflicts involves the following:

- Setting relative priorities for the objectives
- Considering alternative objectives in light of long-term business strategies as well as short-term needs
- Involving the customer, end users, senior management, project management, and other relevant stakeholders in the tradeoff decisions
- Revising the objectives as necessary to reflect the results of the conflict resolution

7. Establish traceability to the project’s quality and process-performance objectives from their sources.

Examples of sources for objectives include the following:

- Requirements
- Organization’s quality and process-performance objectives
- Customer’s quality and process-performance objectives
- Business objectives
- Discussions with customers and potential customers
- Market surveys

An example of a method to identify and trace these needs and priorities is Quality Function Deployment (QFD).

Refer to the Supplier Agreement Management process area for more information about establishing and maintaining agreements with suppliers.

9. Revise the project’s quality and process-performance objectives as necessary.

SP 1.2 Compose the Defined Process

**Select the subprocesses that compose the project’s defined process based on historical stability and capability data.**

Refer to the Integrated Project Management process area for more information about establishing and maintaining the project’s defined process.

Refer to the Organizational Process Definition process area for more information about the organization’s process asset library, which might include a process element of known and needed capability.

Refer to the Organizational Process Performance process area for more information about the organization’s process-performance baselines and process-performance models.

Subprocesses are identified from the process elements in the organization’s set of standard processes and the process artifacts in the organization’s process asset library.

**Typical Work Products**

1. Criteria used in identifying which subprocesses are valid candidates for inclusion in the project’s defined process

2. Candidate subprocesses for inclusion in the project’s defined process

3. Subprocesses to be included in the project’s defined process

4. Identified risks when selected subprocesses lack a process-performance history

**Subpractices**

1. Establish the criteria to use in identifying which subprocesses are valid candidates for use.
Identification may be based on the following:

- Quality and process-performance objectives
- Existence of process-performance data
- Product line standards
- Project lifecycle models
- Customer requirements
- Laws and regulations

2. Determine whether the subprocesses that are to be statistically managed, and that were obtained from the organizational process assets, are suitable for statistical management.

A subprocess may be more suitable for statistical management if it has a history of the following:

- Stable performance in previous comparable instances
- Process-performance data that satisfies the project’s quality and process-performance objectives

Historical data are primarily obtained from the organization’s process-performance baselines. However, these data may not be available for all subprocesses.

3. Analyze the interaction of subprocesses to understand the relationships among the subprocesses and the measured attributes of the subprocesses.

Examples of analysis techniques include system dynamics models and simulations.

4. Identify the risk when no subprocess is available that is known to be capable of satisfying the quality and process-performance objectives (i.e., no capable subprocess is available or the capability of the subprocess is not known).

Even when a subprocess has not been selected to be statistically managed, historical data and process-performance models may indicate that the subprocess is not capable of satisfying the quality and process-performance objectives.

Refer to the Risk Management process area for more information about risk identification and analysis.

**SP 1.3 Select the Subprocesses that Will Be Statistically Managed**

*Select the subprocesses of the project’s defined process that will be statistically managed.*
Selecting the subprocesses to be statistically managed is often a concurrent and iterative process of identifying applicable project and organization quality and process-performance objectives, selecting the subprocesses, and identifying the process and product attributes to measure and control. Often the selection of a process, quality and process-performance objective, or measurable attribute will constrain the selection of the other two. For example, if a particular process is selected, the measurable attributes and quality and process-performance objectives may be constrained by that process.

**Typical Work Products**
1. Quality and process-performance objectives that will be addressed by statistical management
2. Criteria used in selecting which subprocesses will be statistically managed
3. Subprocesses that will be statistically managed
4. Identified process and product attributes of the selected subprocesses that should be measured and controlled

**Subpractices**
1. Identify which of the quality and process-performance objectives of the project will be statistically managed.
2. Identify the criteria to be used in selecting the subprocesses that are the main contributors to achieving the identified quality and process-performance objectives and for which predictable performance is important.

Examples of sources for criteria used in selecting subprocesses include the following:
- Customer requirements related to quality and process performance
- Quality and process-performance objectives established by the customer
- Quality and process-performance objectives established by the organization
- Organization's performance baselines and models
- Stable performance of the subprocess on other projects
- Laws and regulations

3. Select the subprocesses that will be statistically managed using the selection criteria.

It may not be possible to statistically manage some subprocesses (e.g., where new subprocesses and technologies are being piloted). In other cases, it may not be economically justifiable to apply statistical techniques to certain subprocesses.
4. Identify the product and process attributes of the selected subprocesses that will be measured and controlled.

Examples of product and process attributes include the following:

- Defect density
- Cycle time
- Test coverage

SP 1.4 Manage Project Performance

**Monitor the project to determine whether the project’s objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.**

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

A prerequisite for such a comparison is that the selected subprocesses of the project’s defined process are being statistically managed and their process capability is understood. The specific practices of specific goal 2 provide detail on statistically managing the selected subprocesses.

**Typical Work Products**

1. Estimates (predictions) of the achievement of the project’s quality and process-performance objectives
2. Documentation of the risks in achieving the project’s quality and process-performance objectives
3. Documentation of actions needed to address the deficiencies in achieving the project’s objectives

**Subpractices**

1. Periodically review the performance of each subprocess and the capability of each subprocess selected to be statistically managed to appraise progress toward achieving the project’s quality and process-performance objectives.

   The process capability of each selected subprocess is determined with respect to that subprocess’ established quality and process-performance objectives. These objectives are derived from the project’s quality and process-performance objectives, which are for the project as a whole.

2. Periodically review the actual results achieved against established interim objectives for each phase of the project lifecycle to appraise progress toward achieving the project’s quality and process-performance objectives.
3. Track suppliers’ results for achieving their quality and process-performance objectives.

4. Use process-performance models calibrated with obtained measures of critical attributes to estimate progress toward achieving the project’s quality and process-performance objectives.

   Process-performance models are used to estimate progress toward achieving objectives that cannot be measured until a future phase in the project lifecycle. An example is the use of process-performance models to predict the latent defects in the delivered product using interim measures of defects identified during peer reviews.

   *Refer to the Organizational Process Performance process area for more information about process-performance models.*

   The calibration is based on the results obtained from performing the previous subpractices.

5. Identify and manage the risks associated with achieving the project’s quality and process-performance objectives.

   *Refer to the Risk Management process area for more information about identifying and managing risks.*

   Example sources of the risks include the following:
   - Inadequate stability and capability data in the organization’s measurement repository
   - Subprocesses having inadequate performance or capability
   - Suppliers not achieving their quality and process-performance objectives
   - Lack of visibility into supplier capability
   - Inaccuracies in the organization’s process-performance models for predicting future performance
   - Deficiencies in predicted process performance (estimated progress)
   - Other identified risks associated with identified deficiencies

6. Determine and document actions needed to address the deficiencies in achieving the project’s quality and process-performance objectives.

   The intent of these actions is to plan and deploy the right set of activities, resources, and schedule to place the project back on track as much as possible to meet its objectives.
Examples of actions that can be taken to address deficiencies in achieving the project’s objectives include the following:

- Changing quality or process-performance objectives so that they are within the expected range of the project’s defined process
- Improving the implementation of the project’s defined process so as to reduce its normal variability (reducing variability may bring the project’s performance within the objectives without having to move the mean)
- Adopting new subprocesses and technologies that have the potential for satisfying the objectives and managing the associated risks
- Identifying the risk and risk mitigation strategies for the deficiencies
- Terminating the project

Refer to the Project Monitoring and Control process area for more information about taking corrective action.

**SG 2 Statistically Manage Subprocess Performance**

*The performance of selected subprocesses within the project's defined process is statistically managed.*

This specific goal describes an activity critical to achieving the Quantitatively Manage the Project specific goal of this process area. The specific practices under this specific goal describe how to statistically manage the subprocesses whose selection was described in the specific practices under the first specific goal. When the selected subprocesses are statistically managed, their capability to achieve their objectives can be determined. By these means, it will be possible to predict whether the project will be able to achieve its objectives, which is key to quantitatively managing the project.

**SP 2.1 Select Measures and Analytic Techniques**

*Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.*

Refer to the Measurement and Analysis process area for more information about establishing measurable objectives; on defining, collecting, and analyzing measures; and on revising measures and statistical analysis techniques.

**Typical Work Products**

1. Definitions of the measures and analytic techniques to be used in (or proposed for) statistically managing the subprocesses
2. Operational definitions of the measures, their collection points in the subprocesses, and how the integrity of the measures will be determined
3. Traceability of measures back to the project’s quality and process-performance objectives

4. Instrumented organizational support environment to support automatic data collection

Subpractices

1. Identify common measures from the organizational process assets that support statistical management.

Refer to the Organizational Process Definition process area for more information about common measures.

Product lines or other stratification criteria may categorize common measures.

2. Identify additional measures that may be needed for this instance to cover critical product and process attributes of the selected subprocesses.

In some cases, measures may be research oriented. Such measures should be explicitly identified.

3. Identify the measures that are appropriate for statistical management.

Critical criteria for selecting statistical management measures include the following:

- Controllable (e.g., can a measure’s values be changed by changing how the subprocess is implemented?)
- Adequate performance indicator (e.g., is the measure a good indicator of how well the subprocess is performing relative to the objectives of interest?)

Examples of subprocess measures include the following:

- Requirements volatility
- Ratios of estimated to measured values of the planning parameters (e.g., size, cost, and schedule)
- Coverage and efficiency of peer reviews
- Test coverage and efficiency
- Effectiveness of training (e.g., percent of planned training completed and test scores)
- Reliability
- Percentage of the total defects inserted or found in the different phases of the project lifecycle
- Percentage of the total effort expended in the different phases of the project lifecycle
4. Specify the operational definitions of the measures, their collection points in the subprocesses, and how the integrity of the measures will be determined.

Operational definitions are stated in precise and unambiguous terms. They address two important criteria as follows:

- Communication: What has been measured, how it was measured, what the units of measure are, and what has been included or excluded
- Repeatability: Whether the measurement can be repeated, given the same definition, to get the same results

5. Analyze the relationship of the identified measures to the organization’s and project’s objectives, and derive objectives that state specific target measures or ranges to be met for each measured attribute of each selected subprocess.

6. Instrument the organizational support environment to support collection, derivation, and analysis of statistical measures.

The instrumentation is based on the following:

- Description of the organization’s set of standard processes
- Description of the project’s defined process
- Capabilities of the organizational support environment

7. Identify the appropriate statistical analysis techniques that are expected to be useful in statistically managing the selected subprocesses.

The concept of “one size does not fit all” applies to statistical analysis techniques. What makes a particular technique appropriate is not just the type of measures, but more important, how the measures will be used and whether the situation warrants applying that technique. The appropriateness of the selection may need to be investigated from time to time.

Examples of statistical analysis techniques are given in the next specific practice.

8. Revise the measures and statistical analysis techniques as necessary.

**SP 2.2  Apply Statistical Methods to Understand Variation**

*Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.*

Refer to the Measurement and Analysis process area for more information about collecting, analyzing, and using measurement results.
Understanding variation is achieved, in part, by collecting and analyzing process and product measures so that special causes of variation can be identified and addressed to achieve predictable performance.

A special cause of process variation is characterized by an unexpected change in process performance. Special causes are also known as “assignable causes” because they can be identified, analyzed, and addressed to prevent recurrence.

The identification of special causes of variation is based on departures from the system of common causes of variation. These departures can be identified by the presence of extreme values, or other identifiable patterns in the data collected from the subprocess or associated work products. Knowledge of variation and insight about potential sources of anomalous patterns are typically needed to detect special causes of variation.

Sources of anomalous patterns of variation may include the following:

- Lack of process compliance
- Undistinguished influences of multiple underlying subprocesses on the data
- Ordering or timing of activities within the subprocess
- Uncontrolled inputs to the subprocess
- Environmental changes during subprocess execution
- Schedule pressure
- Inappropriate sampling or grouping of data

Typical Work Products

1. Collected measures
2. Natural bounds of process performance for each measured attribute of each selected subprocess
3. Process performance compared to the natural bounds of process performance for each measured attribute of each selected subprocess

Subpractices

1. Establish trial natural bounds for subprocesses having suitable historical performance data.

Refer to the Organizational Process Performance process area for more information about organizational process-performance baselines.
Natural bounds of an attribute are the range within which variation normally occurs. All processes will show some variation in process and product measures each time they are executed. The issue is whether this variation is due to common causes of variation in the normal performance of the process or to some special cause that can and should be identified and removed.

When a subprocess is initially executed, suitable data for establishing trial natural bounds are sometimes available from prior instances of the subprocess or comparable subprocesses, process-performance baselines, or process-performance models. These data are typically contained in the organization’s measurement repository. As the subprocess is executed, data specific to that instance are collected and used to update and replace the trial natural bounds. However, if the subprocess in question has been materially tailored, or if the conditions are materially different from those in previous instantiations, the data in the repository may not be relevant and should not be used.

In some cases, there may be no historical comparable data (e.g., when introducing a new subprocess, when entering a new application domain, or when significant changes have been made to the subprocess). In such cases, trial natural bounds will have to be made from early process data of this subprocess. These trial natural bounds must then be refined and updated as subprocess execution continues.

Examples of criteria for determining whether data are comparable include the following:

- Product lines
- Application domain
- Work product and task attributes (e.g., size of product)
- Size of project

2. Collect data, as defined by the selected measures, on the subprocesses as they execute.

3. Calculate the natural bounds of process performance for each measured attribute.

Examples of where the natural bounds are calculated include the following:

- Control charts
- Confidence intervals (for parameters of distributions)
- Prediction intervals (for future outcomes)

4. Identify special causes of variation.

An example of a criterion for detecting a special cause of process variation in a control chart is a data point that falls outside of the 3-sigma control limits.
The criteria for detecting special causes of variation are based on statistical theory and experience and depend on economic justification. As criteria are added, special causes are more likely to be identified if present, but the likelihood of false alarms also increases.

5. Analyze the special cause of process variation to determine the reasons the anomaly occurred.

Examples of techniques for analyzing the reasons for special causes of variation include the following:
- Cause-and-effect (fishbone) diagrams
- Designed experiments
- Control charts (applied to subprocess inputs or to lower level subprocesses)
- Subgrouping (analyzing the same data segregated into smaller groups based on an understanding of how the subprocess was implemented facilitates isolation of special causes)

Some anomalies may simply be extremes of the underlying distribution rather than problems. The people implementing a subprocess are usually the ones best able to analyze and understand special causes of variation.

6. Determine what corrective action should be taken when special causes of variation are identified.

Removing a special cause of process variation does not change the underlying subprocess. It addresses an error in the way the subprocess is being executed.

