CMMI® Acquisition Module (CMMI-AM), Version 1.0

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TECHNICAL REPORT
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FOR THE COMMANDER

Christos Scondras
Chief of Programs, XPK

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Executive Summary

Building on relevant best practices extracted from the Capability Maturity Model® Integration (CMMI®) Framework, this report defines effective and efficient practices for government acquisition organizations. Acquisition best practices are focused inside the acquisition organization to ensure the acquisition is conducted effectively, and outside the acquisition organization as it conducts project monitoring and control of its suppliers. These best practices provide a foundation for acquisition process discipline and rigor that enables product and service development to be repeatedly executed with high levels of ultimate acquisition success.

This report contains the acquisition practices that should be performed by government acquisition organizations acquiring systems and/or services. These practices, however, can also be used by non-government organizations to improve their acquisition practices. This report does not contain prescribed implementation approaches for achieving acquisition best practices. Instead, the proven content of the CMMI Framework is used as a base and amplifications specific to the acquisition process are added.

Questions related to CMMI process areas are provided in the appendix to help managers and executives understand the acquisition organization's documented acquisition practices and the consistent application of those practices. Descriptions of implementation details can be found in the source documents listed in the bibliography.

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1 Introduction

The *CMMI Acquisition Module (CMMI-AM)* focuses on effective acquisition activities and practices that are implemented by first-level acquisition projects (e.g., System Project Office/Program Manager). This report also is intended to provide guidance to acquisition organizations above the acquisition project level to support their insight into an acquisition project's practices and the institutionalization of those acquisition practices.

1.1 Purpose and Goals

Acquisition activities are complex because acquisition is both outwardly directed toward acquiring products, systems, and services, and inwardly directed toward conducting the acquisition process itself. As a result, this module defines the essential practices required to perform acquisition activities, but recognizes that many of those practices are performed slightly differently or with differing roles when focused either internally or externally. These differences are particularly apparent in activities such as monitoring, directing, or overseeing the selected supplier, which occur after a source selection is completed.

Lack of acquisition guidance is a major concern for government organizations involved in the acquisition and sustainment of systems, including software-intensive systems. Over the past decade, much of the headquarters and field-level acquisition guidance for systems and software acquisition and sustainment has been rescinded, simplified, or reduced in scope such that only minimal acquisition-related guidance remains in many acquisition areas.

This reduction of guidance has occurred as system complexity and the software contribution to overall system functionality rises to unprecedented levels. System development efforts are also challenged to meet established performance, cost, and schedule baselines. At the same time, there are demands for drastic decreases in acquisition cycle times as well as improved credibility as government leaders work to create an environment of maximum flexibility for acquisition projects. These changes in complexity and demands for agile product adaptability and shortened delivery timeframes place stress on existing acquisition practices.

Congressional- and DOD-level guidance continues to emphasize software acquisition process improvement, including the measurement of process performance by acquisition organizations. While some of these driving forces seem inconsistent, one way to meet the intent of those wishing to improve acquisition practices is to build systems right the first time through the disciplined application of effective acquisition processes. This approach requires a renewed dedication to ensuring that the acquisition processes fundamental to a technically sound project are defined, implemented, measured, and maintained.

It is the goal of this document to define effective and efficient acquisition practices, both directed internally toward the acquisition project and directed externally toward the project monitoring and control of the selected supplier. These practices are intended to provide a basis for acquisition process discipline while balancing the need for agility. This report identifies those acquisition practices that should be performed, but does not prescribe specific implementation approaches.

1.2 Acquisition Processes and Practices

Acquisition organizations and projects perform a number of basic processes in achieving success. These processes are described generically to support the numerous variations in application that occur among acquisition organizations. In some cases, the practices included herein are performed at varying degrees by both the acquisition team and the supplier team during the program life cycle. Because variations in execution are at the discretion of the acquisition organization, it is the intent of this module to focus on "what" should be done, not "how" it is done.

The acquisition team for any given program may execute these practices directly, delegate them to another organization, or assign a larger degree of responsibility for the activities to the supplier. Many of these acquisition practices and amplifications are drawn and summarized from existing sources of best practices, including the Software Acquisition Capability Maturity Model (SA-CMM®), the Capability Maturity Model Integration (CMMI) Framework, the Federal Aviation Administration (FAA) Integrated Capability Maturity Model (iCMM), as well as additional coverage areas defined by experienced acquisition professionals. References to these sources are provided in the bibliography.

1.3 Terminology and References to CMMI Content

In general, this module uses the terminology contained within the CMMI Framework and contains amplified text from that framework. Rather than creating a set of recommended processes and practices from scratch, this module utilizes proven content derived from the CMMI Framework and adds amplifications specific to the acquisition process to address the unique facets of acquisition.

Throughout this module, there are references to the CMMI Product Suite and the CMMI Framework to allow an interested reader to explore additional material on collectively understood best practices. References to CMMI products will be more easily utilized if the following definitions and terms are understood from both the acquisition and the process improvement contexts.

For further reference to the CMMI Framework, see the Capability Maturity Model Integration (CMMI) model that contains all currently published disciplines, namely *CMMI for Systems Engineering, Software Engineering, Integrated Product and Process Development and Supplier Sourcing* (CMMI-SE/SW/IPPD/SS), Version 1.1 Continuous Representation, released in March 2002. The continuous representation structures the process areas in groupings related to Process Management, Project Management, Engineering, and Support. In general, this *CMMI Acquisition Module* mainly emphasizes Project Management, Engineering, and Support process areas. The Process Management process areas provide details on how to define and improve processes without regard to the application area (e.g., product development, acquisition) and were excluded from this document for readability purposes. You are encouraged to explore the CMMI Framework for more information.

In the CMMI Product Suite,

- The term 'project' is used to specify all activities related to complete an acquisition. From the acquisition perspective, a project (or program, depending on local interpretation), when used in this module, refers to the entire acquisition project or, perhaps, major subsets of the acquisition project. The scope of the term is tailored to the specific acquisition opportunity.

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- The term 'organization' is typically used to specify an administrative structure in which people collectively manage one or more projects. Those projects share a senior manager and operate under the same policies.

