

4 Relationships Among Process Areas

In this chapter, we describe the key relationships among process areas to help you see the acquirer's view of process improvement and which process areas build on the implementation of other process areas.

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

Successful process improvement initiatives must be driven by the business objectives of the organization. For example, a common business objective is to reduce the time it takes to get a product to market. The process improvement objective derived from that might be to improve the project management processes to ensure on-time delivery. Those improvements rely on best practices in the Project Planning and Project Monitoring and Control process areas.

Although we group process areas in this chapter to simplify the discussion of their relationships, process areas often interact and have an effect on one another regardless of their group, category, or level. For example, the Decision Analysis and Resolution process area (a Support process area at maturity level 3) contains specific practices that address the formal evaluation process used in the Solicitation and Supplier Agreement Development process area (an Acquisition process area at maturity level 2) to select suppliers for acquirer management.

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

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Process areas can be grouped into four categories:¶
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<#>Project Management ¶
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<#>Support¶

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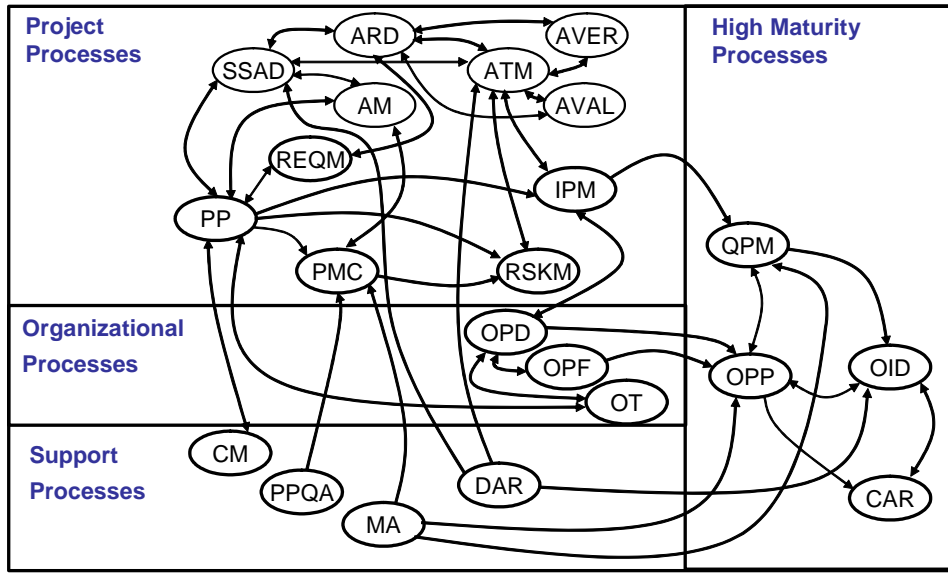
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Figure 4.1 illustrates key relationships among CMMI-ACQ process areas.



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Process Management process areas contain the cross-project activities related to defining, planning, deploying, implementing, monitoring, controlling, appraising, measuring, and improving processes. The Process Management process areas of CMMI are as follows: Organizational Process Focus, Organizational Process Definition +IPPD, Organizational Training, Organizational Process Performance, and Organizational Innovation and Deployment.

Basic Process Management Process Areas

The Basic Process Management process areas provide the organization with a capability to document and share best practices, organizational process assets, and learning across the organization. Figure 4.1 provides a bird's-eye view of the interactions among the Basic Process Management process areas and with other process area categories. As illustrated in Figure 4.1, the Organizational Process Focus process area helps the organization to plan, implement, and deploy organizational process improvements based on an understanding of the current strengths and weaknesses of the organization's processes and process assets.

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Deleted: Project Management process areas cover the project management activities related to planning, monitoring, and controlling the project. The Project Management process areas of CMMI are as follows: Project Planning, Project Monitoring and Control, Supplier Agreement Management, Integrated Project Management +IPPD, Risk Management, and Quantitative Project Management.

Basic Project Management Process Areas

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Figure 4.1 Key Relationships Among Process Areas

Project Processes

The project process areas contain practices that address acquirer activities related to establishing, executing, and transitioning an acquisition project.

The project process areas of CMMI-ACQ are as follows:

- [Project Planning \(PP\)](#)
- [Acquisition Requirements Development \(ARD\)](#)
- [Requirements Management \(REQM\)](#)
- [Solicitation and Supplier Agreement Development \(SSAD\)](#)
- [Agreement Management \(AM\)](#)
- [Project Monitoring and Control \(PMC\)](#)
- [Integrated Project Management \(IPM\)](#)
- [Risk Management \(RSKM\)](#)
- [Acquisition Technical Management \(ATM\)](#)
- [Acquisition Verification \(AVER\)](#)
- [Acquisition Validation \(AVAL\)](#)

The Project Planning process area includes practices for determining the acquisition strategy, developing the project plan, involving

Relationships Among Process Areas

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stakeholders appropriately, obtaining commitment to the plan, and maintaining the plan.