Refer to the Project Monitoring and Control process area for more information about taking corrective action.

7. Recalculate the natural bounds for each measured attribute of the selected subprocesses as necessary.

Recalculating the (statistically estimated) natural bounds is based on measured values that signify that the subprocess has changed, not on expectations or arbitrary decisions.

Examples of when the natural bounds may need to be recalculated include the following:
- There are incremental improvements to the subprocess
- New tools are deployed for the subprocess
- A new subprocess is deployed
- The collected measures suggest that the subprocess mean has permanently shifted or the subprocess variation has permanently changed
Monitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process-performance objectives, and identify corrective action as necessary.

The intent of this specific practice is to do the following:

- Determine statistically the process behavior expected from the subprocess
- Appraise the probability that the process will meet its quality and process-performance objectives
- Identify the corrective action to be taken, based on a statistical analysis of the process-performance data

Corrective action may include renegotiating the affected project objectives, identifying and implementing alternative subprocesses, or identifying and measuring lower level subprocesses to achieve greater detail in the performance data. Any or all of these actions are intended to help the project use a more capable process. (See the definition of “capable process” in the glossary.)

A prerequisite for comparing the capability of a selected subprocess against its quality and process-performance objectives is that the performance of the subprocess is stable and predictable with respect to its measured attributes.

Process capability is analyzed for those subprocesses and those measured attributes for which (derived) objectives have been established. Not all subprocesses or measured attributes that are statistically managed are analyzed regarding process capability.

The historical data may be inadequate for initially determining whether the subprocess is capable. It also is possible that the estimated natural bounds for subprocess performance may shift away from the quality and process-performance objectives. In either case, statistical control implies monitoring capability as well as stability.

Typical Work Products
1. Natural bounds of process performance for each selected subprocess compared to its established (derived) objectives
2. For each subprocess, its process capability
3. For each subprocess, the actions needed to address deficiencies in its process capability
Subpractices

1. Compare the quality and process-performance objectives to the natural bounds of the measured attribute.

   This comparison provides an appraisal of the process capability for each measured attribute of a subprocess. These comparisons can be displayed graphically, in ways that relate the estimated natural bounds to the objectives or as process capability indices, which summarize the relationship of the objectives to the natural bounds.

2. Monitor changes in quality and process-performance objectives and selected subprocess' process capability.

3. Identify and document subprocess capability deficiencies.

4. Determine and document actions needed to address subprocess capability deficiencies.

   Examples of actions that can be taken when a selected subprocess’s performance does not satisfy its objectives include the following:

   • Changing quality and process-performance objectives so that they are within the subprocess’ process capability
   • Improving the implementation of the existing subprocess so as to reduce its normal variability (reducing variability may bring the natural bounds within the objectives without having to move the mean)
   • Adopting new process elements and subprocesses and technologies that have the potential for satisfying the objectives and managing the associated risks
   • Identifying risks and risk mitigation strategies for each subprocess’s process capability deficiency

   Refer to the Project Monitoring and Control process area for more information about taking corrective action.

SP 2.4 Record Statistical Management Data

Record statistical and quality management data in the organization’s measurement repository.

Refer to the Measurement and Analysis process area for more information about managing and storing data, measurement definitions, and results.

Refer to the Organizational Process Definition process area for more information about the organization’s measurement repository.

Typical Work Products

1. Statistical and quality management data recorded in the organization’s measurement repository
## Generic Practices by Goal

### Continuous Only

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<tr>
<th>GG 1</th>
<th>Achieve Specific Goals</th>
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<td></td>
<td>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</td>
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<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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<td>Perform the specific practices of the quantitative project management process to develop work products and provide services to achieve the specific goals of the process area.</td>
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<th>GG 2</th>
<th>Institutionalize a Managed Process</th>
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<td>The process is institutionalized as a managed process.</td>
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### Staged Only

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<thead>
<tr>
<th>GG 3</th>
<th>Institutionalize a Defined Process</th>
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<tr>
<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<tbody>
<tr>
<td></td>
<td>Establish and maintain an organizational policy for planning and performing the quantitative project management process.</td>
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</table>

Elaboration:

This policy establishes organizational expectations for quantitatively managing the project using quality and process-performance objectives, and statistically managing selected subprocesses within the project’s defined process.

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<th>GP 2.2</th>
<th>Plan the Process</th>
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<td>Establish and maintain the plan for performing the quantitative project management process.</td>
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</table>

Elaboration:

This plan for performing the quantitative project management process can be included in (or referenced by) the project plan, which is described in the Project Planning process area.
GP 2.3  Provide Resources

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

Elaboration:

Special expertise in statistics and statistical process control may be needed to define the techniques for statistical management of selected subprocesses, but staff will use the tools and techniques to perform the statistical management. Special expertise in statistics may also be needed for analyzing and interpreting the measures resulting from statistical management.

Examples of other resources provided include the following tools:

- System dynamics models
- Automated test-coverage analyzers
- Statistical process and quality control packages
- Statistical analysis packages

GP 2.4  Assign Responsibility

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

GP 2.5  Train People

Train the people performing or supporting the quantitative project management process as needed.

Elaboration:

Examples of training topics include the following:

- Process modeling and analysis
- Process measurement data selection, definition, and collection

GP 2.6  Manage Configurations

Place designated work products of the quantitative project management process under appropriate levels of control.
Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the quantitative project management process as planned.

Elaboration:

Examples of activities for stakeholder involvement include the following:

- Establishing project objectives
- Resolving issues among the project’s quality and process-performance objectives
- Appraising performance of the selected subprocesses
- Identifying and managing the risks in achieving the project’s quality and process-performance objectives
- Identifying what corrective action should be taken

GP 2.8 Monitor and Control the Process

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

Elaboration:

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

- Profile of subprocesses under statistical management (e.g., number planned to be under statistical management, number currently being statistically managed, and number that are statistically 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
**GP 2.9 Objectively Evaluate Adherence**

**Objectively evaluate adherence of the quantitative project management process against its process description, standards, and procedures, and address noncompliance.**

**Elaboration:**

Examples of activities reviewed include the following:

- Quantitatively managing the project using quality and process-performance objectives
- Statistically managing selected subprocesses within the project's defined process

Examples of work products reviewed include the following:

- Subprocesses to be included in the project’s defined process
- Operational definitions of the measures
- Collected measures

**GP 2.10 Review Status with Higher Level Management**

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

**Continuous Only**

**GG 3 Institutionalize a Defined Process**

**The process is institutionalized as a defined process.**

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1 Establish a Defined Process**

**Establish and maintain the description of a defined quantitative project management process.**

**GP 3.2 Collect Improvement Information**

**Collect work products, measures, measurement results, and improvement information derived from planning and performing the quantitative project management process to support the future use and improvement of the organization’s processes and process assets.**
Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

- Records of statistical and quality management data from the project, including results from the periodic review of the actual performance of the statistically managed subprocesses against established interim objectives of the project
- Process and product quality assurance report that identifies inconsistent but compliant implementations of subprocesses being considered for statistical management

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REQUIREMENTS MANAGEMENT (REQM) SVC

A Project Management Process Area at Maturity Level 2

Purpose

The purpose of Requirements Management (REQM) is to manage the requirements of the project’s products and product components and to identify inconsistencies between those requirements and the project’s plans and work products.

REQM also establishes and maintains written agreements between service providers and customers on service requirements and service levels.

Introductory Notes

The Requirements Management process area addresses all customer and service provider agreed requirements, which might take the form of performance levels or service levels as well as other types of requirements for the service system.

Requirements management processes manage all requirements received or generated by the project, including both technical and nontechnical requirements as well as those requirements levied on the project by the organization. Throughout the process areas, where we use the terms product and product component, their intended meanings also encompass services and their components.

The written agreement on service requirements contains specific targets, measurable performance standards, and acceptable quality levels to support the ongoing measurement, monitoring, and reporting of services.

The written agreement on service requirements can take the form of a service level agreement (SLA), performance work statement (PWS), statement of objectives (SOO), statement of work (SOW), or other types of agreements. The written agreement may be part of a contract, a memorandum of agreement, an agreed requirements document, or may take some other form.
The written agreement may have to be established while service provision is already ongoing. The intent of Requirements Management is to repeat the service requirements agreement process during the course of the service period to support a positive relationship between the service provider and the customer while meeting the needs of both. Requirements management processes should encourage open communication without retribution to support effective Problem Management.

The customer may be internal or external to the service provider’s organization. Examples of customers are as follows:

- government agencies internal or external to the service provider’s company
- private-sector companies internal or external to the service provider’s company
- departments or business units internal or external to the service provider’s company

Examples of service providers are as follows:

- contractors external to government agencies providing maintenance and operations support for air and sea warfare vehicles
- contractors external to government agencies providing weapons systems and communication systems operations support
- service providers internal to a government agency providing network operations support
- service providers internal to a private-sector company providing operations support to other business units or departments within the company
- contractors external to a private-sector company providing operations support

When standard service definitions or baseline data is available at the organizational level, Requirements Management uses that information as a basis for establishing agreements.

Sources and considerations for service requirements include mission-related performance goals and objectives (found in strategic plans and employee performance plans), monitoring capability, current 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). Other considerations affecting service requirements may stem from the customer’s agreements with other suppliers (e.g., the customer’s underpinning contracts, operational level agreements, memoranda of agreement, subcontracts).
The project takes appropriate steps to ensure that the agreed-on set of requirements is managed to support the planning and execution needs of the project. When a project receives requirements from an approved requirements provider, the requirements are reviewed with the requirements provider to resolve issues and prevent misunderstanding before the requirements are incorporated into the project's plans. Once the requirements provider and the requirements receiver reach an agreement, commitment to the requirements is obtained from the project participants. The project manages changes to the requirements as they evolve and identifies any inconsistencies that occur among the plans, work products, and requirements.

Part of the management of requirements is to document requirements changes and rationale and to maintain bidirectional traceability between source requirements and all product and product component requirements. (See the definition of "bidirectional traceability" in the glossary.)

All development projects have requirements. In the case of a project that is focused on maintenance activities, the changes to the product or product components 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 users, or they might take the form of new requirements received from the requirements development process. Regardless of their source or form, the maintenance activities that are driven by changes to requirements are managed accordingly.

**Related Process Areas**

Refer to the Project Planning process area for more information about how project plans reflect requirements and need to be revised as requirements change.

Refer to the Configuration Management process area for more information about baselines and controlling changes to configuration documentation for requirements.

Refer to the Project Monitoring and Control process area for more information about tracking and controlling the activities and work products that are based on the requirements and taking appropriate corrective action.

Refer to the Risk Management process area for more information about identifying and handling risks associated with requirements.

Refer to the Organizational Service Management process area for more information about standard services.
Refer to Supplier Agreement Management for information about ensuring that supplier agreements (e.g., underpinning contracts, operational level agreements, memoranda of agreement, subcontracts) support service and performance targets.

**Specific Goal and Practice Summary**

**SG 1 Manage Requirements**
- SP 1.1 Obtain an Understanding of 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 Identify Inconsistencies Between Project Work and Requirements

**SG 2 Establish Service Requirements Agreements**
- SP 2.1 Analyze Existing Agreements and Service Data
- SP 2.2 Establish and Maintain the Service Requirements Agreement

**Specific Practices by Goal**

**SG 1 Manage Requirements**

*Requirements are managed and inconsistencies with project plans and work products are identified.*

The project maintains a current and approved set of requirements over the life of the project by doing the following:

- Managing all changes to the requirements
- Maintaining the relationships among the requirements, the project plans, and the work products
- Identifying inconsistencies among the requirements, the project plans, and the work products
- Taking corrective action
  - Establishing and maintaining service agreements
  - Reviewing service requirements on a periodic and event-driven basis

Refer to the Project Monitoring and Control process area for more information about taking corrective action.

**SP 1.1 Obtain an Understanding of Requirements**

*Develop an understanding with the requirements providers on the meaning of the requirements.*
As the project 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. The receiving activities conduct analyses of the requirements with the requirements provider to ensure that a compatible, shared understanding is reached on the meaning of the requirements. The result of this analysis and dialog is an agreed-to set of requirements.

**Typical 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. An agreed-to set of requirements

**Subpractices**

1. Establish criteria for distinguishing appropriate requirements providers.
2. Establish objective criteria for the evaluation and acceptance of requirements.

Lack of evaluation and acceptance criteria often results in inadequate verification, costly rework, or customer rejection.

Examples of evaluation and acceptance criteria include the following:

- Clearly and properly stated
- Complete
- Consistent with each other
- Uniquely identified
- Appropriate to implement
- Verifiable (testable)
- Traceable

3. Analyze requirements to ensure that the established criteria are met.
4. Reach an understanding of the requirements with the requirements provider so that the project participants can commit to them.

**SP 1.2 Obtain Commitment to Requirements**

*Obtain commitment to the requirements from the project participants.*
Refer to the Project Monitoring and Control process area for more information about monitoring the commitments made.

Whereas the previous specific practice dealt with reaching an understanding with the requirements providers, this specific practice deals with agreements and commitments among those who have to carry out the activities necessary to implement the requirements. As the requirements evolve, this specific practice ensures that project participants commit to the current, approved requirements and the resulting changes in project plans, activities, and work products.

**Typical 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 project 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 project participants commit to the requirement or requirement change.

---

**SP 1.3 Manage Requirements Changes**

*Manage changes to the requirements as they evolve during the project.*

Refer to the Configuration Management process area for more information about maintaining and controlling the requirements baseline and on making the requirements and change data available to the project.

During the project, requirements change for a variety of reasons. As needs change and as work proceeds, additional requirements are derived and changes may have to be made to the existing requirements. It is essential to manage these additions and changes efficiently and effectively. To effectively analyze the impact of the changes, it is necessary that the source of each requirement is known and the rationale for any change is documented. The project manager may, however, want to track appropriate measures of requirements volatility to judge whether new or revised controls are necessary.
Typical Work Products
1. Requirements status
2. Requirements database
3. Requirements decision database

Subpractices
1. Document all requirements and requirements changes that are given to or generated by the project.
2. Maintain the requirements change history with the rationale for the changes.
   Maintaining the change history helps track requirements volatility.
3. Evaluate the impact of requirement changes from the standpoint of relevant stakeholders.
4. Make the requirements and change data available to the project.

SP 1.4 Maintain Bidirectional Traceability of Requirements

Maintain bidirectional traceability among the requirements and work products.