1.4 Integrated Product and Process Development

The *CMMI Acquisition Module* embeds the concepts of Integrated Product and Process Development (IPPD) throughout. IPPD is a systematic approach that achieves a timely collaboration of relevant stakeholders throughout the life of the product to better satisfy customer needs, expectations, and requirements. Some of these concepts are described in explicit practices found in process areas. These concepts include:

- effective use of cross-functional or multidisciplinary teams
- leadership commitment
- appropriate allocation and delegation of decision making
- definition of organizational structures that reward team performance

Other IPPD concepts are integral parts of the entire module. These concepts include:

- design of downstream processes (e.g., transition to operations and support) during the acquisition
- focus on the customers' needs during the acquisition
- timely and appropriate collaboration of all relevant stakeholders
- continuous and proactive identification and management of risk
- focus on measurement and improvement of processes to develop and deliver the product

2 Acquisition Process Areas

The acquisition process areas in this section are abstracted from a number of sources, principally the CMMI Framework, the Software Acquisition CMM and the FAA's iCMM. Amplifications related specifically to acquisition have been added in the shaded text areas. These amplifications are designed to put into context the best practices of the source models for use in acquisition organizations.

The process areas included in this section represent a minimal set of processes that cover the best practices needed to successfully address the entire acquisition life cycle. Each acquisition project operates within a unique environment that influences the life-cycle definition. The acquisition life cycle, especially as it applies to upgrades and modifications, may restart after a cycle has been initiated and partially completed. For example, acquisition of a major upgrade may be initiated to a system that has already been developed, fielded, and placed into operation. In such cases, the application of this module could result in considering the upgrade acquisition as a new acquisition life cycle with complex implementation requirements that may impact another acquisition life cycle already underway. Or, in other cases, the acquisition life cycle may continue throughout the product's life cycle through disposal.

2.1 Configuration Management

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

For acquisition, work products such as solicitation packages, which are created by the acquisition project, are placed under configuration management internally. In addition, configuration management of acquired products (both final and interim products) created by the primary and subordinate suppliers require monitoring to ensure that project goals are met. The acquisition project should ensure that provisions are made for conducting configuration management of supplier products and documentation. Methods to ensure that the data created by the acquisition project is complete and consistent should be established and maintained. It is left to the acquisition project to determine which work products are controlled using configuration management processes.

Configuration Management generally 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 designated internal work products created by the acquirer, acquired products, tools, and other items that are used by either the acquirer or the supplier in creating and describing these work products.

Configuration Management can be best described by the following goals and practices. The process area's goals are bold and the practices are numbered sequentially below each goal.

1. **Baselines of identified work products are established.**
   - 1.1 Identify the configuration items, components, and related work products that will be placed under configuration management.
   - 1.2 Establish and maintain a configuration management and change management system for controlling work products.
   - 1.3 Create or release baselines for internal use and for delivery to the customer.
2. **Changes to the work products under configuration management are tracked and controlled.**
   - 2.1 Track change requests for the configuration items.
   - 2.2 Control changes to the configuration items.
3. **Integrity of baselines is established and maintained.**
   - 3.1 Establish and maintain records describing configuration items.
   - 3.2 Perform configuration audits to maintain integrity of the configuration baselines.

For more extensive treatment of the goals and practices of Configuration Management, see the source documents referenced in the bibliography.

2.2 Decision Analysis and Resolution

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

For acquisition, a repeatable criteria-based decision-making process is especially important, both while making the critical decisions that define and guide the acquisition process itself and later when critical decisions are made with the selected supplier. The establishment of a formal process for decision-making provides the acquisition project with documentation of the decision rationale. Such documentation allows the criteria for critical decisions to be revisited when changes or technology insertion decisions that impact essential requirements are considered.

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 the relevant stakeholders.

While the primary application of this process area is for selected technical concerns, formal evaluation processes can also be applied to many non-technical 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 environment development or associated tool selection, test environment development, 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, 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 for 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 the relevant stakeholders; it provides a record of the formal evaluation process and rationale useful to other projects that encounter a similar issue.

Decision Analysis and Resolution can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Decisions are based on an evaluation of alternatives using established criteria.**
   1.1 Establish and maintain guidelines to determine which issues are subject to a formal evaluation process.
   1.2 Establish and maintain the criteria for evaluating alternatives, and the relative ranking of these criteria.
   1.3 Identify alternative solutions to address issues.
   1.4 Select the evaluation methods.
   1.5 Evaluate alternative solutions using the established criteria and methods.
   1.6 Select solutions from the alternatives based on the evaluation criteria.

For more extensive treatment of the goals and practices of Decision Analysis and Resolution, see the source documents referenced in the bibliography.

2.3 Integrated Project Management

The purpose of Integrated Project Management 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. Integrated Project Management also covers the establishment of a shared vision for the project and a team structure for integrated teams that will carry out the objectives of the project.

For acquisition, Integrated Project Management involves establishing project management processes consistent with and tailored from the organization's standard processes. This includes higher level acquisition guidance, regulations, instructions, as well as local practices established to be used across various projects in the local organization. Establishing an integrated project management process that incorporates and involves all stakeholders (executive level acquisition offices, users, test organizations, developers, and associated government support organizations) is critical to the successful development of the project. This defined project management process is typically defined in an overall project management plan or equivalent document.

The integrated project management process needs to involve and integrate all affected acquisition, development, support, and operational activities. Depending on the size of the project, the size of the coordination efforts can be significant.

Formal interfaces among project stakeholders take the form of memorandums of understanding (MOUs), memorandums of agreements (MOAs), contractual commitments, associate contractor agreements, and similar documents, depending on the nature of the interfaces and involved stakeholders.

The project's defined process includes all life-cycle processes including the IPPD processes that are applied by the project (tailored from the organization's IPPD processes). Processes to select the team structure, allocate limited personnel resources, implement cross-integrated team communication, and conduct issue-resolution processes are part of the project's defined process.

The plans of the integrated teams are included in this integration. Developing a complete project plan and the project's defined process may require an iterative effort if a complex, multi-layered, integrated team structure is being deployed.

Managing the project's effort, cost, schedule, performance, capability, 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 including the following:

- technical activities such as requirements development, design, and verification
- support activities such as configuration management, documentation, 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 and coordination issues receive appropriate attention. 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.

Integrated Project Management is best described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

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

It is possible that an organization has not established a standard set of processes. If so, the project should define its own processes appropriate to their need.

1.1 Establish and maintain the project's defined process.

1.2 Use the organizational process assets and measurement repository for estimating and planning the project's activities.

1.3 Integrate the project plan and the other plans that affect the project to describe the project's defined process.

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

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

2. Coordination and collaboration of the project with relevant stakeholders are conducted.

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

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

2.3 Resolve issues with relevant stakeholders.

3. **The project is conducted using the project's shared vision.**

   3.1 Identify expectations, constraints, interfaces, and operational conditions applicable to the project's shared vision.

   3.2 Establish and maintain a shared vision for the project.

4. **The integrated teams needed to execute the project are identified, defined, structured, and tasked.**

   4.1 Determine the integrated team structure that will best meet the project objectives and constraints.

   4.2 Develop a preliminary distribution of requirements, responsibilities, authorities, tasks, and interfaces to teams in the selected integrated team structure.