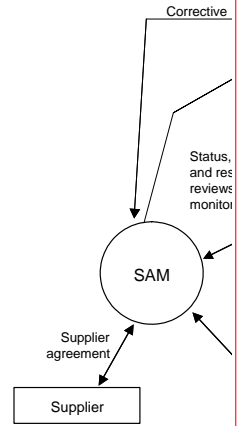
Planning begins with the acquisition strategy, which provides the framework for the acquisition project and its plans. The project plan covers the project management and acquisition activities performed by the project. Other plans (e.g., plans for transition to operations and support, configuration management, verification, and measurement and analysis) from relevant stakeholders that affect the project are reviewed, and commitments with those stakeholders for their contributions to the project are established.

Once the acquisition strategy is established using Project Planning practices, the strategy is used to focus on specifying customer and contractual requirements that express customer value in Acquisition Requirements Development practices. Customer needs are established and translated into customer requirements. The set of customer requirements is prioritized and a set of contractual requirements, including design constraints, is developed.

Development of contractual requirements and operational scenarios also depends on the acquisition strategy developed using Project Planning practices. This set of contractual requirements is used in Solicitation and Supplier Agreement Development practices to select suppliers and establish a supplier agreement to acquire the product or service. The product or service is designed and implemented by the supplier consistent with the acquirer's contractual requirements and design constraints.

Requirements are maintained using Requirements Management practices. These practices describe activities for obtaining and controlling requirement changes and ensuring that other relevant plans and data are kept current. They also describe the traceability of requirements from customer to contractual requirements and supplier agreements. Requirements Management practices interact with Acquisition Requirements Development practices. All changes to contractual requirements must be reflected in the supplier agreements established and maintained using Solicitation and Supplier Agreement Development practices.

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PMC = Project Monitoring and Control
PP = Project Planning
SAM = Supplier Agreement Management

Deleted: Figure 4.3: Basic Project Management Process Areas

¶ Planning begins with requirements that define the product and project ("What to Build" in Figure 4.3).

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The Solicitation and Supplier Agreement Development process area defines practices for preparing a solicitation package, selecting a capable supplier, and establishing and maintaining the supplier agreement. The acquisition strategy developed using Project Planning practices and contractual requirements developed using Acquisition Requirements Development practices are required to prepare for Solicitation and Supplier Agreement Development practices. An agreement is developed to acquire the product or service by identifying potential suppliers, developing the solicitation package, and distributing it to the potential suppliers. The acquirer evaluates the proposed solutions and negotiates with the supplier to finalize the agreement so that both the acquirer and supplier have a mutual understanding of the agreement. This agreement is established and maintained using Solicitation and Supplier Agreement Development, but the execution of the agreement is performed using Agreement Management practices.

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The acquirer uses Agreement Management practices to manage the supplier agreement by performing the acquirer activities defined in the supplier agreement, monitoring selected supplier processes, accepting the product or service, and managing supplier invoices.

After a supplier is selected and a supplier agreement is established, the acquirer continues to apply Requirements Management practices to manage customer and contractual requirements, while the selected supplier is managing the refined product and product component requirements. Using Requirements Management practices ensures that changes to requirements are reflected in project plans, activities, and work products. This cycle of changes may affect or be affected by other processes; thus, the requirements management process is a dynamic and often recursive sequence of events.

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The Project Monitoring and Control process area contains practices for monitoring and controlling acquirer activities and overseeing the supplier's progress and performance according to project plans. The process area includes coverage of monitoring and controlling the transition to operations and support that was planned using Project Planning practices.

Deleted: The Technical Solution process area develops technical data packages for product components that will be used by the Product Integration or Supplier Agreement Management process area. Alternative solutions are examined with the intent of selecting the optimum design based on established criteria. These criteria may be significantly different across products, depending on product type, operational environment, performance requirements, support requirements, and cost or delivery schedules. The task of selecting the final solution makes use of the specific practices in the Decision Analysis and Resolution process area.¶
The Technical Solution process area relies on the specific practices in the Verification process area to perform design verification and peer reviews during design and prior to final build.¶
The Verification process area

Project Monitoring and Control practices also cover taking corrective action. The project plan specifies the appropriate level of project monitoring, the frequency of progress reviews, and the measures used to monitor progress. Progress is determined primarily by comparing project status to the plan. When the actual status deviates significantly from expected values, corrective actions are taken, as appropriate. These actions may include replanning, which requires using Project Planning practices.

Relationships Among Process Areas

As the acquirer's processes improve in capability, Integrated Project Management practices are used to manage the project using a defined process tailored from the organization's set of standard processes (Organizational Process Development). The project uses and contributes to the organization's process assets, the project's work environment is established and maintained from the organization's work environment standards, and integrated teams are established using the organization's rules and guidelines. The project's relevant stakeholders coordinate their efforts in a timely manner through the identification, negotiation, and tracking of critical dependencies and the resolution of coordination issues.

In the acquirer-supplier relationship, the need for an early and aggressive detection of risk is compounded by the complexity of projects acquiring products or services. The purpose of Risk Management is to identify and assess project risks during the project planning process and to manage these risks throughout the project.

The acquirer has a dual role: first, assess and manage overall project risks for the duration of the project, and second, assess and manage risks associated with the performance of the supplier. As the acquisition progresses to the selection of a supplier, the risks specific to the supplier's technical and management approach become more important to the success of the acquisition.