The intent of this specific practice is to maintain the bidirectional traceability of requirements for each level of product decomposition. (See the definition of “bidirectional traceability” in the glossary.) When the requirements are managed well, traceability can be established from the source requirement to its lower level requirements and from the lower level requirements back to their source. Such bidirectional traceability helps determine that all source requirements have been completely addressed and that all lower level requirements can be traced to a valid source.

Requirements traceability can also cover the relationships to other entities such as intermediate and final work products, changes in design documentation, and test plans. The traceability can cover horizontal relationships, such as across interfaces, as well as vertical relationships. Traceability is particularly needed in conducting the impact assessment of requirements changes on the project’s activities and work products.

Typical Work Products
1. Requirements traceability matrix
2. Requirements tracking system
Subpractices
1. Maintain requirements traceability to ensure that the source of lower level (derived) requirements is documented.
2. Maintain requirements traceability from a requirement to its derived requirements and allocation to functions, interfaces, objects, people, processes, and work products.
3. Generate the requirements traceability matrix.

SP 1.5 Identify Inconsistencies Between Project Work and Requirements

**Identify inconsistencies between the project plans and work products and the requirements.**

Refer to the Project Monitoring and Control process area for more information about monitoring and controlling the project plans and work products for consistency with requirements and taking corrective actions when necessary.

This specific practice finds the inconsistencies between the requirements and the project plans and work products and initiates the corrective action to fix them.

**Typical Work Products**
1. Documentation of inconsistencies including sources, conditions, and rationale
2. Corrective actions

Subpractices
1. Review the project’s plans, activities, and work products for consistency with the requirements and the changes made to them.
2. Identify the source of the inconsistency and the rationale.
3. Identify changes that need to be made to the plans and work products resulting from changes to the requirements baseline.
4. Initiate corrective actions.
**Establish Service Requirements Agreements**

*Service requirements agreements are established and maintained.*

The service requirements agreement between a service provider and its customers is established and maintained on an ongoing basis. An ongoing and collaborative approach to this process area will encourage a culture that supports service quality improvement in contrast to a culture of finger-pointing and contractual nit-picking. To succeed in maintaining this partnership 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. Planning for delivery of the agreed requirements must occur during requirements management.

**SP 2.1 Analyze Existing Agreements and Service Data**

*Analyze existing agreements and service data against requested service requirements.*

This practice goes beyond what SP1.1 encompasses by considering the complete context in which requirements are being established by a stakeholder. Overall 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, standard service lines) are included in this analysis.

**Typical Work Products**

1. Collected customer descriptions of plans, goals, and service needs
2. Results of customer and end-user satisfaction surveys and questionnaires
3. 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 perception of service prior to establishing the service agreement. These perceptions may include customer objectives that are not directly represented in expressed service requirements by themselves.
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 Organizational Service Management for more information about systematic collection of customer and end-user need data.

2. Review service delivery and support personnel concerns.

It is important to obtain an understanding of the perspectives of the front-line service delivery and support personnel prior to establishing the service agreement. These individuals will ultimately become responsible for ensuring that service delivery meets agreed-upon requirements, and they have a unique operational insight into the potential impacts of new agreements. This information may be collected through face-to-face or telephone interviews, or through other methods of soliciting employee feedback (e.g., email or surveys).

3. Review existing service agreements and supplier agreements.

The impact of the customer's supplier agreements on the achievement of requested service requirements are considered. The requested service requirements are reviewed against standard service definitions if they exist. Existing Service Level Agreements and supplier agreements (e.g., operational level agreements and underpinning contracts) are reviewed for their ability to meet requested service requirements.

4. Review available current service data and service system designs.

Existing service data (such as performance data, service levels, baselines, data from capacity and availability management) and capabilities (e.g., monitoring capabilities) are reviewed. Available industry benchmarks or other published data may 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 information on capacity and availability.

Refer to the Incident and Request Management process area for information on incidents.

Refer to the Problem Management process area for information on problems.

Refer to the Service System Development process area for information on service system designs.
5. Analyze the capability to supply requested services.

   Consider the overall method of how the requested service delivery will be accomplished: by using the resources of an existing service system, or by modifying or creating a service system to meet new types of requirements.

   Refer to the Capacity and Availability Management process area for information on resource use.

   Refer to the Service System Development process area for information on creating and modifying service systems.

SP 2.2 Establish the Service Requirements Agreement

Establish and maintain the service requirements agreement.

Typical Work Products
1. Service requirements agreement

Subpractices
1. Define the structure and format of the service requirements agreement.

   It is important to define a structure for the service requirements agreement that will meet the needs of the customer and service provider. The structure of the service requirements agreement will complement the critical attributes, categories, and structure or hierarchy of the standard service definitions if they exist. Examples of structures to consider are as follows:

   - service based: the service requirements agreement is organized around a service (e.g., an corporate email system) and may cover several different customers
   - customer based: the service requirements agreement is organized around a customer and may 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 the service requirements agreement. In those situations, this subpractice amounts to developing an understanding of the customer’s expectations and the range of allowable tailorability of the agreement’s structure and format.

2. Define, negotiate, and obtain agreement on a draft service requirements agreement.

3. Publish the service requirements agreement and make it available to service providers and customers as appropriate.

4. Review and revise the service requirements agreement on a periodic and event-driven basis as appropriate.
**Generic Practices by Goal**

**Continuous Only**

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**Elaboration:**

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

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

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Elaboration:

Examples of resources provided include the following tools:

- Requirements tracking tools
- Traceability tools

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the requirements management process as needed.

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

GP 2.6 Manage Configurations

Place designated work products of the requirements management process under appropriate levels of control.

Elaboration:

Examples of work products placed under control include the following:

- Requirements
- Requirements traceability matrix

GP 2.7 Identify and Involve Relevant Stakeholders

Identify and involve the relevant stakeholders of the requirements management process as planned.
Elaboration:

Select relevant stakeholders from customers, end users, developers, producers, testers, suppliers, marketers, maintainers, disposal personnel, and others who may be affected by, or may affect, the product as well as the process.

Examples of activities for stakeholder involvement include the following:

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

GP 2.8 Monitor and Control the Process

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

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

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the requirements management process against its process description, standards, and procedures, and address noncompliance.

Elaboration:

Examples of activities reviewed include the following:

- Managing requirements
- Identifying inconsistencies among project plans, work products, and requirements

Examples of work products reviewed include the following:

- Requirements
- Requirements traceability matrix
GP 2.10  Review Status with Higher Level Management

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

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.

**Staged Only**

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

**Continuous/Maturity Levels 3 - 5 Only**

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 requirements management process.*

GP 3.2  Collect Improvement Information

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the requirements management process to support the future use and improvement of the organization’s processes and process assets.*

Elaboration:

- Examples of work products, measures, measurement results, and improvement information include the following:
  - Requirements traceability matrix
  - Number of unfunded requirements changes after baselining
  - Lessons learned in resolving ambiguous requirements

**Continuous Only**

GG 4  Institutionalize a Quantitatively Managed Process

*The process is institutionalized as a quantitatively managed process.*
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<tr>
<th>GP 5.2</th>
<th>Correct Root Causes of Problems</th>
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<tr>
<td><strong>Identify and correct the root causes of defects and other problems in the requirements management process.</strong></td>
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RISK MANAGEMENT

A Project 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 project to mitigate adverse impacts on achieving objectives.

Introductory Notes

Risk management is a continuous, forward-looking process that is an important part of management. Risk management should address issues that could endanger achievement of critical objectives. A continuous risk management approach is applied to effectively anticipate and mitigate the risks that may have a critical impact on the project.

Effective risk management includes early and aggressive risk identification through the collaboration and involvement of relevant stakeholders, as described in the stakeholder involvement plan addressed in the Project Planning process area. Strong leadership across all relevant stakeholders is needed to establish an environment for the free and open disclosure and discussion of risk.

Risk management must consider both internal and external sources for cost, schedule, and performance risk as well as 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 project.

Risk management can be divided into three parts: defining a risk management strategy; identifying and analyzing risks; and handling identified risks, including the implementation of risk mitigation plans when needed.

As represented in the Project Planning and Project Monitoring and Control process areas, organizations may initially focus simply 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 project.
Although the primary emphasis of the Risk Management process area is on the project, the concepts can also be applied to manage organizational risks.

Related Process Areas

Refer to the Project Planning process area for more information about identification of project risks and planning for involvement of relevant stakeholders.

Refer to the Project Monitoring and Control process area for more information about monitoring project risks.

Refer to the Decision Analysis and Resolution process area for more information about using a formal evaluation process to evaluate alternatives for selection and mitigation of identified risks.

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.

Preparation is conducted by establishing and maintaining a strategy for identifying, analyzing, and mitigating risks. This is typically documented in a risk management plan. The risk management strategy addresses the specific actions and management approach used to apply and control the risk management program. This includes identifying the sources of risk; the scheme used to categorize risks; and the parameters used to evaluate, bound, and control risks for effective handling.

SP 1.1 Determine Risk Sources and Categories

Determine risk sources and categories.
Identification of risk sources provides a basis for systematically examining changing situations over time to uncover circumstances that impact the ability of the project to meet its objectives. Risk sources are both internal and external to the project. As the project progresses, additional sources of risk may be identified. Establishing categories for risks provides a mechanism for collecting and organizing risks as well as ensuring appropriate scrutiny and management attention for those risks that can have more serious consequences on meeting project objectives.

**Typical Work Products**
1. Risk source lists (external and internal)
2. Risk categories list

**Subpractices**
1. **Determine risk sources.**

   Risk sources are the fundamental drivers that cause risks within a project or organization. There are many sources of risks, both internal and external, to a project. Risk sources identify common areas where risks may originate. Typical internal and external risk sources include the following:
   - Uncertain requirements
   - Unprecedented efforts—estimates unavailable
   - Infeasible design
   - Unavailable technology
   - Unrealistic schedule estimates or allocation
   - Inadequate staffing and skills
   - Cost or funding issues
   - Uncertain or inadequate subcontractor capability
   - Uncertain or inadequate vendor capability
   - Inadequate communication with actual or potential customers or with their representatives
   - Disruptions to continuity of operations

   Many of these sources of risk are often accepted without adequate planning. 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 project to preclude occurrence of the risks or reduce the consequences of their occurrence.

2. **Determine risk categories.**

   Risk categories reflect the “bins” for collecting and organizing risks. A reason for identifying risk categories is to help in the future consolidation of the activities in the risk mitigation plans.
The following factors may be considered when determining risk categories:

- The phases of the project's lifecycle model (e.g., requirements, design, manufacturing, test and evaluation, delivery, and disposal)
- The types of processes used
- The types of products used
- Program management risks (e.g., contract risks, budget/cost risks, schedule risks, resources risks, performance risks, and 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 the parameters used to analyze and categorize risks, and the parameters used 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 the various risks to be managed. Without these parameters, it would be very difficult to gauge the severity of the unwanted change caused by the risk and to prioritize the necessary actions required for risk mitigation planning.

Typical Work Products

1. Risk evaluation, categorization, and prioritization criteria
2. Risk management requirements (e.g., control and approval levels, and reassessment intervals)

Subpractices

1. Define consistent criteria for evaluating and quantifying risk likelihood and severity levels.

Consistently used criteria (e.g., the bounds on the likelihood and severity levels) allow the 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., personnel safety versus environmental pollution), it is important to ensure consistency in end result (e.g., a high risk of environmental pollution is as important as a high risk to personnel safety).

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:

- Project-wide thresholds could be established to involve senior management when product costs exceed 10 percent of the target cost or when Cost Performance Indexes (CPIs) fall below 0.95.
- Schedule thresholds could be established to involve senior management when Schedule Performance Indexes (SPIs) fall below 0.95.
- Performance thresholds could be set to involve senior management when specified key items (e.g., processor utilization or average response times) exceed 125 percent of the intended design.

These may be refined later, for each identified risk, to establish points at which more aggressive risk monitoring is employed or to signal the implementation of risk mitigation plans.

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 scope the extent of the risk management effort and avoid excessive resource expenditures. Bounds may include exclusion of a risk source from a category. These bounds can also exclude any condition that occurs less than 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
- Project-specific sources of risks
- How these risks are to be organized, categorized, compared, and consolidated
- Parameters, including likelihood, consequence, and thresholds, for taking action on identified risks
- Risk mitigation techniques to be used, such as prototyping, piloting, simulation, alternative designs, or evolutionary development
- Definition of risk measures to monitor the status of the risks
- Time intervals for risk monitoring or reassessment
The risk management strategy should be guided by a common vision of success that describes the desired future project outcomes in terms of the product that is delivered, its cost, and its fitness for the task. The risk management strategy is often documented in an organizational or a project risk management plan. The risk management strategy is reviewed with relevant stakeholders to promote commitment and understanding.

**Typical Work Products**

1. Project risk management strategy

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**SG 2 Identify and Analyze Risks**

*Risks are identified and analyzed to determine their relative importance.*

The degree of risk impacts the resources assigned to handle an identified risk and the determination of when appropriate management attention is required.

Analyzing risks entails identifying risks from the internal and external sources identified and then evaluating each identified risk to determine its likelihood and consequences. Categorization of the risk, based on an evaluation against the established risk categories and criteria developed for the risk management strategy, provides the information needed for risk handling. Related risks may be grouped for efficient handling and effective use of risk management resources.

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**SP 2.1 Identify Risks**

*Identify and document the risks.*

The identification of potential issues, hazards, threats, and vulnerabilities that could negatively affect work efforts or plans is the basis for sound and successful risk management. Risks must be identified and described in an understandable way 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 be an attempt to address every possible event regardless of how highly improbable it may be. Use of the categories and parameters developed in the risk management strategy, along with the identified sources of risk, can provide the discipline and streamlining appropriate to risk identification. The identified risks form a baseline to initiate risk management activities. The list of 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 activities focus on the identification of risks, not placement of blame. The results of risk identification activities are not used by management to evaluate the performance of individuals.

Risks associated with unrealistic service level agreements, dependencies upon suppliers, and impacts of customer processes should be considered.

There are many methods for identifying risks. Typical identification methods include the following:

- Examine each element of the project work breakdown structure to uncover risks.
- 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.

**Typical 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.

Cost, schedule, and performance risks should be examined to the extent that they impact project objectives. There may be potential risks discovered that are outside the scope of the project’s objectives but vital to customer interests. For example, the 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. The mechanisms for making such decisions should be examined at project and organization levels and put in place if deemed appropriate, especially for risks that impact the ability to verify and validate the product.

In addition to the cost risks identified above, other cost risks may include those associated with funding levels, funding estimates, and distributed budgets.

Schedule risks may include risks associated with planned activities, key events, and milestones.