   4.3 Establish and maintain teams in the integrated team structure.

For more extensive treatment of the goals and practices of Integrated Project Management, see the source documents referenced in the bibliography.

2.4 Integrated Teaming

The purpose of Integrated Teaming is to form and sustain an integrated team for the development of work products.

For acquisition, Integrated Teaming should consider the overall scope of and requirement for participation of stakeholders from users, acquisition executives, acquisition organizations, developers (primes, associate subcontractors, suppliers, and vendors), test organizations, and other support organizations in the establishment of the integrated team structure for the project. The function of each team should drive the inclusion of the appropriate stakeholders to provide the coverage and representation required for team success.

The establishment of the processes to be used by the team is a significant issue that should be addressed. For example, does the team adopt a common process for team operation or rely on each team member to use his or her own organization's processes? An example of this would be the decision regarding the software development processes to be used by each developer (a common process across the team's developers or a unique but compatible process for each developer). At the very least, the various team member processes should be compatible at the interface points of the team member processes. For example, the process used by the acquirer for oversight should be compatible with and derive data from the supplier's selected processes and not require a duplicate process to be used to generate data for acquisition project use that is not used internally by the supplier for day-to-day operation.

Life-cycle support considerations should also drive the selection of processes across the team members in areas such as tools and support data commonality and compatibility.

Integrated information infrastructures to facilitate communication and coordination within and external to the team, especially those related to geographically separated team members and shareholders, are also required. These may involve multiple solutions including, for example, telecommunications, electronic data sharing, automated collaboration tools, and regular team meetings.

Integrated team members:

- provide the needed skills and expertise to accomplish the team's tasks

- provide the advocacy and representation necessary to address all essential phases of the product's life cycle
- collaborate internally and externally with other teams and relevant stakeholders as appropriate
- share a common understanding of the team's tasks and objectives
- conduct themselves in accordance with established operating principles and ground rules

An integrated team (also known as an "Integrated Product Team" or IPT) is composed of relevant stakeholders who generate and implement decisions for the work product being developed. The members of the integrated team are collectively responsible for delivering the work product. The integrated team receives its assignment from its sponsor. The sponsor of an integrated team is a person or a group (e.g., project manager or even another integrated team) who can assign work tasks and provide resources.

The following characteristics distinguish an integrated team from other forms of specialty work or task groups:

- Team members include empowered representatives from both technical and business functional organizations involved with the product. Within defined boundaries, these representatives have decision-making authority and the responsibility to act for their respective organizations.
- Team members may include customers, suppliers, and other stakeholders outside of the organization as appropriate to the product being developed.
- An integrated team consists of people skilled in the functions that need to be performed to develop required work products. Some of them may represent a functional organization. These people have a dual responsibility to focus on the product while maintaining their connections with the functional organization that can assist the development with additional expertise and advice.
- An integrated team focuses on the product life cycle to the extent required by the project. Team members share and integrate considerations, expectations, and requirements of the product life-cycle phases.
- An integrated team understands its role in the structure of teams for the overall project.
- Clearly defined and commonly understood objectives, tasks, responsibilities, authority, and context (of vertical and horizontal interfaces) provide a strong basis for implementing integrated teams.

Integrated Teaming can best be described by the following activities. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **A team composition that provides the knowledge and skills required to deliver the team's product is established and maintained.**
   - 1.1 Identify and define the team's specific internal tasks to generate the team's expected output.
   - 1.2 Identify the knowledge, skills, and functional expertise needed to perform team tasks.
   - 1.3 Assign the appropriate personnel to be team members based on required knowledge and skills.
2. **Operation of the integrated team is governed according to established principles.**
   - 2.1 Establish and maintain a shared vision for the integrated team that is aligned with any overarching or higher level vision.

2.2 Establish and maintain a team charter based on the integrated team's shared vision and overall team objectives.

2.3 Clearly define and maintain each team member's roles and responsibilities.

2.4 Establish and maintain integrated team operating procedures.

2.5 Establish and maintain collaboration among interfacing teams.

For more extensive treatment of the goals and practices of Integrated Teaming, see the source documents referenced in the bibliography.

2.5 Measurement and Analysis

The purpose of Measurement and Analysis is to develop and sustain a measurement capability that is used to support management information needs.

For acquisition, the acquisition project has information needs for determining the status of its activities throughout the life cycle of the acquisition, the supplier's activities per contractual requirements, as well as the status of the evolving products acquired. In acquisition projects where multiple products are acquired to deliver a capability to the end user, or where there are teaming relationships with other acquisition projects to acquire joint capabilities, additional information needs may be identified to ensure programmatic, technical, and operational interoperability objectives are identified, measured, and achieved.

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, data collection and storage mechanisms, analysis techniques, and reporting and feedback mechanisms
- 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 project. 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.

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 can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Measurement objectives and activities are aligned with identified information needs and objectives.**
   - 1.1 Establish and maintain measurement objectives that are derived from identified information needs and objectives.
   - 1.2 Specify measures to address the measurement objectives.
   - 1.3 Specify how measurement data will be obtained and stored.
   - 1.4 Specify how measurement data will be analyzed and reported.
2. **Measurement results that address identified information needs and objectives are provided.**
   - 2.1 Obtain specified measurement data.
   - 2.2 Analyze and interpret measurement data.
   - 2.3 Manage and store measurement data, measurement specifications, and analysis results.
   - 2.4 Report results of measurement and analysis activities to all relevant stakeholders.

For more extensive treatment of the goals and practices of Measurement and Analysis, see the source documents referenced in the bibliography.

2.6 Organizational Environment for Integration

The purpose of Organizational Environment for Integration is to provide an IPPD infrastructure and manage people for integration.

For acquisition, Organization Environment for Integration is an important element establishing an environment where integrated teams are used. Practices in this process area provide the infrastructure to establish fully functional teams from among all stakeholders (acquisition project, supplier, and other supporting organizations).

For acquisition, there are two focuses on integration—Technical and Organizational. To achieve integrated product integration, the technical aspects of the project must be brought together and holistically considered by all elements of the project. If appropriate decisions are to be reached, technical capabilities and requirements must be examined and understood as they relate to the project's overall goals and objectives. To achieve organizational integration, the project entities must operate with a single vision and a cooperative purpose. When establishing the goals and objectives of each of the entities, the project members involved must be cognizant of both the interrelationships of all aspects of the project and how they relate to the specific goals and objectives of the entity.

Successful integration of the business and technical elements of projects is dependent upon substantive and proactive organizational processes and guidelines. The organization is an integrated system capable of providing and sustaining the people, products, and processes necessary for the effective and efficient execution of its projects. The organization should raise performance expectations from all projects while providing mechanisms that stimulate both team and individual excellence.