Although risk identification and monitoring are covered in the Project Planning and Project Monitoring and Control process areas, using the Risk Management process area enables the acquirer to take a continuing, forward-looking approach to managing risks with activities that include identification of risk parameters, risk assessments, and risk mitigation.

Acquisition Technical Management practices are used to combine the project's defined process and risk management activities to perform technical and interface management. This management includes activities such as managing the technical evaluation of selected supplier products and services, conducting technical reviews with the supplier, and managing selected interfaces throughout the project's lifecycle. Acquisition Technical Management practices, Agreement Management practices, and the Project Monitoring and Control practices are all used in concert, as they all contain reviews that are conducted throughout the project.

Using Acquisition Verification practices ensures that the acquirer's selected work products meet specified requirements. Using Acquisition Verification practices enables the acquirer to select work products and verification methods to verify acquirer work products against specified requirements.

Acquisition Verification practices also are used to address peer reviews. Peer reviews are a proven method for removing defects early and provide valuable insight into the work products and product components being developed and maintained by the acquirer.

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The acquirer uses Acquisition Validation processes to ensure that the products or services received from the supplier will fulfill the relevant stakeholders' needs. Products and services are incrementally validated against the customer's needs.

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Validation may be performed in the operational environment or in a simulated operational environment. Coordination with the customer on the validation requirements is an important element of this process area.

The scope of the Acquisition Validation process area includes the validation of products, product components, selected intermediate work products, and processes. These validated elements may often require reverification and revalidation. Issues discovered during validation are usually resolved using Acquisition Requirements Development practices or by working with the supplier through the supplier agreement and technical reviews.

As mentioned above, Integrated Project Management processes establish a defined process and integrated plan for managing all the activities of the project. These activities include all project processes described above, from Project Planning through Acquisition Validation. The organization's set of standard processes and other process assets provide critical guidance to projects for establishing a defined process and plan. How the organization creates and deploys such process assets for use by the whole organization, along with other forms of critical project support, is the subject of the next section.

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The Product Integration process area contains the specific practices associated with generating the best possible integration sequence, integrating product components, and delivering the product to the customer.¶
Product Integration uses the specific practices of both Verification and Validation in implementing the product integration process. Verification practices verify the interfaces and interface requirements of product components prior to product integration. This is an essential event in the integration process. During product integration in the operational environment, the specific practices of the Validation process area are used.¶
Recursion and Iteration of Engineering Processes¶

Most process standards agree that there are two ways that processes can be applied. These two ways are called recursion and iteration.¶
Recursion occurs when a process is applied to successive levels of system elements within a system structure. The outcomes of one application are used as inputs to the next level in the system structure. For example, the verification process is designed to apply to the entire assembled product, the major product components, and even components of components. How far into the product you apply the verification process depends entirely on the size and complexity of the end product.¶
Iteration occurs when processes are repeated at the same system level. New information is created by the implementation of one process that feeds back into a related process. This new information typically raises questions that must be resolved before completing the processes. For example, iteration will most likely occur between requirements development and technical solution. Reapplication of the processes can resolve the questions that are r[... [9]

Deleted: Product Integration process area. Recursion and iteration of these processes enable the project to ensure quality in all components of the product before it is delivered to the customer

Organizational Processes

Organizational process areas contain the cross-project activities related to defining, planning, deploying, implementing, monitoring, controlling, appraising, measuring, and improving processes.

The organizational process areas contain practices that provide the acquiring organization with a capability to develop and deploy processes and supporting assets and to document and share best practices and learning across the organization.

The organizational process areas of CMMI-ACQ are as follows:

- Organizational Process Focus (OPF)
- Organizational Process Definition (OPD)
- Organizational Training (OT)

Organizational Process Focus practices help the acquiring organization to plan, implement, and deploy organizational process improvements based on an understanding of the current strengths and weaknesses of the organization's processes and process assets. Candidate improvements to the organization's processes are obtained through activities in the processes of related projects. These activities include

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generating process improvement proposals, measuring processes, collecting lessons learned in implementing the processes, and evaluating products and services.

Using Organizational Process Focus practices, the acquirer encourages participation of suppliers in process improvement activities. Suppliers may be involved in developing process action plans if processes that define interfaces between the acquirer and supplier are targeted for improvement.

Organizational Process Definition practices form the basis for establishing and maintaining the organization's set of standard processes, work environment standards, rules and guidelines for the operation of integrated teams, and other assets based on the process needs and objectives of the organization.

These other assets include descriptions of lifecycle models, process tailoring guidelines, and process-related documentation and data. Projects tailor the organization's set of standard processes to create their defined processes using Integrated Project Management practices. Experiences and work products from performing these defined processes, including measurement data, process descriptions, process artifacts, and lessons learned, are incorporated, as appropriate, into the organization's set of standard processes and other assets.

The acquirer's set of standard processes may also describe standard interactions with suppliers. Supplier interactions are typically characterized by the deliverables expected from suppliers, acceptance criteria applicable to those deliverables, standards (e.g., architecture and technology standards), and standard milestone and progress reviews. The acquirer defines in the supplier agreement how changes to organizational process assets that impact the supplier (e.g., standard supplier deliverables and acceptance criteria) are deployed.

The purpose of implementing Organizational Training practices is to develop the skills and knowledge of people so they can perform their roles effectively and efficiently. For example, an acquiring organization may want to develop its project managers' capability in managing supplier agreements.