Performance risks may include risks associated with the following:

- Requirements
- Analysis and design
- Application of new technology
- Physical size
- Shape
- Weight
- Manufacturing and fabrication
- Functional performance and operation
- Verification
- Validation
- Performance maintenance attributes

Performance maintenance attributes are those characteristics that enable an in-use product or service to provide originally required performance, such as maintaining safety and security performance.

There are other risks that do not fall into cost, schedule, or performance categories.

Examples of these other risks include the following:
- Risks associated with strikes
- Diminishing sources of supply
- Technology cycle time
- Competition
- Over reliance on key personnel

2. Review environmental elements that may impact the project.

Risks to a project that frequently are missed include those supposedly outside the scope of the project (i.e., the project does not control whether they occur but can mitigate their impact), such as weather, natural or manmade disasters that affect continuity of operations, 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 project plan as part of identifying risks to help ensure that all aspects of the project have been considered.

Refer to the Project Planning process area for more information about identifying project risks.

5. Document the context, conditions, and potential consequences of the risk.
Risks statements are typically documented in a standard format that contains the risk context, conditions, and consequences of occurrence. The risk context provides additional information such that the intent of the risk can be easily understood. In documenting the context of the risk, consider 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 the defined risk categories and parameters, and determine its relative priority.*

The evaluation of risks is needed to assign 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 must be taken to ensure that important lower level risks are not ignored.

Collectively, the activities of risk evaluation, categorization, and prioritization are sometimes called “risk assessment” or “risk analysis.”

**Typical Work Products**

1. List of risks, with a priority assigned to each risk

**Subpractices**

1. Evaluate the identified risks using the defined risk parameters.

Each risk is evaluated and assigned values in accordance with the defined risk parameters, which may include likelihood, consequence (severity, or impact), and thresholds. The assigned risk parameter values can be integrated to produce additional measures, such as risk exposure, 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 a near certainty.
Examples for consequences 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 and severity of injury).

This evaluation is often a difficult and time-consuming task. Specific expertise or group techniques may be needed to assess the risks and gain confidence in the prioritization. In addition, priorities may require reevaluation as time progresses.

2. Categorize and group risks according to the defined risk categories.

Risks are categorized into the defined risk categories, providing a means to look at risks according to their source, taxonomy, or project component. Related or equivalent risks may 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 the assigned risk parameters. Clear criteria should be used to determine the risk priority. The intent of prioritization is to determine the most effective areas to which resources for mitigation of risks can be applied with the greatest positive impact to the project.

**SG 3 Mitigate Risks**

*Risks are handled and mitigated, where 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. This can also include contingency plans to deal with the impact of selected risks that may occur despite attempts to mitigate them. The 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 for the most important risks to the project as defined by the risk management strategy.

A critical component of a risk mitigation plan is to develop alternative courses of action, workarounds, and fallback positions, with 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 occurrence of the risk, the extent of damage incurred should the risk occur (sometimes called a “contingency plan”), or both. Risks are monitored and when they exceed the established thresholds, the risk mitigation plans are deployed to return the impacted effort to an acceptable risk level. If the risk cannot be mitigated, a contingency plan can be invoked. Both risk mitigation and contingency plans are often generated only for selected risks where the consequences of the risks are determined to be 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 the user’s needs
- Risk control: Taking active steps to minimize risks
- Risk transfer: Reallocating requirements to lower the risks
- Risk monitoring: Watching and periodically reevaluating the risk for changes to the assigned risk parameters
- Risk acceptance: Acknowledgment of risk but not taking any action

Often, especially for high risks, more than one approach to handling a risk should be generated.

For example, in the case of an event that disrupts continuity of operations, approaches to risk management can include the following:

- Resource reserves to respond to disruptive events
- Lists of appropriate back-up equipment to be available
- Back-up personnel for key personnel
- Plans and results of/for testing emergency response systems
- Posted procedures for emergencies
- Disseminated lists of key contacts and information resources for emergencies
In many cases, risks will be 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 of performance, time, or risk exposure (the combination of likelihood and consequence) that will trigger risk mitigation planning or invoke a contingency plan if it is needed.

Adequate consideration should be given early to technology demonstrations, models, simulations, pilots, and prototypes as part of risk mitigation planning.

**Typical Work Products**
1. Documented handling options for each identified risk
2. Risk mitigation plans
3. Contingency plans
4. List of those 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 a 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 performance must be clearly understood and defined to provide a means with which risk can be understood. Proper categorization of risk is essential for ensuring appropriate priority based on severity and the associated management response. There may 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 cost-to-benefit ratio of implementing the risk mitigation plan for each risk.

   Risk mitigation activities should be examined for the benefits they provide versus the resources they will expend. Just like any other design activity, alternative plans may need to be developed and the costs and benefits of each alternative assessed. The most appropriate plan is then selected for implementation. At times the risk may be significant and the benefits small, but the risk must be mitigated to reduce the probability of incurring unacceptable consequences.
4. Develop an overall risk mitigation plan for the project to orchestrate the implementation of the 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 the 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 may be unavoidable and will become problems that impact the project. Contingency plans can be developed for critical risks to describe the actions a project may take to deal with the occurrence of this impact. The intent is to define a proactive plan for handling the risk, either to reduce the risk (mitigation) or respond to the risk (contingency), but in either event to manage the risk.

   Some risk management literature may consider contingency plans a synonym or subset of risk mitigation plans. These plans also may be addressed together as risk-handling or risk action plans.

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**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 the risk status should be revisited. This activity may result in the discovery of new risks or new risk-handling options that can require replanning and reassessment. In either event, the acceptability thresholds associated with the risk should be compared against the status to determine the need for implementing a risk mitigation plan.

**Typical Work Products**

1. Updated lists of risk status
2. Updated assessments of risk likelihood, consequence, and thresholds
3. Updated lists of risk-handling options
4. Updated list of actions taken to handle risks
5. Risk mitigation plans

**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 periodic mechanism for monitoring should be employed.

2. Provide a method for tracking open risk-handling action items to closure.

   Refer to the Project Monitoring and Control process area for more information about tracking action items.

3. Invoke selected risk-handling options when monitored risks exceed the defined thresholds.

   Quite often, risk handling is only performed for those risks judged to be “high” and “medium.” The risk-handling strategy for a given risk may include techniques and methods to avoid, reduce, and control the likelihood of the risk or the extent of damage incurred should the risk (anticipated event or situation) 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 project objectives and to bring about acceptable outcomes in light of probable impacts. Actions generated to handle a risk require proper resource loading and scheduling within plans and baseline schedules. This replanning effort needs to closely consider the effects on adjacent or dependent work initiatives or activities.

   Refer to the Project Monitoring and Control process area for more information about revising the project plan.

4. Establish a schedule or period of performance for each risk-handling activity that includes the start date and anticipated completion date.

5. Provide continued commitment of resources for each plan to allow successful execution of the risk-handling activities.

6. Collect performance measures on the risk-handling activities.

**Generic Practices by Goal**

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<th>Continuous Only</th>
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<tbody>
<tr>
<td><strong>GG 1</strong> Achieve Specific Goals</td>
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<tr>
<td><em>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</em></td>
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| GP 1.1 Perform Specific Practices |
### Continuous Only

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

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<th>GG 2</th>
<th>Institutionalize a Managed Process</th>
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<td>The process is institutionalized as a managed process.</td>
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### Staged Only

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<th>GG 3</th>
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<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<td>Establish and maintain an organizational policy for planning and performing the risk management process.</td>
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**Elaboration:**

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

<table>
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<tr>
<th>GP 2.2</th>
<th>Plan the Process</th>
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<tr>
<td></td>
<td>Establish and maintain the plan for performing the risk management process.</td>
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**Elaboration:**

This plan for performing the risk management process can be included in (or referenced by) the project plan, which is described in the Project Planning process area. The plan called for in this generic practice would address 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 would address more focused items such as the levels that trigger risk-handling activities.

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<th>GP 2.3</th>
<th>Provide Resources</th>
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<td>Provide adequate resources for performing the risk management process, developing the work products, and providing the services of the process.</td>
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Elaboration:

Examples of resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the risk management process as needed.

Elaboration:

Examples of training topics include the following:

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

GP 2.6 Manage Configurations

Place designated work products of the risk management process under appropriate levels of control.

Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

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

GP 2.8 Monitor and Control the Process

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

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 the risk mitigation plans (e.g., processes, schedule, and funding)
- Occurrence of unanticipated risks
- Risk categorization volatility
- Comparison of estimated versus actual risk mitigation effort and impact
- Schedule for risk analysis activities
- Schedule of actions for a specific mitigation

GP 2.9 Objectively Evaluate Adherence

*Objectively evaluate adherence of the risk management process against its process description, standards, and procedures, and address noncompliance.*

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

**GP 2.10 Review Status with Higher Level Management**

_Review the activities, status, and results of the risk management process with higher level management and resolve issues._

**Elaboration:**

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

**Continuous Only**

**GG 3 Institutionalize a Defined Process**

_The process is institutionalized as a defined process._

This generic goal's appearance here reflects its location in the continuous representation.

**GP 3.1 Establish a Defined Process**

_Establish and maintain the description of a defined risk management process._

**GP 3.2 Collect Improvement Information**

_Collect work products, measures, measurement results, and improvement information derived from planning and performing the risk management process to support the future use and improvement of the organization’s processes and process assets._
Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

- Risk parameters
- Risk categories
- Risk status reports

Continuous Only

GG 4 Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

GP 4.1 Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the risk management process, which address quality and process performance, based on customer needs and business objectives.

GP 4.2 Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the risk management process to achieve the established quantitative quality and process-performance objectives.

GG 5 Institutionalize an Optimizing Process

The process is institutionalized as an optimizing process.

GP 5.1 Ensure Continuous Process Improvement

Ensure continuous improvement of the risk management process in fulfilling the relevant business objectives of the organization.

GP 5.2 Correct Root Causes of Problems

Identify and correct the root causes of defects and other problems in the risk management process.
SUPPLIER AGREEMENT MANAGEMENT
A Project Management Process Area at Maturity Level 2

Purpose

The purpose of Supplier Agreement Management (SAM) is to manage the acquisition of products from suppliers.

Introductory Notes

The Supplier Agreement Management process area involves the following:

- Determining the type of acquisition that will be used for the products to be acquired
- Selecting suppliers
- Establishing and maintaining agreements with suppliers
- Executing the supplier agreement
- Monitoring selected supplier processes
- Evaluating selected supplier work products
- Accepting delivery of acquired products
- Transitioning acquired products to the project

This process area primarily addresses the acquisition of products and product components that are delivered to the project's customer. Throughout the process areas, where we use the terms product and product component, their intended meanings also encompass services and their components.

Examples of products and product components that may be acquired by the project include the following:

- Subsystems (e.g., navigational system on an airplane)
- Software
- Hardware
- Documentation (e.g., installation, operator's, and user's manuals)
- Parts and materials (e.g., gauges, switches, wheels, steel, and raw materials)
To minimize risks to the project, this process area can also address the acquisition of significant products and product components not delivered to the project’s customer but used to develop and maintain the product or service (for example, development tools and test environments).

Typically, the products to be acquired by the project are determined during the early stages of the planning and development of the product. The Technical Solution process area provides practices for determining the products and product components that may be acquired from suppliers.

This process area does not directly address arrangements in which the supplier is integrated into the project team and uses the same processes and reports to the same management as the product developers (for example, integrated teams). Typically, these situations are handled by other processes or functions, possibly external to the project, though some of the specific practices of this process area may be useful in managing the formal agreement with such a supplier.

Suppliers may take many forms depending on business needs, including in-house vendors (i.e., vendors that are in the same organization but are external to the project), fabrication capabilities and laboratories, and commercial vendors. (See the definition of “supplier” in the glossary.)

A formal agreement is established to manage the relationship between the organization and the supplier. A formal agreement is any legal agreement between the organization (representing the project) and the supplier. This agreement may be a contract, license, service level agreement, or memorandum of agreement. The acquired product is delivered to the project from the supplier according to this formal agreement (also known as the “supplier agreement”).

**Related Process Areas**

*Refer to the Project Monitoring and Control process area for more information about monitoring projects and taking corrective action.*

*Refer to the Requirements Development process area for more information about defining requirements.*

*Refer to the Requirements Management process area for more information about managing requirements, including the traceability of requirements for products acquired from suppliers.*

*Refer to the Technical Solution process area for more information about determining the products and product components that may be acquired from suppliers.*
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 Monitor Selected Supplier Processes
   SP 2.3 Evaluate Selected Supplier Work Products
   SP 2.4 Accept the Acquired Product
   SP 2.5 Transition 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.

Refer to the Technical Solution process area for more information about identifying the products and product components to be acquired.

There are many different types of acquisition that can be used to acquire products and product components that will be used by the project.

Examples of types of acquisition include the following:

- Purchasing commercial off-the-shelf (COTS) products
- Obtaining products through a contractual agreement
- Obtaining products from an in-house vendor
- Obtaining products from the customer
- Combining some of the above (e.g., contracting for a modification to a COTS product or having another part of the business enterprise codevelop products with an external supplier)

In the event that COTS products are desired, care in evaluating and selecting these products and the vendor may be critical to the project. Things to consider in the selection decision include proprietary issues and the availability of the products.

Typical Work Products

1. List of the acquisition types that will be used for all products and product components to be acquired
Select Suppliers

Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.

Refer to the Decision Analysis and Resolution process area for more information about formal evaluation approaches that can be used to select suppliers.

Refer to the Requirements Management process area for more information about specified requirements.

Criteria should be established to address factors that are important to the project.

Examples of factors 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 applications

Typical 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, including candidates from suppliers of custom-made products and vendors of COTS products.

Refer to the Organizational Innovation and Deployment process area for examples of sources of process and technology improvements and how to pilot and evaluate such improvements.
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 evaluating project risks.

5. Evaluate proposed suppliers' ability to perform the work.

   Examples of methods to evaluate the proposed supplier's ability to perform the work include the following:
   • Evaluation of prior experience in similar applications
   • 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 project's ability to work with the proposed supplier
   • Evaluation of the impact of candidate COTS products on the project's plan and commitments

   When COTS products are being evaluated consider the following:
   • Cost of the COTS products
   • Cost and effort to incorporate the COTS products into the project
   • Security requirements
   • Benefits and impacts that may result from future product releases

   Future releases of the COTS product may provide additional features that support planned or anticipated enhancements for the project, but may result in the supplier discontinuing support of its current release.

6. Select the supplier.

**SP 1.3 Establish Supplier Agreements**

**Establish and maintain formal agreements with the supplier.**

A formal agreement is any legal agreement between the organization (representing the project) and the supplier. This agreement may be a contract, license, service level agreement, or memorandum of agreement.