Important characteristics of effective environments for integration include people trained to exploit the collaborative environment; a workplace that provides resources to maximize the productivity of people and facilitate integrated teams; and a set of organizational standard processes and organizational process assets that culturally enable an IPPD environment that promotes and rewards team as well as individual excellence.

Organizational Environment for Integration can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **An infrastructure that maximizes the productivity of people and affects the collaboration necessary for integration is provided.**
   - 1.1 Establish and maintain a shared vision for the organization.
   - 1.2 Establish and maintain an integrated work environment that supports IPPD by enabling collaboration and concurrent development.
   - 1.3 Identify the unique skills needed to support the IPPD environment.
2. **People are managed to nurture the integrative and collaborative behaviors of an IPPD environment.**
   - 2.1 Establish and maintain leadership mechanisms to enable timely collaboration.
   - 2.2 Establish and maintain incentives for adopting and demonstrating integrative and collaborative behaviors at all levels of the organization.
   - 2.3 Establish and maintain organizational guidelines to balance team and home organization responsibilities.

For more extensive treatment of the goals and practices of Organizational Environment for Integration, see the source documents referenced in the bibliography.

2.7 Process and Product Quality Assurance

The purpose of Process and Product Quality Assurance is to provide staff and management with objective insight into processes and associated work products.

For acquisition, the products and processes evaluated are those of the acquisition project. For example, the acquisition project may develop and maintain a solicitation package. The process and product quality assurance (PPQA) function would ensure that the solicitation package was developed per the standard or format agreed to by the project team and that it conforms to all applicable policies and laws. As a process evaluation, the PPQA function may evaluate the acquisition project's risk management process against their plan for risk management to ensure the project is effectively implementing their agreed to process. In most cases, the PPQA function in an acquisition project is not performed by a quality assurance group separate from the project.

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 acquisition 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 care to minimize duplication of effort.

Objectivity in process and product quality assurance evaluations is critical to the success of the project. Objectivity is achieved by both independence and the use of criteria. 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.

If quality assurance is embedded in the process, several issues should be addressed to ensure objectivity. Everyone performing quality assurance activities should be trained in quality assurance. Those 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 should be established so that noncompliance issues may be escalated as 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.

Process and Product Quality Assurance can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated.**

   1.1 Objectively evaluate the designated performed processes against the applicable process descriptions, standards, and procedures.

   1.2 Objectively evaluate the designated work products and services against the applicable process descriptions, standards, and procedures.

2. **Noncompliance issues are objectively tracked and communicated, and resolution is ensured.**
   2.1 Communicate quality issues and ensure resolution of noncompliance issues with the staff and managers.
   2.2 Establish and maintain records of the quality assurance activities.

For more extensive treatment of the goals and practices of Process and Product Quality Assurance, see the source documents referenced in the bibliography.

2.8 Project Monitoring and Control

The purpose of Project Monitoring and Control 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.

For acquisition, monitoring and control functions are directed within the acquisition project early in the process as the acquisition planning is performed and the strategy is defined. As the acquisition process unfolds, monitoring and controlling are essential to ensuring that appropriate resources are being applied and that internal acquisition activities are progressing according to plan. Project monitoring and control involves establishing the planned internal activities and schedule for completion and then monitoring the status of these activities and work product completions through measurement and analysis (metrics). It is important that the acquisition project has internal processes, plans, and work products that are monitored for satisfactory completion and progress.

Included in those internal items monitored should be work product completion (specifications, plans, Request for Proposal components, etc.), staffing levels and qualifications applied, system performance objectives and thresholds, infrastructure readiness (tools, networks, etc.) and other activities and products included in project planning. Project risk should be actively identified and managed (mitigated) as well.

Corrective action should be applied when execution does not match project planning (e.g., internal staffing, project plan completion dates, draft and final solicitation and contract award milestone date slippages).

If a corrective action is required to resolve variances from project plans, these actions should be defined and tracked to closure.

Once a supplier is selected and an award is made, the role of monitoring and control becomes twofold, concerned with continuing to monitor and control internally while also monitoring and controlling the progress of the supplier's execution under the supplier's project plan. The goals and practices described in this process area are equally applicable to monitoring and controlling the acquirer's internal activities and monitoring and controlling the supplier's activities after a contract is executed. The acquirer should monitor the supplier's establishment of a project plan that will effectively complete the contract as reflected in the contractual agreement and the supplier's implementation of processes that will successfully execute that plan.

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. 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 re-planning, which may include revising the original plan, establishing new agreements, or including additional mitigation activities within the current plan.

Project Monitoring and Control can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Actual performance and progress of the project are monitored against the project plan.**
   - 1.1 Monitor the actual values of the project planning parameters against the project plan.
   - 1.2 Monitor commitments against those identified in the project plan.
   - 1.3 Monitor risks against those identified in the project plan.
   - 1.4 Monitor the management of project data against the project plan.
   - 1.5 Monitor stakeholder involvement against the project plan.
   - 1.6 Periodically review the project's progress, performance, and issues.
   - 1.7 Review the accomplishments and results of the project at selected project milestones.
2. **Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.**
   - 2.1 Collect and analyze the issues and determine the corrective actions necessary to address the issues.
   - 2.2 Take corrective action on identified issues.
   - 2.3 Manage corrective actions to closure.

For more extensive treatment of the goals and practices of Project Monitoring and Control, see the source documents referenced in the bibliography.

2.9 Project Planning

The purpose of Project Planning is to establish and maintain plans that define project activities.

For acquisition, project planning starts by setting the acquisition strategy and is followed by planning the acquisition process in ever-increasing levels of detail. As the acquisition proceeds toward selection of a supplier, the supplier's planning process should be reviewed for sufficiency. The resulting plans should also be reviewed for consistency with the system acquisition plans. The acquirer's and developer's project planning processes are continuous and the plans evolve to meet the projects' needs.

If there is an existing system to be replaced as part of the acquisition, the acquirer may be required to consider transition from operation and disposal of the existing system as part of the planning for executing the new system. Any such transition activities should be included in the project plan and provision for accommodation of such specialized requirements should be included. It may be beneficial to refer to paragraph 2.14, Transition to Operations and Support, when planning.

When integrated teams are formed, ensure the following:

- *Project data includes data developed and used solely within a particular team as well as data applicable across integrated team boundaries, if there are multiple integrated teams.*
- *Planning for project resources must consider staffing of the integrated teams.*
- *Stakeholder involvement must be planned down to the integrated team level.*
- *The integrated teams' integrated work plans are among the plans to review.*
- *Special attention must be paid to resource commitments whenever there are distributed integrated teams and whenever people are on multiple integrated teams in one or many projects.*
- *The integrated team plans must get buy-in from the team members, the interfacing teams, the project, and the process owners of the standard processes that team has selected for tailored application.*

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 re-planning are contained in this process area.