Using Organizational Training practices helps the acquirer identify the strategic training needs of the organization as well as the tactical training needs that are common across projects and support groups. In particular, training is created or obtained to develop the skills required to perform the organization's set of standard processes. The main components of training include a managed training development program, documented plans, personnel with appropriate knowledge, and mechanisms for measuring the effectiveness of the training program.

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Support Processes

Support process areas cover the activities that support acquisition and address processes that are used in the context of performing other processes. The support process areas address acquisition project processes and may address processes that apply more generally to the organization. For example, Process and Product Quality Assurance practices can be used to provide an objective evaluation of the processes and work products described in all the process areas.

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Although all support process areas rely on other process areas for input, some support process areas provide support functions that also help implement several generic practices.

Deleted: The Support process areas of CMMI are as follows:
<#>Configuration Management
<#>Process and Product Quality Assurance
<#>Measurement and Analysis
<#>Decision Analysis and Resolution
<#>Causal Analysis and Resolution
Basic Support Process Areas

The Basic Support process areas address fundamental support functions that are used by all process areas.

The support process areas of CMMI-ACQ are as follows:

- Measurement and Analysis (MA)
- Process and Product Quality Assurance (PPQA)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)

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The Measurement and Analysis process area is related to other process areas because its practices guide projects and organizations in aligning measurement needs and objectives with a measurement approach that provides objective results. These results can be used in making informed decisions and taking appropriate corrective actions.

An acquirer uses Measurement and Analysis practices to support the information needs of the organization and project. Some of this information may be needed from the acquirer, some from the supplier, and some from all parts of a project. Supplier Solicitation and Agreement Development describes how these measures are specified in the solicitation process and supplier agreement. The measurement results from the acquirer and supplier support project, supplier, and technical reviews through project monitoring and control, agreement management, and acquisition technical management.

The Process and Product Quality Assurance process area is related to all process areas because it describes specific practices for objectively evaluating performed processes and work products against applicable process descriptions, standards, and procedures, and by ensuring that issues arising from these evaluations are addressed. Process and Product Quality Assurance practices support the acquisition of high-quality products and services by providing the acquirer with appropriate visibility into, and feedback on, the processes and associated work products throughout the life of the project.

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Relationships Among Process Areas

The Configuration Management process area is related to all process areas because its practices describe establishing and maintaining the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits. The work products placed under configuration control 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.

Examples of work products that may be placed under configuration control include plans, process descriptions, and requirements. Suppliers may play a part in any of these activities on behalf of the acquirer, so the supplier agreement should specify the configuration management roles and responsibilities of the acquirer and supplier. Configuration management of acquired products (both final and interim products) created by the suppliers requires monitoring to ensure that project requirements are met.

The Decision Analysis and Resolution process area is related to all process areas because its practices describe determining which issues should be subjected to a formal evaluation process and applying a formal evaluation process to them. A repeatable Decision Analysis and Resolution process is important for an acquirer when making the critical decisions that define and guide the acquisition process and later when critical decisions are made with the selected supplier.

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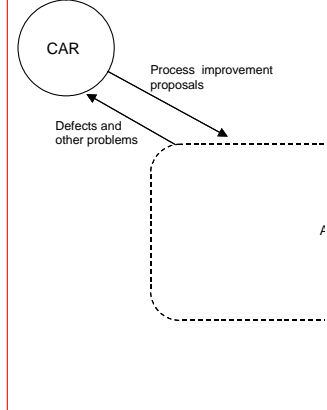
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The Advanced Support process areas provide the projects and organization with an improved support capability. Each of these process areas relies on specific inputs or practices from other process areas.¶
Figure 4.7 provides a bird's-eye view of the interactions among the Advanced Support process areas and with all other process areas.¶



CAR = Causal Analysis and Resolution
DAR = Decision Analysis and Resolution

Figure 4.7: Advanced Support Process Areas¶
Using the

High Maturity Processes

High maturity process areas describe practices that further align organizational, project, and support processes with the business objectives of the organization. These process areas describe practices at both the organizational and project level for establishing objectives for quality and process performance, monitoring variation in the organization's and projects' processes, evaluating the impacts of proposed changes to those processes, and systematically deploying processes across the organization. To effectively implement these practices, mature measurement and analysis processes are needed.

The acquirer achieves an effective implementation of high maturity practices by ensuring that all members of the organization collect and analyze measurements and propose and evaluate changes to processes. In other words, high maturity practices should be integrated as much as possible into the practices in other process areas.

The high maturity process areas of CMMI-ACQ are as follows:

- Organizational Process Performance (OPP)
- Quantitative Project Management (OPM)
- Causal Analysis and Resolution (CAR)
- Organizational Innovation and Deployment (OID)

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At the organizational level, Organizational Process Performance practices are used to derive quantitative objectives for quality and process performance from the organization's business objectives. The organization provides projects and support groups with common measures, process-performance baselines, and process-performance models. These organizational assets support quantitative project management and the statistical management of critical subprocesses for both projects and support groups.

The organization analyzes the process-performance data collected from these defined processes to develop a quantitative understanding of product quality, service quality, and the performance of the organization's set of standard processes.