The content of the agreement should specify the reviews, monitoring, evaluations, and acceptance tests to be performed, if such activities are appropriate to the acquisition or product being acquired.
Formal agreements between independent legal entities are typically reviewed by legal or contract advisors prior to approval.

All formal agreements will address expected end of service, early end of service, and transition of service as appropriate.

**Typical Work Products**
1. Statements of work
2. Contracts
3. Memoranda of agreement
4. Licensing agreement

**Subpractices**
1. Revise the requirements (e.g., product requirements and service level requirements) to be fulfilled by the supplier to reflect negotiations with the supplier when necessary.

   *Refer to the Requirements Development process area for more information about revising requirements.*

   *Refer to the Requirements Management process area for more information about managing changes to requirements.*

2. Document what the project will provide to the supplier.
   
   Include the following:
   
   • Project-furnished facilities
   • Documentation
   • Services

3. Document the supplier agreement.

   The supplier agreement should include a statement of work, a specification, terms and conditions, a list of deliverables, a schedule, a budget, and a defined acceptance process.

   This subpractice typically includes the following:
   
   • Establishing the statement of work, specification, terms and conditions, list of deliverables, schedule, budget, and acceptance process
   • Identifying who from the project 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 project and the supplier
- Identifying the type and depth of project oversight of the supplier, procedures, and evaluation criteria to be used in monitoring supplier performance including selection of processes to be monitored and work products to be evaluated
- 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 usage rights for the acquired products
- Identifying acceptance criteria
  - Identifying specific requirements, scope, level of service, and communication processes to be provided by the supplier(s) SVC
  - Aligning subcontract service level agreements with contractor's service level agreements SVC
  - Ensuring risks are flowed to suppliers as appropriate SVC

In some cases, selection of COTS products may 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 project suppliers, team members, and the project's 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 project's relationship with the supplier and current risks and market conditions.

5. Ensure that all parties to the 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 project's plans and commitments, including changes to the project's processes or work products, as necessary to reflect the supplier agreement.

Refer to the Project Monitoring and Control process area for more information about revising the project plan.
SG 2  Satisfy Supplier Agreements

Agreements with the suppliers are satisfied by both the project and the supplier.

SP 2.1  Execute the Supplier Agreement

**Perform activities with the supplier as specified in the supplier agreement.**

Refer to the Project Monitoring and Control process area for more information about monitoring projects and taking corrective action.

Typical Work Products

1. Supplier progress reports and performance measures
2. Supplier review materials and reports
3. Action items tracked to closure
4. Documentation of product and document deliveries

Subpractices

1. Monitor supplier progress and performance (schedule, effort, cost, and technical performance) as defined in the supplier agreement.
2. Conduct reviews with the supplier as specified in the supplier agreement.

Refer to the Project Monitoring and Control process area for more information about conducting 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

Reviews include targets in service level agreements and operating level agreements.

3. Conduct technical reviews with the supplier as defined in the supplier agreement.

Technical reviews typically include the following:

- Providing the supplier with visibility into the needs and desires of the project’s 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 project’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

4. Conduct management reviews with the supplier as defined in the supplier agreement.

Management reviews typically include the following:
• Reviewing critical dependencies
• Reviewing project risks involving the supplier
• Reviewing schedule and budget

Technical and management reviews may be coordinated and held jointly.

5. Use the results of reviews to improve the supplier’s performance and to establish and nurture long-term relationships with preferred suppliers.

A comprehensive review of supplier agreements is held periodically to ensure alignment of business needs and contractual obligations. Service improvements identified during this review are recorded and included in an improvement plan.

6. Monitor risks involving the supplier and take corrective action as necessary.

Refer to the Project Monitoring and Control process area for more information about monitoring project risks.

Examples of sources of service risks to monitor include
• 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 Monitor Selected Supplier Processes
Select, monitor, and analyze processes used by the supplier.

In situations where there must be tight alignment between some of the processes implemented by the supplier and those of the project, monitoring these processes will help prevent interface problems.
The selection must consider the impact of the supplier's processes on the project. On larger projects with significant subcontracts for development of critical components, monitoring of key processes is expected. For most vendor agreements where a product is not being developed or for smaller, less critical components, the selection process may determine that monitoring is not appropriate. Between these extremes, the overall risk should be considered in selecting processes to be monitored.

The processes selected for monitoring should include engineering, project management (including contracting), and support processes critical to successful project performance.

Monitoring, if not performed with adequate care, can at one extreme be invasive and burdensome, or at the other extreme be uninformative and ineffective. There should be sufficient monitoring to detect issues, as early as possible, that may affect the supplier's ability to satisfy the requirements of the supplier agreement.

Analyzing selected processes involves taking the data obtained from monitoring selected supplier processes and analyzing it to determine whether there are serious issues.

Documenting the roles and relationships between the project and all suppliers helps to ensure that effective monitoring and management of the service suppliers can be accomplished.

**Typical Work Products**

1. List of processes selected for monitoring or rationale for non-selection
2. Activity reports
3. Performance reports
4. Performance curves
5. Discrepancy reports

**Subpractices**

1. Identify the supplier processes that are critical to the success of the project.
2. Monitor the selected supplier's processes for compliance with requirements of the agreement.
3. Analyze the results of monitoring the selected processes to detect issues as early as possible that may affect the supplier's ability to satisfy the requirements of the agreement.

Trend analysis can rely on internal and external data.
Refer to the Verification process area for more information about recording the results of verification and analyses.

Refer to the Project Monitoring and Control process area for more information about taking corrective action.

**SP 2.3 Evaluate Selected Supplier Work Products**

*Select and evaluate work products from the supplier of custom-made products.*

The scope of this specific practice is limited to suppliers providing the project with custom-made products, particularly those that present some risk to the program due to complexity or criticality. The intent of this specific practice is to evaluate selected work products produced by the supplier to help detect issues as early as possible that may affect the supplier's ability to satisfy the requirements of the 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.

**Typical Work Products**

1. List of work products selected for monitoring or rationale for non-selection
2. Activity reports
3. Discrepancy reports

**Subpractices**

1. Identify those work products that are critical to the success of the project and that should be evaluated to help detect issues early.

   *Examples of work products that may be critical to the success of the project include the following:*
   - Requirements
   - Analyses
   - Architecture
   - Documentation

2. Evaluate the selected work products.

Work products are evaluated to ensure the following:

- Derived requirements are traceable to higher level requirements
- The architecture is feasible and will satisfy future product growth and reuse needs.
- Documentation that will be used to operate and to support the product is adequate.
- Work products are consistent with one another.
- Products and product components (e.g., custom-made, off-the-shelf, and customer-supplied products) can be integrated.

3. Determine and document actions needed to address deficiencies identified in the evaluations.

Refer to the Project Monitoring and Control process area for more information about taking corrective action.

**SP 2.4 Accept the Acquired Product**

*Ensure that the supplier agreement is satisfied before accepting the acquired product.*

Acceptance reviews and tests and configuration audits should be completed before accepting the product as defined in the supplier agreement.

**Typical Work Products**

1. Acceptance test procedures
2. Acceptance test results
3. Discrepancy reports or corrective action plans

**Subpractices**

1. Define the acceptance procedures.
2. Review and obtain agreement with relevant stakeholders on the acceptance procedures before the acceptance review or test.
3. Verify that the acquired products satisfy their requirements.

Refer to the Verification process area for more information about verifying products.

4. Confirm that the nontechnical commitments associated with the acquired work product are satisfied.

This may include confirming that the appropriate license, warranty, ownership, usage, 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.

6. Establish and obtain supplier agreement on an action plan for any acquired work products that do not pass their acceptance review or test.

7. Identify, document, and track action items to closure.
Refer to the Project Monitoring and Control process area for more information about tracking action items.

**SP 2.5 Transition Products**

*Transition the acquired products from the supplier to the project.*

Before the acquired product is transferred to the project for integration, appropriate planning and evaluation should occur to ensure a smooth transition.

Refer to the Product Integration process area for more information about integrating the acquired products.

**Typical Work Products**
1. Transition plans
2. Training reports
3. Support and maintenance reports

**Subpractices**
1. Ensure that there are appropriate facilities to receive, store, use, and maintain the acquired products.
2. Ensure that appropriate training is provided for those involved in receiving, storing, using, and maintaining the acquired products.
3. Ensure that storing, distributing, and using the acquired products are performed according to the terms and conditions specified in the supplier agreement or license.
## Generic Practices by Goal

### Continuous Only

<table>
<thead>
<tr>
<th>GG 1</th>
<th>Achieve Specific Goals</th>
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</thead>
<tbody>
<tr>
<td><strong>The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.</strong></td>
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</table>

<table>
<thead>
<tr>
<th>GP 1.1</th>
<th>Perform Specific Practices</th>
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</thead>
<tbody>
<tr>
<td><strong>Perform the specific practices of the supplier agreement management process to develop work products and provide services to achieve the specific goals of the process area.</strong></td>
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### GG 2 Institutionalize a Managed Process

<table>
<thead>
<tr>
<th>GG 2</th>
<th>Institutionalize as a managed process.</th>
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<table>
<thead>
<tr>
<th>GP 2.1</th>
<th>Establish an Organizational Policy</th>
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<tbody>
<tr>
<td><strong>Establish and maintain an organizational policy for planning and performing the supplier agreement management process.</strong></td>
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</table>

Elaboration:

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

<table>
<thead>
<tr>
<th>GP 2.2</th>
<th>Plan the Process</th>
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<tbody>
<tr>
<td><strong>Establish and maintain the plan for performing the supplier agreement management process.</strong></td>
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</table>

Elaboration:

Portions of this plan for performing the supplier agreement management process can be part of (or referenced by) the project plan as described in the Project Planning process area. Often, however, some portions of the plan reside outside of the project with an independent group, such as contract management.

<table>
<thead>
<tr>
<th>GP 2.3</th>
<th>Provide Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provide adequate resources for performing the supplier agreement management process, developing the work products, and providing the services of the process.</strong></td>
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</tr>
</tbody>
</table>
Elaboration:

Examples of resources provided include the following tools:

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

GP 2.4 Assign Responsibility

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

GP 2.5 Train People

Train the people performing or supporting the supplier agreement management process as needed.

Elaboration:

Examples of training topics include the following:

- Regulations and business practices related to negotiating and working with suppliers
- Acquisition planning and preparation
- COTS products acquisition
- Supplier evaluation and selection
- Negotiation and conflict resolution
- Supplier management
- Testing and transitioning of acquired products
- Receiving, storing, using, and maintaining acquired products

GP 2.6 Manage Configurations

Place designated work products of the supplier agreement management process under appropriate levels of control.
Elaboration:

Examples of work products placed under control include the following:

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

GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the supplier agreement management process as planned.*

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

GP 2.8 Monitor and Control the Process

*Monitor and control the supplier agreement management process against the plan for performing the process and take appropriate corrective action.*

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 per supplier agreement
- Number of supplier work product evaluations completed (planned versus actuals)
- Number of supplier process evaluations completed (planned versus actuals)
- Schedule for selecting a supplier and establishing an agreement
GP 2.9  Objectively Evaluate Adherence

Objectively evaluate adherence of the supplier agreement management process against its process description, standards, and procedures, and address noncompliance.

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

GP 2.10  Review Status with Higher Level Management

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

Staged Only

GG3 and its practices do not apply for a maturity level 2 rating, but do apply for a maturity level 3 rating and above.

Continuous/Maturity Levels 3 - 5 Only

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 supplier agreement management process.

GP 3.2  Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the supplier agreement management process to support the future use and improvement of the organization’s processes and process assets.
Continuous/Maturity Levels 3 - 5 Only

Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

- Results of supplier reviews
- Trade studies used to select suppliers
- Revision history of supplier agreements
- Supplier performance reports
- Results of supplier work product and process evaluations

Continuous Only

GG 4 Institutionalize a Quantitatively Managed Process

*The process is institutionalized as a quantitatively managed process.*

GP 4.1 Establish Quantitative Objectives for the Process

*Establish and maintain quantitative objectives for the supplier agreement management process, which address quality and process performance, based on customer needs and business objectives.*

GP 4.2 Stabilize Subprocess Performance

*Stabilize the performance of one or more subprocesses to determine the ability of the supplier agreement management process to achieve the established quantitative quality and process-performance objectives.*

GG 5 Institutionalize an Optimizing Process

*The process is institutionalized as an optimizing process.*

GP 5.1 Ensure Continuous Process Improvement

*Ensure continuous improvement of the supplier agreement management process in fulfilling the relevant business objectives of the organization.*

GP 5.2 Correct Root Causes of Problems

*Identify and correct the root causes of defects and other problems in the supplier agreement management process.*
SERVICE CONTINUITY

A Project Management Process Area at Maturity Level 3

Purpose

The purpose of Service Continuity (SCON) is to establish and maintain contingency plans for continuity of agreed services during and following any significant disruption of normal operations.

Introductory Notes

The Service Continuity process area describes the practices that enable an organization to continue to deliver services despite having its normal operations significantly disrupted. Typically, such disruption is an emergency situation that involves an event (or sequence of events) that make it virtually impossible for an organization to conduct “business as usual.” Examples of such events include

- Natural disasters: hurricanes, tornados, earthquakes
- Human events: building collapse, civil unrest, acts of terrorism

Customer goodwill and sympathy may only provide an organization with a few days respite while it recovers and resumes providing the services it is obliged to deliver. Therefore, the organization must resume delivering services in a rapid and orderly manner.

The SCON process area consists of goals and practices to develop, test, and maintain a service continuity plan. First, the following must be identified:

- The essential functions that the organization performs that support agreed services
- The assets and organizational infrastructure that are required to deliver the organization's agreed services
- The potential hazards or threats to these assets
- The susceptibility of the organization to the effects of each hazard or threat
- The potential impact of each threat
This information is used to develop a Service Continuity Plan (SCP) that, in the event of a disruption, provides guidance to enable the organization to resume service delivery. Creating the SCP typically involves three activities, which are repeated on a periodic basis to keep the plan current; these activities are

- Documenting the SCP based on the information previously collected
- Documenting the tests to validate the SCP
- Documenting the training materials and training delivery methods for carrying out the SCP

Finally, service continuity planning must be validated. Because it is obviously unwise to wait until an emergency occurs to first execute the SCP, personnel who will implement the process and procedures depicted in the SCP must be trained in how to perform this implementation. In addition, periodic tests must be conducted to determine whether the SCP would be effective in an actual emergency and what changes to the plan are needed to enable the organization to continue to deliver services.

**Related Process Areas**

Refer to the Organizational Training process area for information about delivering training.