Project Planning can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. Estimates of project planning parameters are established and maintained.

1.1 Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.

1.2 Establish and maintain estimates of the attributes of the work products and tasks.

1.3 Define the project life-cycle phases upon which to scope the planning effort.

1.4 Estimate the project effort and cost for the work products and tasks based on estimation rationale.

2. A project plan is established and maintained as the basis for managing the project.

2.1 Establish and maintain the project's budget and schedule.

2.2 Identify and analyze project risks.

2.3 Plan for the management of project data.

2.4 Plan for necessary resources to perform the project.

2.5 Plan for knowledge and skills needed to perform the project.

2.6 Plan the involvement of identified stakeholders.

2.7 Establish and maintain the overall project plan content.

3. **Commitments to the project plan are established and maintained.**

3.1 Review all plans that affect the project to understand project commitments.

3.2 Reconcile the project plan to reflect available and estimated resources.

3.3 Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.

For more extensive treatment of the goals and practices of Project Planning, see the source documents referenced in the bibliography.

2.10 Requirements Development

The purpose of Requirements Development is to produce and analyze customer, product, and product-component requirements.

For acquisition, Requirements Development has two contexts. The first context is the amalgamation and coordination of the operational requirements (i.e., customer requirements) into a set of requirements that will define the scope and direction of the acquisition. The second context is the allocation and extension of the customer requirements and additional acquirer requirements (e.g., architecture requirements, formal and informal review requirements, reporting requirements, or data requirements) that become the basis of the processes utilized by the supplier's organization.

There is a continuous iteration of requirements down through the multiple tiers of requirements documents associated with the components of a system. For example, requirements flow from the stakeholders to the system level to multiple subsystem levels and eventually to either hardware or software component levels. The responsibility for developing requirements across the levels is generally split between the acquirer and the supplier. The acquirer is generally responsible for the higher level, starting with operational requirements and the supplier is responsible for successive levels below that.

As each level of requirements is defined there is an iterative process of allocation, high-level design, and requirements definition (for the next lower level).

The acquirer is responsible for defining and baselining the requirements levels under their control and also monitoring the supplier definition of lower level requirements, reviewing and assuring that the work products associated with the requirements are being produced It is also the responsibility of the acquirer to monitor the lower level requirements development process to assure the requirements contained at each level will produce a system that will satisfy the overall system and operational requirements.

Requirements include not only the classical functional and performance requirements, but also interface requirements, whether they are contained in a separate interface specification or contained within the requirements specification.

Requirements also include non-functional requirements such as data rights, delivery dates, milestone exit criteria, and other attributes such as evolvability, maintainability, and re-usability, which can drive the definition of the product requirements.

When acquiring services instead of products, the same requirements process is used to define high-level operational needs and to allocate those needs to lower level components of the service to ensure the resulting service meets the original intent.

Requirements Development describes three types of requirements: customer requirements, product requirements, and product-component requirements. Taken together, these requirements address the needs of relevant stakeholders, including those pertinent to various product life-cycle phases (e.g., verification criteria) and product attributes (e.g., safety, reliability, and maintainability).

This process area addresses all customer requirements rather than only product-level requirements because the customer may also provide specific design requirements.

Requirements are identified and refined throughout the phases of the product life cycle. Design decisions, subsequent corrective actions, and feedback during each phase of the product's life cycle are analyzed for impact on allocated and derived requirements.

Analyses are used by both the acquirer and the supplier to understand, define, and select the requirements at all levels from competing alternatives. These analyses include the following:

- analysis of needs and requirements for each product life-cycle phase, including needs of relevant stakeholders, the operational environment, and factors that reflect overall customer and end-user expectations and satisfaction, such as safety, security, and affordability
- development of an operational concept
- definition of the required functionality

After award to a supplier, analyses occur recursively at successively more detailed layers of a product's architecture until sufficient detail is available to enable detailed design, implementation, and testing of the product to proceed. As a result of the analysis of requirements and the operational concept (including functionality, support, maintenance, and disposal), the manufacturing or production concept produces more derived requirements, including consideration of the following:

- constraints of various types
- technological limitations
- cost and cost drivers
- time constraints and schedule drivers
- risks
- consideration of issues implied but not explicitly stated by the customer or end user
- factors introduced by the supplier's unique business considerations, regulations, and laws

Involvement of relevant stakeholders in both requirements development and analysis gives them visibility into the evolution of requirements. This activity continually assures that the requirements are being properly defined.

Requirements Development can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.**
   1.1 Elicit stakeholder needs, expectations, constraints, and interfaces for all phases of the product life cycle.
   1.2 Transform stakeholder needs, expectations, constraints, and interfaces into customer requirements.
2. **Customer requirements are refined and elaborated to develop product and product-component requirements.**
   2.1 Establish and maintain product and product-component requirements, which are based on the customer requirements.
   2.2 Allocate the requirements for each product component.
   2.3 Identify interface requirements.
3. **The requirements are analyzed and validated, and a definition of required functionality is developed.**
   3.1 Establish and maintain operational concepts and associated scenarios.
   3.2 Establish and maintain a definition of required functionality.
   3.3 Analyze requirements to ensure that they are necessary and sufficient.
   3.4 Analyze requirements to balance stakeholder needs and constraints.
   3.5 Validate requirements to ensure the resulting product will perform as intended in the user's environment using multiple techniques as appropriate.

For more extensive treatment of the goals and practices of Requirements Development, see the source documents referenced in the bibliography.

2.11 Requirements Management

The purpose of Requirements Management 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.

For acquisition, requirements management is applied to the requirements that are received from the requirements development process. During the acquisition, requirements management includes the direct management of acquirer-controlled requirements and oversight of supplier requirements management. Requirements are managed and maintained with discipline so that changes are not executed without recognizing the impact to the project.

Requirements management should define "approved" requirements providers and an approved path by which requirements are provided to the supplier. This definition prevents suppliers from receiving requirements changes from unauthorized sources that are outside the flow of the acquirer's established requirements management process.

Commitment to the requirements by the project participants includes having coordinated and approved documents that define requirements.

Each change to a controlled requirement should be assessed for impact to the project's performance, cost, and schedule baselines and to project risk. The existing cost, schedule, and performance baselines should be changed, as required, to accommodate the requirements change.

Requirements management processes manage all requirements received or generated by the project, including both technical and non-technical requirements as well as those requirements levied on the project by the organization. In particular, if the Requirements Development process area is implemented, its processes will generate product and product-component requirements that will also be managed by the requirements management processes. When the Requirements Management, Requirements Development, and Technical Solution process areas are all implemented, their associated processes may be closely tied and be performed concurrently.