At the project level, acquirers use Quantitative Project Management practices when applying quantitative and statistical techniques to manage process performance and product quality. Quality and process-performance objectives for the project are based on the objectives established by the organization. Through an evaluation of which subprocesses will help the project best achieve its objectives, the project's defined process is composed.

The project's defined process comprises, in part, process elements and subprocesses for which process performance can be predicted. At a minimum, the process variation of subprocesses critical to achieving the project's quality and process-performance objectives must be understood. Corrective action is taken when special causes of process variation are identified.

Acquirers use Causal Analysis and Resolution practices to guide identification of root causes of selected defects and other problems and taking action to prevent their reoccurrence. While the project's defined processes are the principal targets for identifying the cause of the defect, the process improvement proposals they create target the organization's set of standard processes, which will prevent recurrence of the selected defects across the organization. These processes may be used to improve the performance of a subprocess, focusing on the central tendency of a product or process attribute, its spread, or both.

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At the organizational level, Organizational Innovation and Deployment practices are used to select and deploy proposed incremental and innovative improvements that improve the organization's ability to meet its quality and process-performance objectives. Identifying promising incremental and innovative improvements should involve an empowered workforce aligned with the business values and objectives of the organization. The selection of improvements to deploy is based on a quantitative understanding of the benefits and costs of deploying candidate improvements, and the funding available.

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Together, the high maturity processes enable the organization with an improved capability to achieve its quantitative objectives for quality and process performance.

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Technical Solution process area for selecting a technical solution from alternative solutions. Technical Solution is an Engineering process area

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Decision Analysis and Resolution is a Support process area

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and which process areas are Basic and Advanced

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The following sections describe the interactions of process areas within the categories and only briefly describe the interactions

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in other categories. Interactions among process areas that belong to different categories

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Process Management

Process Management process areas contain the cross-project activities related to defining, planning, deploying, implementing, monitoring, controlling, appraising, measuring, and improving processes.

The Process Management process areas of CMMI are as follows:

- Organizational Process Focus
- Organizational Process Definition +IPPD¹
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

¹ Organizational Process Definition (OPD) has one goal that applies only when using CMMI with the IPPD group of additions.

Basic Process Management Process Areas

The Basic Process Management process areas provide the organization with a capability to document and share best practices, organizational process assets, and learning across the organization.

Figure 4.1 provides a bird’s-eye view of the interactions among the Basic Process Management process areas and with other process area categories. As illustrated in Figure 4.1, the Organizational Process Focus process area helps the organization to plan, implement, and deploy organizational process improvements based on an understanding of the current strengths and weaknesses of the organization’s processes and process assets.

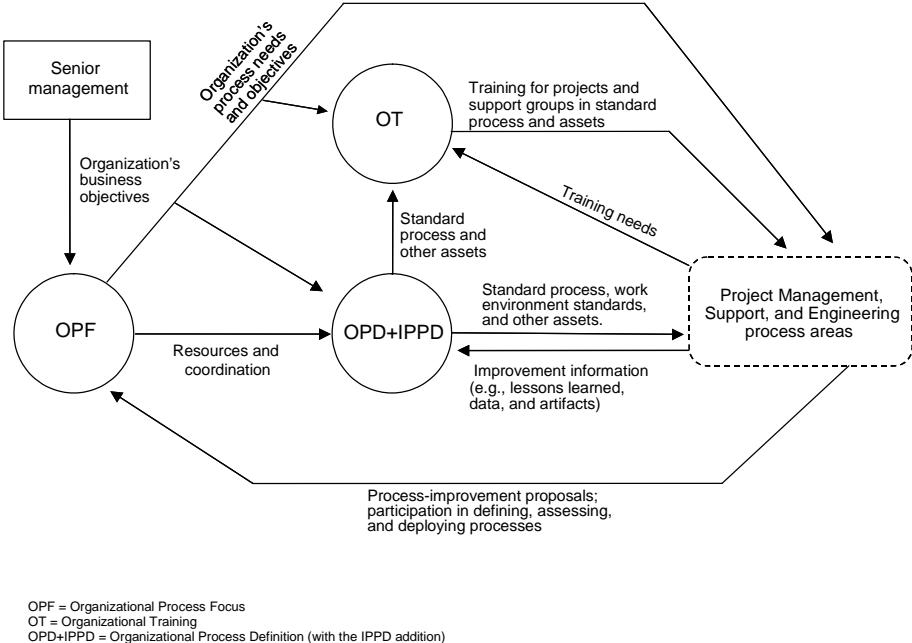


Figure 4.1: Basic Process Management Process Areas

Candidate improvements to the organization’s processes are obtained through various means. These include process improvement proposals, measurement of the processes, lessons learned in implementing the processes, and results of process appraisal and product evaluation activities.