Refer to the Decision Analysis and Resolution process area for more information about evaluating alternate solutions

Refer to the Project Planning process area for more information about developing project plans

Refer to the Risk Management process area to determine and prioritize possible risks to executing the SCP under disruptive conditions. Determine possible ways to mitigate their impact.

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

**Specific Goal and Practice Summary**

SG 1 Identify and Prioritize Essential Functions

- SP 1.1 Identify the Organization’s Essential Functions
- SP 1.2 Identify Internal and External Dependencies and Interdependencies
- SP 1.3 Identify Organization Vital Records and Databases

SG 2 Establish and Maintain the Service Continuity Plan

- SP 2.1 Document a Service Continuity Plan
- SP 2.2 Document Service Continuity Plan Tests
- SP 2.3 Develop Service Continuity Plan Training
Specific Practices by Goal

SG 1 Identify and Prioritize Essential Functions

The current functions, resources, and work products of the organization on which services depend are identified, documented, and prioritized.

SP 1.1 Identify the Organization’s Essential Functions

Identify the essential functions that the organization must perform to ensure service continuity.

Identifying essential functions for ensuring service continuity requires an intimate understanding of all the organization’s operations. Although many functions are important, not every activity the organization performs is an essential function that must be sustained in an emergency or significant disruption of services.

Typical Work Products:
1. A business impact analysis (BIA) includes a description of the services provided.

Subpractices
1. Identify and document the essential functions that the organization performs and on which agreed services rely.
2. Analyze and document the criticality of providing those functions and the impact to the agreed services if the essential functions cannot be performed.
3. Prioritize and document the list of essential functions that must be provided even in the event of a significant disruption.

Refer to the Risk Management process area for information about determining impacts and outcomes for critical services in the event of emergencies, service disruptions, or significant threats.

SP 1.2 Identify Internal and External Dependencies and Interdependencies

Identify internal and external dependencies and interdependencies to ensure service continuity.

Identifying the internal and external dependencies and interdependencies provides an understanding of

• the resources from an organization’s infrastructure needed to deliver services
• the external assets and resources the organization relies upon to deliver the services
• the services called for in service level agreement(s) and standard service definition(s)
The dependencies typically include information and data sources (from both inside and outside the organization) and the key personnel who make decisions regarding the service delivery or who are significant contributors to performing service delivery tasks.

**Typical Work Products:**
1. BIA describing the dependencies and interdependencies within the organizational infrastructure and any external assets and resources required for service continuity
2. Key contact list

**Subpractices**
1. Identify and document internal infrastructure dependencies that the organization relies on to provide services
2. Identify and document external resources that the organization relies on to provide services
3. Identify and document external assets that the organization relies on to provide services

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**SP 1.3 Identify Organization Vital Records and Databases**

Identify organization vital records and databases for service continuity.

Vital records and databases are those that are essential to continued functioning or reconstitution of an organization during and after an emergency. These resources are irreplaceable or have intrinsic uniqueness and are required to provide services.

These vital resources generally fall into one of two categories:

- emergency operating resources necessary to reconstitute the service delivery environment
- legal and financial rights that are essential to protecting the rights and interests of an organization and of individuals directly affected by the emergency

**Typical Work Products:**
Emergency operating resources:

1. Orders of succession
2. Delegations of authority
3. Directory of critical personnel with contact information
4. Files and databases required to support identified essential service functions
Legal and financial rights resources:

1. service level agreements and contracts
2. organization legal operating charters
3. personnel benefit balances, payroll, and insurance records

Subpractices
1. Identify and document vital records and databases.
2. Identify and document key personnel and their specific roles in relation to the services being provided.
3. Identify and document organization responsibilities.
4. Ensure that records and databases are protected, accessible, and immediately usable in the emergency.

SG 2 Establish and Maintain the Service Continuity Plan

The service continuity plan (SCP) is established and maintained.

SP 2.1 Document a Service Continuity Plan

Develop a service continuity plan that, if executed, would enable an organization to resume performing its agreed to services.

Since an emergency is typically a time when personnel are under stress, service resumption activities can be impeded by having a lack of clear direction. To avoid this situation, the SCP is developed to provide explicit guidance to the organization in the event of an emergency.

Typical Work Products
The SCP typically includes the following:

1. Identification of the authority for initiating and executing the SCP
2. Identification of the communication mechanism to initiate the execution of the SCP
3. Identification of the threats and vulnerabilities that could impede the ability of the organization to deliver services

For each threat and vulnerability
a. identification of alternate resources and locations that would support the organization’s essential functions
b. documentation of the recovery sequence at alternate site(s)
c. identification of key personnel’s roles and responsibilities
d. identification of stakeholders and of method of communicating with stakeholders

e. documentation of the methods for handling security-related material, as appropriate

4. Documentation of service continuity training plan

**Subpractices**

1. Identify threats and vulnerabilities to ongoing services delivery.

   Consider risk information gathered on individual services.

   *Refer to Risk Management process area for information about identifying, analyzing, and mitigating risk.*

2. Document the SCP.

3. Review the SCP with stakeholders.

4. Ensure secure storage and access methods exist for the SCP.

   *Refer to Verification process area for information about conducting peer reviews*

5. Protect vital records and databases.

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**SP 2.2 Document Service Continuity Plan Tests**

*Document the tests that measure and validate the effectiveness of the Service Continuity Plan.*

Testing the SCP determines whether the SCP would be effective and, if not, what changes would improve its effectiveness.

It may be necessary to involve stakeholders in developing the SCP tests if they have a role in the successful outcome of executing the SCP during an emergency.

**Typical Work Products**

1. Tests to exercise the SCP

2. Description of environments necessary to execute the tests

**Subpractices**

1. Develop strategy for conducting service continuity tests.

2. Develop and document service continuity tests for each category of threat and vulnerability to service delivery.

3. Review service continuity tests with stakeholders.
SP 2.3 Develop Service Continuity Plan Training

*Develop training materials and delivery methods to train for the Service Continuity Plan.*

By training personnel who are involved in executing the SCP, the organization communicates the contents of the plan and increases the probability of success in the event that the plan must be executed.

Typical Work Products
1. SCP training material

Subpractices
1. Develop a strategy for conducting SCP training.
2. Develop and document SCP training for each category of threat and vulnerability to service delivery.
3. Review service continuity training material with stakeholders

Refer to Verification process area for information about conducting Peer Reviews

SP 2.4 Maintain the Service Continuity Plan

*Maintain the Service Continuity Plan based on changing environment and service needs.*

Testing should be conducted on a periodic as well as an event-driven basis. Typically, service continuity testing is performed on a periodic basis (e.g., annually) although there are occasionally major changes to the services or service environment that would call for testing all or part of the SCP.

Testing the SCP helps to determine whether any changes to the plan are necessary. Such changes can typically be brought about by

- internal organizational infrastructure or operating changes that occur over time
- changes in service delivery obligations

Refer to the Decision Analysis and Resolution process area for information about evaluating alternate service solutions in the SCP based on these changes.

Refer to the Risk Management process area for evaluating the impact of new and changed risks on the SCP based on these changes.
Typical Work Products
1. Updated SCP

Subpractices
1. Identify and document changes that have formed the basis of the SCP.

   Refer to Specific Goal 1 of this process area for information about documenting current organization functions, resources, and work products for the services being provided

2. Modify the SCP based on changes previously identified.

SG 3  Validate the Effectiveness of the Service Continuity Plan

   The effectiveness of the Service Continuity Plan is validated.

SP 3.1  Train Personnel in Executing the Service Continuity Plan

   Conduct Service Continuity Plan execution training and evaluate effectiveness of this training.

Training provides instruction to personnel that might have to participate in executing the SCP in the event of a real emergency. In addition, training provides a mechanism for gathering feedback on whether the SCP needs further clarification or other changes.

Typical Work Products
1. Training records
2. Training effectiveness student evaluations
3. Suggested improvements to the Service Continuity Plan

Subpractices
1. Deliver training to personnel in executing the SCP.

   Refer to the Organizational Training process area for information about delivering training.

2. Evaluate training feedback results and document suggested changes to the SCP.

SP 3.2  Execute Service Continuity Plan Tests

   Execute Service Continuity Plan tests.

SCP testing is used to validate whether the SCP is reasonable and effective. It is a method to identify service continuity preparedness and emergency response in a relatively benign environment.
Typical Work Products
1. Roster of personnel and stakeholders involved in service continuity tests
2. Results of the effectiveness of the service continuity tests

Subpractices
1. Prepare to conduct SCP tests.
2. Execute SCP tests.
3. Record results of SCP tests.

SP 3.3 Evaluate Results of Service Continuity Plan Tests

Evaluate results from the tests of the Service Continuity Plan and identify areas for corrective action.

The results of the SCP tests must be evaluated to identify areas needing improvement and to correct planned elements that did not work as expected.

Typical Work Products
1. Documented SCP test execution results analysis
2. Documented SCP improvement recommendations
3. Documented SCP test improvement recommendations

Subpractices
1. Evaluate results of SCP tests.
2. Document recommendations for SCP improvements.
Generic Practices by Goal

Continuous Only

GG 1  Achieve Specific Goals

The process supports and enables achievement of the specific goals of the process area by transforming identifiable input work products to produce identifiable output work products.

GP 1.1  Perform Specific Practices

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

GG 2  Institutionalize a Managed Process

The process is institutionalized as a managed process.

Staged Only

GG 3  Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the staged representation.

GP 2.1  Establish an Organizational Policy

Establish and maintain an organizational policy for planning and performing the Service Continuity process.

GP 2.2  Plan the Process

Establish and maintain the plan for performing the Service Continuity process.

GP 2.3  Provide Resources

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

GP 2.4  Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the Service Continuity process.
GP 2.5 Train People

Train the people performing or supporting the Service Continuity process as needed.

GP 2.6 Manage Configurations

Place designated work products of the Service Continuity process under appropriate levels of control.

GP 2.7 Identify and Involve Relevant Stakeholders

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

GP 2.8 Monitor and Control the Process

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

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the Service Continuity process against its process description, standards, and procedures, and address noncompliance.

GP 2.10 Review Status with Higher Level Management

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

Continuous Only

GG 3 Institutionalize a Defined Process

The process is institutionalized as a defined process.

This generic goal's appearance here reflects its location in the continuous representation.

GP 3.1 Establish a Defined Process

Establish and maintain the description of a defined decision analysis and resolution process.

GP 3.2 Collect Improvement Information

Collect work products, measures, measurement results, and improvement information derived from planning and performing the decision analysis and resolution process to support the future use and improvement of the organization’s processes and process assets.
Elaboration:

Examples of work products, measures, measurement results, and improvement information include the following:

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

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SERVICE DELIVERY

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of Service Delivery (SD) is to deliver services in accordance with service agreements.

Introductory Notes

The Service Delivery process area involves the delivery of services in accordance with service agreements. (See the Glossary for the definition of “service agreement.”) The Service Delivery process area involves performing the activities required to plan and prepare for service delivery and to operate, manage, monitor and maintain the service system. The scope of service delivery may involve the delivery of one or more services. Service delivery may require the use of one or more service systems.

Requirements for service delivery are established in the Requirements Management and Incident and Request Management process areas. Service systems may be developed using the CMMI for Development model’s Engineering process areas or using the CMMI for Services model’s Service System Development process area. The refinement of the initial planning accomplished in the Project Planning process area is part of the Service Delivery process area. The Service Transition process area focuses on the preparation for and execution of the deployment of service systems to a fully operational state.

The process area focuses on the following:

• Preparing and maintaining a service delivery operational plan
• Preparing for service delivery
• Acquiring service system components
• Delivering services
• Operating and managing the service systems
• Monitoring service delivery performance
• Maintaining the service systems
**Related Process Areas**

Refer to the Requirements Management and Incident and Request Management process areas for information about service delivery requirements.

Refer to the Service Transition process area for information on the deployment of new or significantly changed service systems into the operational environment.

Refer to the Service System Development process area for information pertaining to analyzing, designing, developing, and testing new service systems or subsequent service system functionality changes to satisfy existing or anticipated service delivery requirements.

Refer to the Configuration Management process area for information pertaining to controlling changes to configuration items and baselines and releasing changes.

Refer to the Capacity and Availability Management process area for information pertaining to managing the performance of the service system with the overriding purpose of meeting business requirements.

**Specific Goal and Practice Summary**

**SG 1 Prepare for Service Delivery**
- **SP 1.1** Prepare a Service Delivery Operational Plan
- **SP 1.2** Prepare for Service Delivery

**SG 2 Deliver the Services**
- **SP 2.1** Confirm Service Systems Operation
- **SP 2.2** Acquire Service System Consumables
- **SP 2.3** Deliver Services
- **SP 2.4** Monitor Service Delivery
- **SP 2.5** Maintain the Service Systems

**Specific Practices by Goal**

**SG 1 Prepare for Service Delivery**

*Preparation for service delivery is conducted.*

Preparing for service delivery involves planning for the delivery of services specified in the service agreements. Service delivery planning includes planning the service delivery activities and ensuring that the service systems are ready for service delivery in the appropriate operating environments.

**SP 1.1 Prepare a Service Delivery Operational Plan**

*Establish and maintain a service delivery operational plan.*
Operational planning refines the initial resource activity and funding for the operations of the service system. The operations service delivery plan provides the detailed service delivery approach; schedules; staffing assignments; risks and mitigations; funding requirements; communications mechanisms, and reporting formats.

**Typical Work Products**
1. Service delivery operational plan
2. Call trees
3. Internal status reporting templates (e.g., dashboards)
4. External status reporting templates (e.g., service request completion notices)

**Subpractices**
1. Identify and integrate the service delivery activities and tasks.
2. Prepare schedules for delivering services.
3. Determine the continuing resource requirements for service delivery.
   
   Continuing resource requirements are generated by service agreements, by the need to respond to service requests and incidents, and by the need to maintain service systems so that service delivery can continue over time. These resources may include staff, consumables, funding, and any other resources that must be operationally controlled to ensure that service is delivered in accordance with service agreements.
4. Identify potential risks and mitigations.
   
   *Refer to the Risk Management process area for more information on risk identification and mitigation.*
5. Review, refine, and develop stakeholder communications mechanisms as necessary.
   
   Methods and tools for communicating with customers, end users, service provider personnel, and other stakeholders during the course of service delivery are components of a complete service system. These may be created during service system development, but they will need to be regularly reviewed, tailored, and possibly supplemented to meet ongoing service delivery needs.

   *Refer to the Service System Development process area for more information on developing or changing service system components.*
6. Document the service delivery operational plan.
7. Review and get agreement with relevant stakeholders on the plan for delivering each separately identifiable service.