The project takes appropriate steps to ensure that the agreed-upon 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 maintain bidirectional traceability between source requirements and all product and product-component requirements.

Requirements Management can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Requirements are managed and inconsistencies with project plans and work products are identified.**
   - 1.1 Develop an understanding with the requirements providers on the meaning of the requirements.
   - 1.2 Obtain commitment to the requirements from the project participants.
   - 1.3 Manage changes to the requirements as they evolve during the project.
   - 1.4 Maintain bidirectional traceability among the requirements and the project plans and work products.
   - 1.5 Identify inconsistencies between the project plans and work products and the requirements.

For more extensive treatment of the goals and practices of Requirements Management, see the source documents referenced in the bibliography.

2.12 Risk Management

The purpose of Risk Management is to identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

For acquisition, risk identification and estimation of probability and impact, particularly the risk involved in meeting performance requirements, schedules, and cost targets, largely determines the acquisition strategy. The acquirer has a dual role: first, in assessing and managing overall project risks for the duration of the project, and second, in assessing and managing risks associated with the performance of the supplier. As the acquisition progresses to the selection of a

supplier, the risk specific to the supplier's technical and management approach then becomes important to the success of the acquisition.

The particular risks associated with conducting the project using integrated teams should be considered, such as risks associated with loss of inter-team or intra-team coordination.

Risk management is a continuous, forward-looking process that is an important part of business and technical management processes. 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 have 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.

While technical issues are a primary concern both early on and throughout all project phases, risk management should consider both internal and external sources for cost, schedule, and technical risk. 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 may also be applied to manage organizational risks.

Risk Management can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Preparation for risk management is conducted.**
   - 1.1 Determine risk sources and categories.
   - 1.2 Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.
   - 1.3 Establish and maintain the strategy to be used for risk management.
2. **Risks are identified and analyzed to determine their relative importance.**
   - 2.1 Identify and document the risks.
   - 2.2 Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.

3. **Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.**

   3.1 Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy.

   3.2 Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate.

For more extensive treatment of the goals and practices of Risk Management, see the source documents referenced in the bibliography.

2.13 Solicitation and Contract Monitoring

The purpose of Solicitation and Contract Monitoring is to prepare a solicitation package that identifies the needs of a particular acquisition, to select a supplier that is best capable of satisfying those needs, and to provide leadership throughout the life of the acquisition to ensure those needs are met.

For acquisition, the solicitation must comply with the applicable federal, departmental, and service acquisition regulations and policies. The solicitation should address issues appropriate to the system domain or acquisition environment (e.g., supplier process evaluations, operational safety suitability and effectiveness, safety, certifications, architecture evaluations, and interoperability). The representatives responsible for these functional disciplines within the project or stakeholder organizations should be consulted for proper inclusion of those disciplines into the solicitation and contract monitoring process.

When integrated teams are formed, team membership should be negotiated with suppliers and incorporated into the agreement. The agreement should identify integrated decision-making, reporting requirements (i.e., business and technical), and trade studies requiring supplier involvement. The supplier efforts should be orchestrated to support the IPPD efforts undertaken by the acquirer.

The Solicitation and Contract Monitoring process area is intended to create a proactive environment to enable the acquirer to initialize and adapt the relationship with the supplier over the duration of that relationship for the successful execution of the project. In addition, it is intended to encourage creation of a contract that will enable the acquirer to execute its monitoring and control of supplier activities using other process areas, such as Project Monitoring and Control. This encouragement may include levying a contractual requirement on the supplier to create a project plan that will successfully execute the contract, to define and execute the processes needed to achieve success, and to commit to execute their plan as it evolves during contract execution.

The Solicitation and Contract Monitoring process area involves planning for and performing the practices necessary to develop and issue a solicitation package, preparing for the evaluation of responses, conducting an evaluation, conducting supporting negotiations, making recommendations for award of the contract, and overseeing the execution phase to ensure the needs of the acquisition are met.

The acquirer and supplier establish and maintain a mutual understanding through effective, timely, and appropriate communication. The acquirer should clearly identify and prioritize its needs and expectations, as well as its suppliers' limitations. The acquirer works closely with suppliers to achieve a mutual understanding of product requirements, responsibilities, and processes that will be applied to achieve project objectives.

Solicitation and Contract Monitoring can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **The project is prepared to conduct the solicitation.**
   - 1.1 Designate a selection official responsible for making the selection decision.
   - 1.2 Establish and maintain a solicitation package that includes the needs of the acquisition and corresponding proposal evaluation criteria.
   - 1.3 Establish and maintain independently reviewed cost and schedule estimates for the products to be acquired.
   - 1.4 Validate the solicitation package with end users and potential bidders to ensure the approach and cost and schedule estimates are realistic and can reasonably lead to a usable product.
2. **Suppliers are selected based on the solicitation package.**
   - 2.1 Evaluate proposals according to the documented solicitation plans.
   - 2.2 Use proposal evaluation results as a basis to support selection decisions.
3. **Contracts are issued based on the needs of the acquisition and the suppliers' proposed approaches.**
   - 3.1 Establish and maintain a mutual understanding of the contract with selected suppliers and end users based on the acquisition needs and the suppliers' proposed approaches.
   - 3.2 Establish and maintain communication processes and procedures with suppliers that emphasize the needs, expectations, and measures of effectiveness to be used throughout the acquisition.
4. **Work is coordinated with suppliers to ensure the contract is executed properly.**
   - 4.1 Monitor and analyze selected processes used by the supplier based on the supplier's documented processes.
   - 4.2 Evaluate selected supplier work products based on documented evaluation criteria.
   - 4.3 Revise the supplier agreement or relationship, as appropriate, to reflect changes in conditions.

For more extensive treatment of the goals and practices of Solicitation and Contract Monitoring, see the source documents referenced in the bibliography.

2.14 Transition to Operations and Support

The purpose of Transition to Operations and Support is to provide for the transition of the product to the end user and the eventual support organization and to accommodate life-cycle evolution.

For acquisition, planning for transition includes establishing strategies for support (i.e., source of repair) through organic support infrastructures, contractor logistics support (CLS), or other sources. The roles and responsibilities of the acquirer, supporter, and user should be defined in the life-cycle support of the system. The acquirer must determine if it will execute the function directly or make provision for the function to be executed as a result of the acquisition itself. Responsibility for capability enhancements during the support phase should be defined, considering the magnitude and complexity of the envisioned change. Explicitly identifying organizationally who has responsibility for support (i.e., "level 1 maintenance") and for enhancements (i.e., "level 2 maintenance") ensures that relevant stakeholders are involved early in the acquisition project's planning processes. The acquisition project should also assign responsibility for imple-

mentation of the practices identified in this process area (see generic practice discussion in Section 3 of this document). Additionally, the acquisition project must work with the operational units to plan for transition of the products into operational use. This planning includes identifying and providing for initial spares, operational training capabilities, etc. Eventual disposal of the product should also be considered.