The Organizational Process Definition process area establishes and maintains the organization’s set of standard processes, work environment standards, and other assets based on the process needs and objectives of the organization. These other assets include descriptions of lifecycle models, process tailoring guidelines, and process-related documentation and data. Projects tailor the organization’s set of standard processes to create their defined processes. The other assets support tailoring as well as implementation of the defined processes. Experiences and work products from performing these defined processes, including

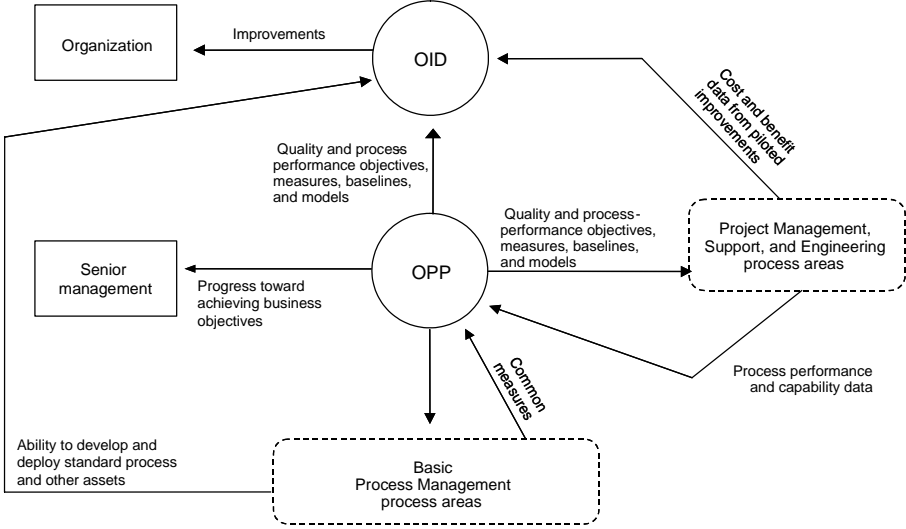
measurement data, process descriptions, process artifacts, and lessons learned, are incorporated as appropriate into the organization's set of standard processes and other assets. With the +IPPD addition, Organizational Process Definition +IPPD provides IPPD rules and guidelines to the projects.

The Organizational Training process area identifies the strategic training needs of the organization as well as the tactical training needs that are common across projects and support groups. In particular, training is developed or obtained to develop the skills required to perform the organization's set of standard processes. The main components of training include a managed training development program, documented plans, personnel with appropriate knowledge, and mechanisms for measuring the effectiveness of the training program.

Advanced Process Management Process Areas

The Advanced Process Management process areas provide the organization with an improved capability to achieve its quantitative objectives for quality and process performance.

Figure 4.2 provides a bird's-eye view of the interactions among the Advanced Process Management process areas and with other process area categories. Each of the Advanced Process Management process areas depends on the ability to develop and deploy processes and supporting assets. The Basic Process Management process areas provide this ability.



OID = Organizational Innovation and Deployment
 OPP = Organizational Process Performance

Figure 4.2: Advanced Process Management Process Areas

As illustrated in Figure 4.2, the Organizational Process Performance process area derives quantitative objectives for quality and process

performance from the organization's business objectives. The organization provides projects and support groups with common measures, process-performance baselines, and process-performance models. These additional organizational assets support quantitative project management and statistical management of critical subprocesses for both projects and support groups. The organization analyzes the process-performance data collected from these defined processes to develop a quantitative understanding of product quality, service quality, and process performance of the organization's set of standard processes.

The Organizational Innovation and Deployment process area selects and deploys proposed incremental and innovative improvements that improve the organization's ability to meet its quality and process-performance objectives. The identification of promising incremental and innovative improvements should involve the participation of an empowered workforce aligned with the business values and objectives of the organization. The selection of improvements to deploy is based on a quantitative understanding of the likely benefits and predictable costs of deploying candidate improvements, and the funding available for such deployment.

Project Management process areas cover the project management activities related to planning, monitoring, and controlling the project.

The Project Management process areas of CMMI are as follows:

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management +IPPD²
- Risk Management
- Quantitative Project Management

Basic Project Management Process Areas

The Basic Project Management process areas address the activities related to establishing and maintaining the project plan, establishing and maintaining commitments, monitoring progress against the plan, taking corrective action, and managing supplier agreements.

Figure 4.3 provides a bird's-eye view of the interactions among the Basic Project Management process areas and with other process area categories. As illustrated in Figure 4.3, the

² Integrated Project Management (IPM) has one goal that applies only when using CMMI with the IPPD group of additions.

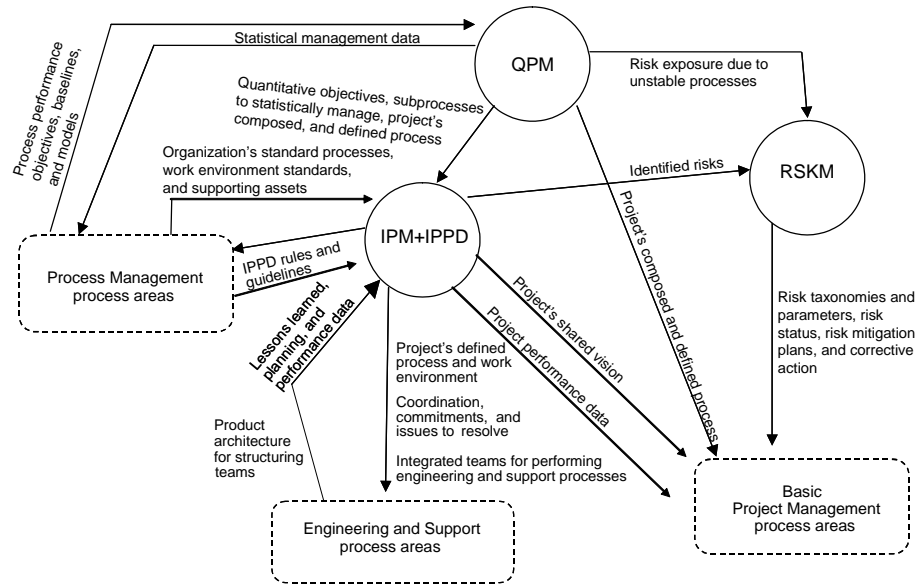
The Project Monitoring and Control process area includes monitoring activities and taking corrective action. The project plan specifies the appropriate level of project monitoring, the frequency of progress reviews, and the measures used to monitor progress. Progress is determined primarily by comparing project status to the plan. When the actual status deviates significantly from the expected values, corrective actions are taken as appropriate. These actions may include replanning.