8. Revise the plan for delivering services as necessary.

SP 1.2 Prepare for Service Delivery

**Prepare the appropriate service systems for delivering the services in accordance with the service delivery operational plan.**

This practice ensures that the appropriate service system infrastructure, tools, consumables, resources, processes, and procedures are ready for service delivery operations.

**Typical Work Products**
1. Service delivery operating procedures
2. List of consumables

**Subpractices**
1. Review, refine, and develop service delivery operating procedures.

   Detailed processes, standard operating procedures, or work instructions may be created during service system development, but they will need to be regularly reviewed, tailored, and possibly supplemented to meet ongoing service delivery needs.

   *Refer to the Service System Development process area for more information on developing or changing service system components.*

2. Ensure that the skilled resources are available for performing the service delivery tasks including: operating, monitoring, and repairing service system components; supporting users of the service system; and acquiring and replacing service system components.

3. Ensure that the necessary consumables are available for service delivery and procedures are documented for replenishing consumables and replacing or upgrading infrastructure components.

4. Ensure that service delivery and support personnel have received appropriate training to perform the necessary service delivery activities.

   *Refer to the Service Transition process area for more information about training service provider personnel for changes in service delivery activities.*
5. Provide orientation to incoming service delivery and support personnel on current service delivery operations during personnel changes.

Whenever there is a change of personnel involved in service delivery (e.g., a staff rotation at a shift change), incoming personnel are oriented on the current state of operations to ensure that ongoing service delivery is not interrupted.

**SG 2 Deliver the Services**

*Services are delivered in accordance with their service agreements.*

The Service Transition process implements the service system in the intended operating environments. Services are delivered on a continuous basis and in response to incident and service requests.

**SP 2.1 Confirm Service Systems Operation**

*Confirm that the appropriate service systems are operational in their intended operating environments.*

**Typical Work Products**

1. Verified configuration management baseline
2. Review of monitoring tool thresholds
3. Verified operating procedures

**Subpractices**

1. Confirm that the appropriate service systems infrastructure, components, and tools are transitioned to operations.

Examples of service system tools include the following:

- Monitoring tools
- System management tools
- Tracking systems
- System administration tools (e.g., back-up and restoration)
- Presentation tools
- Log file analysis tools
- Online knowledge management tools
- Virus scanning tools
- Database management tools

2. Review service agreement service level requirements and ensure that proper thresholds are set in the service system monitoring tools.

3. Walk through operating procedures in the intended operating environments.
SP 2.2 Acquire Service System Consumables

**Acquire service system consumables to enable delivery of services in accordance with their service agreements.**

Service systems may require the acquiring of consumables to enable consistent service delivery.

**Typical Work Products**
1. Consumables (e.g., paper, magnetic media)
2. Logs of consumable acquisition and usage

**Subpractices**
1. Acquire service system consumables according to documented procedures.
2. Inspect consumables as necessary.

SP 2.3 Deliver Services

**Deliver services by operating service systems in accordance with the service delivery operational plan.**

This practice encompasses the activities necessary to deliver services by the operation of existing service systems under the direction of the service delivery operational plan. This plan reflects inputs from service agreements negotiated with customers, from service requests and incidents identified during incident and request management, and from monitoring the current operating environment. Operation of a service system means the integrated performance and use of its processes, procedures, and resources by service provider personnel to deliver services to end users.

Refer to the Requirements Management process area for more information about establishing service agreements.

Refer to the Incident and Request Management process area for more information about establishing and managing service requests and incidents.

**Typical Work Products**
1. Services delivered
2. Incident and service request records
3. Service logs
4. Performance reports and dashboards
Subpractices
1. Operate service system components in accordance with service operating procedures.
2. Start and stop service system components, as appropriate.
3. Provide input to the service system components according to their operational procedures.
4. Process output of the service system components according to operating procedures.
5. Process incident, problem, and service requests.
6. Perform management activities.
7. Manage the critical dependencies and paths of the service delivery operations schedules according to operating procedures.
8. Manage and control service delivery security including the monitoring for security breaches and ensuring that vulnerabilities are corrected.

SP 2.4 Monitor Service Delivery

Monitor service delivery for expected performance and customer satisfaction, and take appropriate corrective actions.

Service delivery is monitored for expected performance. As appropriate, corrective actions are undertaken. Information is collected about customer satisfaction and other customer feedback on services delivered.

Typical Work Products
1. Performance reports
2. Corrective actions
3. Customer satisfaction data

Subpractices
1. Monitor service delivery using monitoring tools as appropriate.
2. Collect performance data from the service system on service delivery transactions.
3. Compare the performance data to service agreement service levels.
4. Report findings.
5. Take corrective action once measurement data exceeds earlier set threshold.
6. Collect information about customer satisfaction with the quality of service delivery.

**SP 2.5 Maintain the Service Systems**

*Maintain the service systems to ensure continuation of service delivery.*

Operational service systems must be maintained to ensure a continuing capability to deliver services in accord with service agreements over time. This practice may encompass a variety of types of maintenance:

- Corrective maintenance (i.e., correcting and repairing problems that degrade the operational capability of the service system)
- Preventive maintenance (i.e., preventing potential service system problems and defects from occurring through pre-planned activities)
- Adaptive maintenance (i.e., adapting the service system to a different operating environment)
- Perfective maintenance (i.e., developing or acquiring an additional or improved operational capability of the service system).

Depending on the type and scope of actual instances of service system maintenance, other process areas may contribute practices that are relevant to accomplishing this effort, especially for any maintenance that may

- represent a change to service system requirements or design (e.g., perfective maintenance)
- entail significant risks in implementing changes required by maintenance activities

*Refer to the Service System Development process area for more information about making changes to the requirements or design of a service system.*

*Refer to the Service Transition process area for more information about managing significant changes to a service system.*

**Typical Work Products**

1. Corrective or preventive maintenance change requests
2. Maintenance notifications
3. Preventive maintenance schedules
Subpractices

1. Review maintenance request.

2. Analyze impacts on service systems and services delivery.

3. Develop plan for implementation of maintenance.

4. Implement maintenance and test in a non-operational environment when appropriate.

   Significant maintenance changes to a service system that require prior testing outside of the operational environment should apply Service Transition practices as well.

5. Release maintenance notification to appropriate parties.

6. Update the service system documentation as appropriate.

7. Implement corrective or preventive maintenance according to plan and operating procedures.

8. Submit maintenance documentation and configuration changes to configuration management repository.
## Generic Practices by Goal

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### GP 2.5 Train People

*Train the people performing or supporting the service delivery process as needed.*

### GP 2.6 Manage Configurations

*Place designated work products of the service delivery process under appropriate levels of control.*

### GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the service delivery process as planned.*

### GP 2.8 Monitor and Control the Process

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

### GP 2.9 Objectively Evaluate Adherence

*Objectively evaluate adherence of the service delivery process against its process description, standards, and procedures, and address noncompliance.*

### GP 2.10 Review Status with Higher Level Management

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

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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, and test service systems to satisfy existing or anticipated service agreements.

Introductory Notes

The Service System Development process area is applicable to all aspects of a service system including services, service components, and service consumables. Development encompasses service system requirements and components either singly or in combination as appropriate. It therefore applies to changes an existing service system, particularly in those situations that include changes to the service system's requirements or design.

Service provider organizations may choose to employ the complete CMMI for Development model as the basis for appraising their service development processes. This approach is preferred for those organizations that are already experienced with the CMMI for Development model, and for those that must develop large-scale, complex service delivery systems. However, the Service System Development process area offers an alternative means of achieving similar ends covering requirements development, service system development, integration, and verification in a single process area. This approach may be preferred by those service provider organizations that are new to the CMMI framework—especially those that are developing simple services with relatively few components and interfaces.

The process area focuses on the following:

- Collecting, coordinating, analyzing, validating, and allocating service stakeholder requirements for service systems
- Evaluating, selecting, designing, building, integrating, and documenting service systems that satisfy an appropriate set of allocated requirements
- Testing service systems to verify they satisfy their intended requirements and to validate that they will satisfy customer expectations during actual service delivery
Related Process Areas

Refer to the Decision Analysis and Resolution process area for more information about formal evaluation.

Refer to the Requirements Management process area for more information about managing requirements and service agreements.

Refer to the Service Transition process area for more information about deploying a developed service system into an operational service delivery environment.

Refer to the Organizational Service Management process area for more information about the development of requirements for standard service systems.

Specific Goal and Practice Summary

SG 1 Develop and Analyze Service Requirements
  SP 1.1 Develop Stakeholder Requirements
  SP 1.2 Develop Service 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 Build Service System Components
  SP 2.5 Integrate Service Systems

SG 3 Test Service Systems
  SP 3.1 Prepare for Testing
  SP 3.2 Perform Peer Reviews
  SP 3.3 Verify Selected Service System Components
  SP 3.4 Validate Service Delivery Capabilities

Specific Practices by Goal

SG 1 Develop and Analyze Service Requirements

Required service functionality is determined through development, analysis, elaboration, and validation of stakeholder needs, expectations, and constraints.

SP 1.1 Develop Stakeholder Requirements

Collect and transform stakeholder needs, expectations, constraints, and interfaces into stakeholder requirements.
The needs of stakeholders (e.g., customers, end users, suppliers, builders, testers, manufacturers, logistics support personnel, and service delivery personnel) are the basis for determining service requirements. The stakeholder needs, expectations, constraints, interfaces, operational concepts, and service concepts are analyzed, harmonized, refined, and elaborated for translation into a set of service requirements.

**Typical Work Products**
1. Customer requirements
2. Customer constraints on the conduct of verification
3. Customer constraints on the conduct of validation

**SP 1.2 Develop Service Requirements**

*Refine and elaborate stakeholder requirements to develop service and 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 the needs associated with all service system components associated with service delivery, including work products, services, processes, consumables, and customer resources.

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, and the developer's unique business considerations. The extent and depth of derived requirements will vary with the complexity of the service system needed to meet stakeholder requirements. In some service contexts, derived requirements may be as simple as extrapolations of required resources. For complex service systems with many types of components and interfaces, the initial requirements are reexamined in lower level sets of more detailed requirements that parallel the functional architecture as the preferred service system solution concept is refined.

**Typical Work Products**
1. Derived requirements
2. Service requirements
3. Service system requirements
4. Requirement allocation sheets
5. Provisional requirement allocations
6. Design constraints
7. Relationships among derived requirements
8. Interface requirements

**SP 1.3 Analyze and Validate Requirements**

*Develop and define the required service system functionality based upon analyzed and validated requirements.*

Requirements analyses are performed to determine what impact the intended operational 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 acquisition strategy must be taken into account. A definition of required functionality is also established. All specific methods of service delivery are considered, and a timeline analysis is generated for time-critical sequencing of functions.

The objectives of the analyses are to determine candidate requirements for service system solution concepts that will satisfy stakeholder needs, expectations, and constraints, and then to translate these concepts into requirements. In parallel with this activity, the parameters that will be used to evaluate the effectiveness of service delivery are determined based on customer input and the preliminary service delivery concept.

Requirements are validated to increase the probability that the resulting service system will deliver services as intended in the expected operating environment.

**Typical Work Products**
1. Operational concept
2. Service system and service system component installation, training, operational, maintenance, and support concepts
3. Disposal concepts
4. Use cases
5. Timeline scenarios
6. New requirements
7. Functional architecture
8. Activity diagrams and use cases
9. Requirements defects reports
10. Proposed requirements changes to resolve defects
11. Service performance and quality measures and thresholds
12. Assessment of risks related to requirements

13. Record of analysis methods and results

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**SG 2 Develop Service Systems**

**Solutions to service requirements are selected, designed, implemented, and integrated.**

**SP 2.1 Select Service System Solutions**

*Select service system component solutions from alternative solutions.*

Alternative solutions and their relative merits are considered in advance of selecting a solution. Key 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. Portions of the service system, including service delivery and support processes, may be allocated to external suppliers and prospective supplier agreements are investigated. Using commercial off-the-shelf (COTS) components is considered relative to cost, schedule, performance, and risk. COTS alternatives may be used with or without modification. Sometimes such items may require modifications to aspects such as interfaces or a customization of some of their features to better meet service or service system requirements.

A typical failure mode of this practice is to generate solutions that are based only on 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 personnel responsibilities, or prescheduled vs. on-the-fly service request management).

**Typical Work Products**

1. Alternative solution screening criteria
2. Evaluation reports of new methods and technologies
3. Alternative solutions
4. Selection criteria for final selection
5. Evaluation reports of COTS products
6. Service system component selection decisions and rationale
7. Documented relationships between requirements and service system components
8. Documented solutions, evaluations, and rationale
SP 2.2 Develop the Design

*Develop designs for service system components.*

Service system and service system component designs must 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 future changes to the design both during development and in subsequent phases of the lifecycle. A complete design description is documented in a design data package that includes a full range of features and parameters including functions, interfaces, operating thresholds, manufacturing and service process characteristics, and other parameters. Established organizational or project design standards (e.g., checklists, templates, process frameworks) form the basis for achieving a high degree of definition and completeness in design documentation.

**Typical Work Products**

1. Service system architecture
2. Service system component designs
3. Design data package
4. Interface design specifications
5. Interface control documents
6. Interface specification criteria
7. Rationale for selected interface design
8. Criteria for design and service system component reuse
9. Make-or-buy analyses
10. Guidelines for choosing COTS product components

SP 2.3 Ensure Interface Compatibility

*Manage internal and external interface definitions, designs, and changes for services and service system components.*

Many integration problems arise from unknown or uncontrolled aspects of both internal and external interfaces. Effective management of service system component interface requirements, specifications, and designs helps to ensure that implemented interfaces will be complete and compatible.
Typical Work Products
1. Categories of interfaces
2. List of interfaces per category
3. Mapping of the interfaces to the service system components and the service system environment
4. Table of relationships among the service system components and the external environment
5. Table of relationships among the different service system components
6. List of agreed-to interfaces defined for each pair of service system components, when applicable
7. Reports from the interface control working group meetings
8. Action items for updating interfaces
9. Application program interface (API)
10. Updated interface description or agreement

SP 2.4 Build Service System Components

Implement the design of service system components and document their intended use, operation, and maintenance.

Service system components are implemented from the designs established by the specific practices in the Develop the Design specific goal. The implementation usually includes unit testing of the components and development of end-user documentation.