Transition to Operations and Support involves the processes used to plan for and manage the transition of new or evolved products into operational use and their transition to the eventual maintenance or support organization. Identify any special conditions that may apply during the eventual decommissioning or disposal of the products. The acquisition project is responsible for ensuring the acquired products not only meet specified requirements (see the Verification section) and can be used in its intended environment (see the Validation section), but also that they can be transitioned into operational use to achieve the users' desired mission capabilities and be maintained and sustained over their intended life cycles. The acquisition project is responsible for ensuring reasonable planning for transition into operations is conducted, clear transition criteria exist and are agreed to by all relevant stakeholders, and products are maintained and supported once operational. These plans include reasonable accommodation for known and potential evolution of the products and their eventual removal from operational use.

Transition to Operations and Support can best be described by the following. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Preparation for transition to operations and support is conducted.**
   - 1.1 Establish and maintain a strategy for transition to operations and support.
   - 1.2 Establish and maintain plans for transitioning acquired products into operational use and support.
   - 1.3 Establish and maintain training requirements for operational and support personnel.
   - 1.4 Establish and maintain initial and life-cycle resource requirements for performing operations and support.
   - 1.5 Identify and assign organizational responsibility for support.
   - 1.6 Establish and maintain criteria for assigning responsibility for enhancements.
   - 1.7 Establish and maintain transition criteria for the acquired products.
2. **Acquired products are transitioned to operations and support based on transition criteria.**
   - 2.1 Evaluate the readiness of the acquired products to undergo transition to operations and support.
   - 2.2 Evaluate the readiness of the operational and support personnel to undergo transition to the acquired products.
   - 2.3 Analyze the results of all transition activities and identify appropriate action.

For more extensive treatment of the goals and practices of Transition to Operations and Support, see the source documents referenced in the bibliography.

2.15 Validation

The purpose of Validation is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

For acquisition, validation is normally performed early and continuously throughout the acquisition life cycle. The acquirer uses validation processes to demonstrate that the work products of the acquisition process will fulfill the acquisition strategy and that the processes will effectively acquire the product or services. The acquirer also uses validation to ensure that the product or service received from the supplier will fulfill its intended use. In this context, the test community is a major stakeholder, including up-front planning through final-system validation. It is important that the acquirer define at the outset the degree to which validation is required both early in the definition of the project and later when the products are received. In addition, plans should identify adequate resources to execute validation activities.

Validation activities can be applied to all aspects of the product in any of its intended environments, such as operation, training, manufacturing, maintenance, and support services. The methods employed to accomplish validation can be applied to work products as well as to the product and product components. The work products (e.g., requirements, designs, prototypes) should be selected on the basis of which are the best predictors of how well the product and product component will satisfy user needs.

The validation environment should represent the intended environment for the product and product components as well as represent the intended environment suitable for validation activities with work products.

Validation demonstrates that the product, as provided, will fulfill its intended use; whereas, verification addresses whether the work product properly reflects the specified requirements. In other words, verification ensures that "you built it right;" whereas, validation ensures that "you built the right thing." Validation activities use approaches similar to verification (e.g., test, analysis, inspection, demonstration, or simulation). Often, the end users are involved in the validation activities. Both validation and verification activities often run concurrently and may use portions of the same environment.

Refer to the Verification process area for more information about verification activities.

Where possible, validation should be accomplished using the product or product component operating in its intended environment. The entire environment may be used or only part of it. However, validation issues can be discovered early in the life of the project using work products.

When validation issues are identified, they are referred to the processes associated with the Requirements Development, Technical Solution, or Project Monitoring and Control process areas for resolution.

The practices of this process area build on each other in the following way. Practice 1.1 enables the identification of the product or product component to be validated and the methods to be used to perform the validation. Practice 1.2 enables the determination of the environment that will be used to carry out the validation. Practice 1.3 enables the development of validation procedures and criteria that are aligned with the characteristics of selected products, customer constraints on validation, methods, and the validation environment. Practice 2.1 enables the performance of validation according to the methods, procedures, and criteria.

Validation can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Preparation for validation is conducted.**
   1.1 Select products and product components to be validated and the validation methods that will be used for each.
   1.2 Establish and maintain the environment needed to support validation.
   1.3 Establish and maintain procedures and criteria for validation.
2. **The product or product components are validated to ensure that they are suitable for use in their intended operating environment.**
   2.1 Perform validation on the selected products and product components.
   2.2 Analyze the results of the validation activities and identify issues.

For more extensive treatment of the goals and practices of Validation, see the source documents referenced in the bibliography.

2.16 Verification

The purpose of Verification is to ensure that selected work products meet their specified requirements.

For acquisition, verification is normally performed early and continuously throughout the acquisition life cycle. The acquirer ensures that selected work products of the acquisition process meet the project requirements (e.g., the solicitation package and other plans are built according to specified templates, meet all laws and regulations, and are inspected for defects). The acquirer also ensures the evolving acquired products satisfy contractual requirements.

The Verification process area involves the following: verification preparation, verification performance, and identification of corrective action.

Verification processes include verification of the product and intermediate work products against all selected requirements, including customer, product, and product-component requirements.

Verification is inherently an incremental process because it occurs throughout the development of the product and work products, beginning with verification of the requirements, progressing through the verification of the evolving work products, and culminating in the verification of the completed product.

The specific practices of this process area build upon each other in the following way: practice 1.1 enables the identification of the work products to be verified, the methods to be used to perform the verification, and the requirements to be satisfied by each selected work product. Practice 1.2 enables the determination of the environment that will be used to carry out the verification. Practice 1.3 then enables the development of verification procedures and criteria that are aligned with the selected work products, requirements, methods, and characteristics of the verification environment. Practice 3.1 conducts the verification according to the available methods, procedures, and criteria.

Verification of work products substantially increases the likelihood that the product will meet the customer, product, and product-component requirements.

The Verification and Validation process areas are similar, but they address different issues. Validation demonstrates that the product, as provided (or as it will be provided), will fulfill its intended use, whereas verification addresses whether the work product properly reflects the specified requirements. In other words, verification ensures that "you built it right;" whereas, validation ensures that "you built the right thing."

Product and process inspections, often called peer reviews, are an important part of verification and are a proven mechanism for effective defect removal. An important corollary is to develop a better understanding of the work products and the processes that produced them so defects can be prevented and process-improvement opportunities can be identified.

Peer reviews involve a methodical examination of work products by the producers' peers to identify defects and other changes that are needed.