The Supplier Agreement Management process area addresses the need of the project to acquire those portions of work that are produced by suppliers. Sources of products that may be used to satisfy project requirements are proactively identified. The supplier is selected, and a supplier agreement is established to manage the supplier. The supplier's progress and performance are tracked by monitoring selected work products and processes, and the supplier agreement is revised as appropriate. Acceptance reviews and tests are conducted on the supplier-produced product component.

Advanced Project Management Process Areas

The Advanced Project Management process areas address activities such as establishing a defined process that is tailored from the organization's set of standard processes, establishing the project work environment from the organization's work environment standards, coordinating and collaborating with relevant stakeholders, managing risk, forming and sustaining integrated teams for the conduct of projects, and quantitatively managing the project's defined process.

Figure 4.4 provides a bird's-eye view of the interactions among the Advanced Project Management process areas and with other process area categories. Each Advanced Project Management process area depends on the ability to plan, monitor, and control the project. The Basic Project Management process areas provide this ability.



IPM+IPPD = Integrated Project Management (with the IPPD addition)
 QPM = Quantitative Project Management
 RSKM = Risk Management

Figure 4.4: Advanced Project Management Process Areas

The Integrated Project Management process area establishes and maintains the project's defined process that is tailored from the organization's set of standard processes. The project is managed using the project's defined process. The project uses and contributes to the organization's process assets. The project's work environment is established and maintained from the organization's work environment standards.

The management of the project ensures that the relevant stakeholders associated with the project coordinate their efforts in a timely manner. It does this by providing for the management of stakeholder involvement; the identification, negotiation, and tracking of critical dependencies; and the resolution of coordination issues within the project and with relevant stakeholders.

With the +IPPD addition, Integrated Project Management +IPPD establishes and maintains the shared vision of the project and an integrated team structure for the project and then establishes integrated teams to perform the work of the project, ensuring the appropriate collaboration across teams.

Although risk identification and monitoring are covered in the Project Planning and Project Monitoring and Control process areas, the Risk Management process area takes a continuing, forward-looking approach to managing risks with activities that include identification of risk parameters, risk assessments, and risk mitigation.

The Quantitative Project Management process area applies quantitative and statistical techniques to manage process performance and product quality. Quality and process-performance objectives for the project are based on the objectives established by the organization. The project's defined process comprises, in part, process elements and subprocesses whose process performance can be predicted. At a minimum, the process variation experienced by subprocesses critical to achieving the project's quality and process-performance objectives is understood. Corrective action is taken when special causes of process variation are identified. (See the definition of "special cause of process variation" in the glossary.)

Engineering

Engineering process areas cover the development and maintenance activities that are shared across engineering disciplines. The Engineering process areas were written using general engineering terminology so that any technical discipline involved in the product development process (e.g., software engineering or mechanical engineering) can use them for process improvement.

The Engineering process areas also integrate the processes associated with different engineering disciplines into a single product development process, supporting a product-oriented process improvement strategy. Such a strategy targets essential business objectives rather than specific technical disciplines. This approach to processes effectively avoids the tendency toward an organizational "stovepipe" mentality.

The Engineering process areas apply to the development of any product or service in the development domain (e.g., software products, hardware products, services, or processes).

The technical foundation for IPPD is grounded in a robust systems engineering approach that encompasses development in the context of the phases of the product's life. The Engineering process areas provide this technical foundation. The implementation of IPPD is further addressed through amplifications to specific practices in the Engineering process areas that emphasize concurrent development and focus on all phases of the product's life.

The Engineering process areas of CMMI are as follows:

- Requirements Development
- Requirements Management
- Technical Solution
- Product Integration
- Verification
- Validation

Figure 4.5 provides a bird's-eye view of the interactions among the six Engineering process areas.