Typical Work Products
1. Implemented design
2. End-user training materials
3. User's manual
4. Operator's manual
5. Maintenance manual
6. Online help

SP 2.5 Integrate Service System Components

Assemble and integrate implemented service system components into verifiable configurations.
Integration of service system components proceeds according to a planned integration sequence and available procedures. Before integration, each service system component should be confirmed to be compliant with its interface requirements. Manual processes that are part of the service system are performed while making appropriate use of any necessary infrastructure components. Subordinate components are assembled into larger, more complex service system components, and more complete service delivery functions are performed. These assembled service system components are checked for correct interoperation. This process continues until service system integration is complete. During this process, if problems are identified, the problem should be documented and a corrective action process initiated.

**Typical Work Products**

1. Service system integration sequence
2. Rationale for selecting or rejecting integration sequences
3. Verified environment for service system integration
4. Support documentation for the service system integration environment
5. Service system integration procedures
6. Service system integration criteria
7. Exception reports
8. Assembled service system and service system components
9. Interface evaluation reports
10. Service system integration summary reports

**SG 3 Test Service Systems**

*Selected service system components and services are verified and validated to ensure correct operational service delivery.*

Verification practices include verification preparation, verification performance, and identification of corrective action. Verification includes testing of the service system and its components against all selected requirements, including existing service agreements, service requirements, and component requirements.
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, or simulation). End users and other relevant stakeholders are usually involved in validation activities. Both validation and verification activities often run concurrently and may use portions of the same environment.

SP 3.1 Prepare for Testing

**Establish and maintain an approach and an environment for verification and validation.**

Up-front preparation is necessary to ensure that verification provisions are embedded in service and service system component requirements, designs, developmental plans, and schedules. Verification encompasses selection, inspection, testing, analysis, and demonstration of service components, including work products, processes, and consumable resources.

Similar preparation activities are necessary for validation to be meaningful and successful, and include selecting services and service system components, establishing and maintaining the validation environment, procedures, and criteria. It is particularly important to involve actual end users and front-line service delivery personnel in validation activities because their perspectives on successful service delivery can vary significantly from each other and from service system developers.

**Typical Work Products**

1. Lists of service system components selected for verification
2. Verification methods for each selected component
3. Verification environment
4. Verification procedures
5. Verification criteria

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 other changes that are needed.
Typical Work Products
1. Peer review schedule
2. Peer review checklist
3. Entry and exit criteria for components
4. Criteria for requiring another peer review
5. Peer review training material
6. Selected service system components to be reviewed
7. Peer review results
8. Peer review issues
9. Peer review data
10. Peer review action items

SP 3.3 Verify Selected Service System Components

**Verify selected service system components against their specified requirements.**

The verification methods, procedures, and criteria are used to verify the selected service system and any associated maintenance, training, and support processes using the appropriate verification environment. Verification activities should be performed throughout the service system lifecycle.

Typical Work Products
1. Verification results
2. Verification reports
3. Demonstrations
4. As-run procedures log
5. Analysis report (e.g., statistics on performances, causal analysis of nonconformance, comparison of the behavior between the real service system and models, and trends)
6. Trouble reports
7. Change requests for the verification methods, criteria, and environment

SP 3.4 Validate Service Delivery Capabilities

**Validate service delivery capabilities to ensure that they will be suitable for use in the intended operating environment and will meet stakeholder expectations.**
The validation methods, procedures, and criteria are used to validate the selected services and 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. It is particularly important to involve actual end users and front-line service delivery personnel in validation activities because their perspectives on successful service delivery can vary significantly from each other and from service system developers.

**Typical Work Products**

1. Validation reports
2. Validation results
3. Validation cross-reference matrix
4. As-run procedures log
5. Operational demonstrations
6. Validation deficiency reports
7. Validation issues
8. Procedure change request
## Generic Practices by Goal

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<th>Provide Resources</th>
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<td><em>Assign responsibility and authority for performing the process, developing the work products, and providing the services of the service system development process.</em></td>
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<th>Manage Configurations</th>
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<td>Place designated work products of the service system development process under appropriate levels of control.</td>
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<th>GP 2.7</th>
<th>Identify and Involve Relevant Stakeholders</th>
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<td>Identify and involve the relevant stakeholders of the service system development process as planned.</td>
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<th>GP 2.8</th>
<th>Monitor and Control the Process</th>
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<td>Monitor and control the service system development process against the plan for performing the process and take appropriate corrective action.</td>
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<th>GP 2.9</th>
<th>Objectively Evaluate Adherence</th>
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<td>Objectively evaluate adherence of the service system development process against its process description, standards, and procedures, and address noncompliance.</td>
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<th>GP 2.10</th>
<th>Review Status with Higher Level Management</th>
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<td>Review the activities, status, and results of the service system development process with higher level management and resolve issues.</td>
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<th>GP 3.2</th>
<th>Collect Improvement Information</th>
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<tr>
<td>Collect work products, measures, measurement results, and improvement information derived from planning and performing the service system development process to support the future use and improvement of the organization’s processes and process assets.</td>
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### GG 4
Institutionalize a Quantitatively Managed Process

The process is institutionalized as a quantitatively managed process.

**GP 4.1** Establish Quantitative Objectives for the Process

Establish and maintain quantitative objectives for the service system development process that address quality and process performance based on customer needs and business objectives.

**GP 4.2** Stabilize Subprocess Performance

Stabilize the performance of one or more subprocesses to determine the ability of the service system development process to achieve the established quantitative quality and process-performance objectives.

### GG 5
Institutionalize an Optimizing Process

The process is institutionalized as an optimizing process.

**GP 5.1** Ensure Continuous Process Improvement

Ensure continuous improvement of the service system development process in fulfilling the relevant business objectives of the organization.

**GP 5.2** Correct Root Causes of Problems

Identify and correct the root causes of defects and other problems in the service system development process.
SERVICE TRANSITION

A Service Establishment and Delivery Process Area at Maturity Level 3

Purpose

The purpose of the Service Transition (ST) process area is to deploy new or significantly changed service systems while managing their effect on ongoing service delivery.

Introductory Notes

The Service Transition process area addresses the preparation for and execution of the deployment of a service system to a fully operational state. Preparing for a deployment also encompass compatibility evaluations of a service system within the current operational 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, as well as impacts on other service systems that may share interfaces or resources with a new one. This process area also addresses significant changes to an existing service system, where significant is defined as a change that would introduce unacceptable risk of service system failure if not formally controlled.

Emergency changes to a service system may be made when approved by designated authority according to established policies. The normal, expected order of system transition practices may be altered to accommodate the unique needs of an emergency situation, but all relevant practices should eventually be completed once the situation returns to normal. This will allow any unanticipated impacts associated with emergency changes to be identified and addressed.

Critical aspects of service transition are the management of

• service system configuration control
• internal and external interfaces
• deployment into service operations
• user acceptance of new or revised system
Related Process Areas

Refer to the Service System Development process area for information about service system development, integration, and testing prior to deployment.

Refer to the Service Delivery process area for more information about operating a service system in its intended operational environment to deliver services.

Refer to the Problem Management process area for more information about managing the problems and defects identified in a service system during its operation.

Refer to the Incident and Request Management process area for more information about managing service requests and incidents that require service delivery actions to address them.

Refer to the Configuration Management process area for more information about how changes to service systems are managed.

Refer to the Causal Analysis and Resolution process area for more information about identifying the causes of defects and other service system problems through quantitatively managed analysis and taking action to prevent them from occurring in the future.

Specific Goal and Practice Summary

SG 1 Prepare for the Service System Transition
   SP 1.1 Ensure Service System Compatibility
   SP 1.2 Plan for Service System Transition
   SP 1.3 Obtain Commitment to the Plan

SG 2 Deploy the Service System
   SP 2.1 Place the Service System Under Configuration Control
   SP 2.2 Install the Service System
   SP 2.3 Test the Service System Against Operational Scenarios
   SP 2.4 Prepare Stakeholders for Changes
   SP 2.5 Assess and Control the Impacts of the Transition

SG 3 Retire the Service System
   SP 3.1 Plan for Service System Retirement
   SP 3.2 Archive the Service System Artifacts
   SP 3.3 Remove the Service System from the Operational Environment
Specific Practices by Goal

SG 1  Prepare for the Service System Transition

Preparation for service system transition into the operational environment is conducted.

SP 1.1  Ensure Service System Compatibility

Ensure the operational functionality and compatibility of the service system in the current operating environment.

The deployment of a new service system or modified service system will create effects on the service delivery operating environment. Some of these may have been anticipated during the development of the service system. Others can only be determined after development; ongoing service delivery activities (if any), unscheduled service requests, and environmental circumstances may lead to a deployment failure if their constraints are not also considered. Actual deployment of new or changed service delivery capabilities may need to be phased over time because of these constraints and the service system design may need to be adjusted to make this feasible. Consequently, this practice should be conducted in parallel with service system development practices and it should continue throughout the transition to an operational state.

Subpractices

1. Define the specific procedures needed to ensure service system compatibility prior to actual deployment.

   These procedures may reuse applicable testing methods employed during service system development, but they must also take into account 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 may range from a simple analysis and resolution of potential compatibility issues to a formal test and evaluation regimen.

2. Baseline the service system to be replaced if this has not been done previously.

3. Ensure the compatibility of service system functions in the current operational context.

4. Ensure the compatibility of service system internal and external interfaces in the current operational context.

SP 1.2  Plan for Service System Transition

Establish and maintain a transition plan for deployment of the service system.
The service system transition plan should encompass all activities from acceptance of the service system from development or procurement to resolution of impacts of the system on the users and the operational environment. The plan should identify all specific activities and resources that will be required for the deployment, covering when appropriate:

- Full-scale acquisition of service system components
- Installation and integration of service system components within the operational environment
- Training of service delivery and support personnel
- Initial provisioning of consumables
- Communication of transition status and service changes to stakeholders.

**Typical Work Products**

1. Service transition plan

**Subpractices**

1. Define the deployment approach for service system transition.

2. Determine the cost, resources, and schedule required to transition the service system to an operational state.

   Schedule the system 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 the transition.

---

**SP 1.3 Obtain Commitment to the Plan**

*Review plans with stakeholders and obtain commitment to the plan.*

---

**SG 2 Deploy the Service System**

*The service system is deployed to the operational environment.*

The deployment process includes obtaining the service system from the configuration control authority and installing and integrating it in the operational environment. This process will be conducted in accordance with the specifications of the service system transition plan.

---

**SP 2.1 Place the Service System Under Configuration Control**

*Establish and maintain a baseline.*

---

**SP 2.2 Install the Service System**

*Package, distribute, integrate, and install service system components within the operational environment.*
SP 2.3 Test the Service System Against Operational Scenarios

*Test the capability to deliver services against operational scenarios within the operational environment.*

SP 2.4 Prepare Stakeholders for Changes

*Prepare users and service provider personnel for changes in services and in the planned service availability.*

This practice ensures that a service system deployment is not impaired because of failure to prepare stakeholders for all of the changes caused by introducing a new or modified service system.

**Subpractices**

1. Establish and maintain a deployment notification strategy.

2. Implement the deployment notification strategy to keep stakeholders informed about scheduled changes in services and service availability during the deployment.

3. Establish and maintain a deployment training strategy.

The training strategy for a service system deployment may encompass a broad range of orientation and training activities involving customers, end users, service delivery and support personnel, managers, and senior leadership as appropriate.

Examples of information that should be communicated to appropriate stakeholders 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

4. Implement the deployment training strategy

SP 2.5 Assess and Control the Impacts of the Transition

*Assess the impacts to stakeholders and delivered services after deploying the service system and take appropriate corrective action.*
SG 3   Retire the Service System

*The service system is retired according to plan from the operational environment.*

The retirement process includes planning for the retirement of the service system; archival of all the service system documentation and support documentation such as operations and training manuals; management of the interfaces of the remaining service system; and removal of the service system from the operational environment.

SP 3.1   Plan for Service System Retirement

*Plan for the removal of the service system from the operational environment.*

Include stakeholder buy-in for the retirement plan.

SP 3.2   Archive the Service System Artifacts

*As required, maintain service system work products for future retrieval.*

SP 3.3   Remove the Service System from the Operational Environment

*Remove the service system from the operational environment.*

Ensure that interfaces from the retired service system are adequately handled.

If the retired service system is being replaced with another service system, the other goals and practices of Service Transition are applicable to the replacement service system.
## Generic Practices by Goal

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GP 2.5 Train People

*Train the people performing or supporting the service transition process as needed.*

GP 2.6 Manage Configurations

*Place designated work products of the service transition process under appropriate levels of control.*

GP 2.7 Identify and Involve Relevant Stakeholders

*Identify and involve the relevant stakeholders of the service transition process as planned.*

GP 2.8 Monitor and Control the Process

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

GP 2.9 Objectively Evaluate Adherence

*Objectively evaluate adherence of the service transition process against its process description, standards, and procedures, and address noncompliance.*

GP 2.10 Review Status with Higher Level Management

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

**Continuous Only**

GG 3 Institutionalize a Defined Process

*The process is institutionalized as a defined process.*

This generic goal's appearance here reflects its location in the continuous representation.

GP 3.1 Establish a Defined Process

*Establish and maintain the description of a defined service transition process.*

GP 3.2 Collect Improvement Information

*Collect work products, measures, measurement results, and improvement information derived from planning and performing the service transition process to support the future use and improvement of the organization's processes and process assets.*
# Continuous Only

<table>
<thead>
<tr>
<th>GG 4</th>
<th>Institutionalize a Quantitatively Managed Process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The process is institutionalized as a quantitatively managed process.</strong></td>
<td></td>
</tr>
<tr>
<td>GP 4.1</td>
<td>Establish Quantitative Objectives for the Process</td>
</tr>
<tr>
<td><strong>Establish and maintain quantitative objectives for the service transition process that address quality and process performance based on customer needs and business objectives.</strong></td>
<td></td>
</tr>
<tr>
<td>GP 4.2</td>
<td>Stabilize Subprocess Performance</td>
</tr>
<tr>
<td><strong>Stabilize the performance of one or more subprocesses to determine the ability of the service transition process to achieve the established quantitative quality and process-performance objectives.</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>GG 5</th>
<th>Institutionalize an Optimizing Process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The process is institutionalized as an optimizing process.</strong></td>
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</tr>
<tr>
<td>GP 5.1</td>
<td>Ensure Continuous Process Improvement</td>
</tr>
<tr>
<td><strong>Ensure continuous improvement of the service transition process in fulfilling the relevant business objectives of the organization.</strong></td>
<td></td>
</tr>
<tr>
<td>GP 5.2</td>
<td>Correct Root Causes of Problems</td>
</tr>
<tr>
<td><strong>Identify and correct the root causes of defects and other problems in the service transition process.</strong></td>
<td></td>
</tr>
</tbody>
</table>