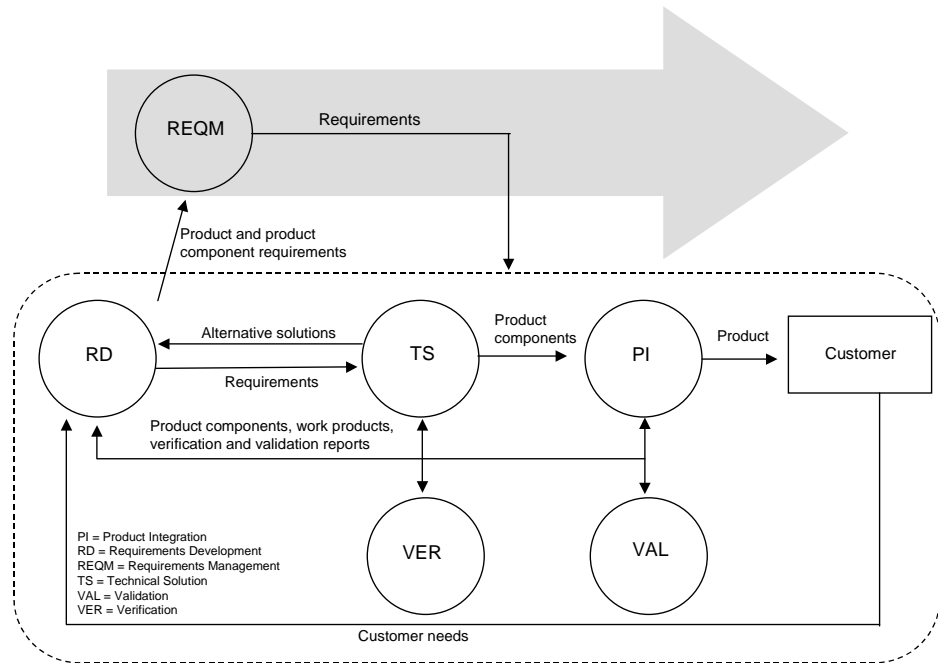


Figure 4.5: Engineering Process Areas

The Requirements Development process area identifies customer needs and translates these needs into product requirements. The set of product requirements is analyzed to produce a high-level conceptual solution. This set of requirements is then allocated to establish an initial set of product component requirements. Other requirements that help define the product are derived and allocated to product components. This set of product and product component requirements clearly describes the product's performance, design features, verification requirements, and so forth, in terms the developer understands and uses.

The Requirements Development process area supplies requirements to the Technical Solution process area, where the requirements are converted into the product architecture, the product component design, and the product component itself (e.g., coding and fabrication). Requirements are also supplied to the Product Integration process area, where product components are combined and interfaces are verified to ensure that they meet the interface requirements supplied by Requirements Development.

The Requirements Management process area maintains the requirements. It describes

in the Requirements Development or Technical Solution process area.

The Product Integration process area contains the specific practices associated with generating the best possible integration sequence, integrating product components, and delivering the product to the customer.

Product Integration uses the specific practices of both Verification and Validation in implementing the product integration process. Verification practices verify the interfaces and interface requirements of product components prior to product integration. This is an essential event in the integration process. During product integration in the operational environment, the specific practices of the Validation process area are used.

Recursion and Iteration of Engineering Processes

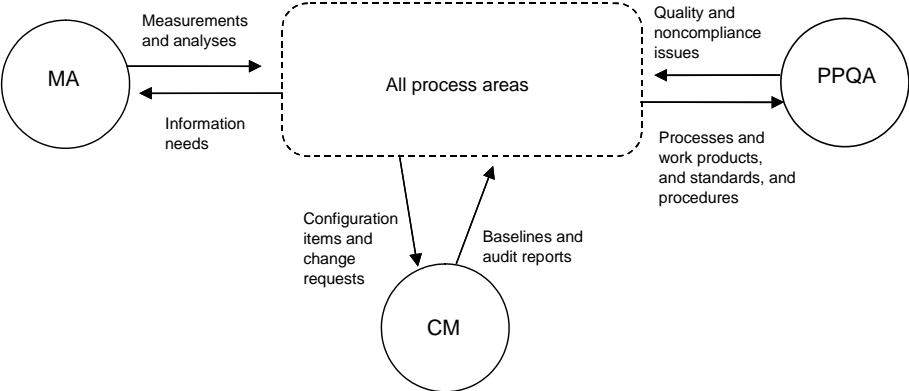
Most process standards agree that there are two ways that processes can be applied. These two ways are called recursion and iteration.

Recursion occurs when a process is applied to successive levels of system elements within a system structure. The outcomes of one application are used as inputs to the next level in the system structure. For example, the verification process is designed to apply to the entire assembled product, the major product components, and even components of components. How far into the product you apply the verification process depends entirely on the size and complexity of the end product.

Iteration occurs when processes are repeated at the same system level. New information is created by the implementation of one process that feeds back into a related process. This new information typically raises questions that must be resolved before completing the processes. For example, iteration will most likely occur between requirements development and technical solution. Reapplication of the processes can resolve the questions that are raised. Iteration can ensure quality prior to applying the next process.

Engineering processes (e.g., requirements development or verification) are implemented repeatedly on a product to ensure that these engineering processes have been adequately addressed before delivery to the customer. Further, engineering processes are applied to components of the product. For example, some questions that are raised by processes associated with the Verification and Validation process areas may be resolved by processes associated with the

Figure 4.6 provides a bird's-eye view of the interactions among the Basic Support process areas and with all other process areas.



MA = Measurement and Analysis
CM = Configuration Management
PPQA = Process and Product Quality Assurance

Figure 4.6: Basic Support Process Areas