Examples of peer review methods include inspections and structured walkthroughs.

Verification can best be described by the following goals and practices. Goals are shown in bold and practices are numbered sequentially below each goal.

1. **Preparation for verification is conducted.**
   - 1.1 Select the work products to be verified and the verification methods that will be used for each.
   - 1.2 Establish and maintain the environment needed to support verification.
   - 1.3 Establish and maintain verification procedures and criteria for the selected work products.
2. **Peer reviews are performed on selected work products.**
   - 2.1 Prepare for peer reviews of selected work products.
   - 2.2 Conduct peer reviews on selected work products and identify issues resulting from the peer review.
   - 2.3 Analyze data about preparation, conduct, and results of the peer reviews.
3. **Selected work products are verified against their specified requirements.**
   - 3.1 Perform verification on the selected work products.
   - 3.2 Analyze the results of all verification activities and identify corrective action.

For more extensive treatment of the goals and practices of Verification, see the source documents referenced in the bibliography.

3 Generic Practices

Generic practices are practices that should be included in every process area in addition to the specific practices that appear in each process area description. The generic practices improve the power of a process by assuring that the specific practices are executed and that there is appropriate planning of the process to assure that it is feasible and well-supported. They also ensure that stakeholders are properly involved in the activities of the process. The last two generic practices assure that the performance of each process and the lessons learned are saved and that this knowledge is used to establish new projects or to improve the performance of an existing project.

Although a generic practice, by definition, applies to all process areas, the practical implications of applying a generic practice vary for each process area. Consider two examples that illustrate these differences as they relate to planning the process. First, the planning described by this generic practice as applied to the Project Monitoring and Control process area may be carried out in full by the processes associated with the Project Planning process area. In such a situation, the generic practice imposes no additional expectations for planning. Second, the planning described by this generic practice as applied to the Project Planning process area typically would not be addressed by the processes associated with other process areas in the model. Therefore, the generic practice sets an expectation that the project planning process itself be planned. It is important to be aware of the extent to which this generic practice may either reinforce expectations set elsewhere in the model, or set new expectations that should be addressed.

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

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

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

2. Establish and maintain the plan for performing the process.

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

The objectives for the process may be derived from other plans (e.g., the project plans). Included are objectives for the specific situation, including quality, cost, and schedule objectives. For example, an objective might be to reduce the cost of performing a process for an implementation over its previous implementation.

Establishing a plan includes documenting the plan and providing a process description. Maintaining the plan includes changing it as necessary in response to either corrective actions or to changes in requirements and objectives for the process.

The plan for performing the process typically includes the following:

- process description
- standards for the work products and services of the process
- requirements for the work products and services of the process
- specific objectives for the performance of the process (e.g., quality, time scale, cycle time, and resource usage)
- dependencies among the activities, work products, and services of the process
- resources (including funding, people, and tools) needed to perform the process
- assignment of responsibility and authority
- training needed for performing and supporting the process
- work products to be placed under configuration management and the level of configuration management for each item
- measurement requirements to provide insight into the performance of the process, its work products, and its services
- involvement of identified stakeholders
- activities for monitoring and controlling the process
- objective evaluation activities for the process and the work products
- management review activities for the process and the work products

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

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

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

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

Responsibility can be assigned using detailed job descriptions or in living documents, such as the plan for performing the process. Dynamic assignment of responsibility is another legitimate way to perform this generic practice, as long as the assignment and acceptance of responsibility are ensured throughout the life of the process.

5. Train the people performing or supporting the process as needed.

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

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

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

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

The designated work products are specifically identified in the plan for performing the process, along with a specification of the level of configuration management.

7. Identify and involve the relevant stakeholders as planned.

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

Involve relevant stakeholders as described in an appropriate plan for stakeholder involvement.

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

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

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

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

The purpose of this generic practice is to provide credible assurance that the process is implemented as planned and adheres to its process description, standards, and procedures.

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

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

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

The two following generic practices form the basis for propagating good practice to future acquisition projects. They are intended to facilitate process definition and identify process benefits that encourage adoption of best practices on new projects.

A defined process is tailored from the organization's set of standard processes according to the organization's tailoring guidelines, and contributes work products, measures, and other process-improvement information to the organizational process assets.

These two generic practices activate a process improvement cycle. The organization maintains a process asset library and standard process that can be drawn upon by a project to create its processes. In turn, the project provides information about the performance of its process to the organization's process asset library that is used to improve and extend the standard processes.

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

11. Establish and maintain the description of a defined process.

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

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

The purpose of this generic practice is to collect information and artifacts derived from planning and performing the process. This generic practice is performed so that the information and artifacts can be included in the organizational process assets and made available to those who are (or who will be) planning and performing the same or similar processes. The information and artifacts are stored in the organization's measurement repository and the organization's process asset library.

Appendix

The series of questions included in this appendix are intended to aid acquisition project managers and program executives in determining if their projects are performing acquisition activities in accordance with best practices. The questions are intended to both verify that best practices are being employed and to provide a means of gathering the background information necessary to determine that the products or services acquired are adequate and focused.

References to the process areas, by document section number, described in the body of this document are included in parenthesis after each question. The questions especially focus on setting strategy and on planning and estimating in the belief that these early activities determine, in large part, the success of an acquisition from the outset. Questions also focus on risk identification and management and on capabilities definition and requirements generation, as well as on having repeatable processes that enable organizations to institutionalize best practices. The combination of these questions and the process areas in this document were designed to facilitate assessment and improvement of the acquisition process in your organizations.

Executive Guidance Questions

1 **Do you have an acquisition Strategy?**
- 1A How have you determined it is the most appropriate strategy for this acquisition? (2.2, 2.9, 2.10, 2.12)
- 1B How does your selected acquisition strategy mitigate the risks you've identified? (2.9, 2.12)
- 1C Which stakeholders were involved in its preparation? (2.3, 2.4, 2.6, 2.9)
- 1D How do your acquisition plans reflect and implement the acquisition strategy? (2.3, 2.9)

2 **Have you established and maintained an acquisition plan for the program?**
- 2A How did you determine and document the scope of the program? (2.9, 2.10)
- 2B How did you determine resource needs for each element within the scope of the program? (2.9)
- 2C How has the program defined a critical path? (2.3, 2.9)
- 2D How has the plan been coordinated with all relevant stakeholders at both the management and working levels? (2.3, 2.4, 2.6, 2.9)
- 2E How will you ensure that you have adequate staff with the necessary experience and training to execute your plan? (2.4, 2.9)
- 2F How will you ensure that the contractor has the resources and tools needed to complete the program? (2.13)
- 2G How will you ensure the contractor has the domain experience and process capability needed to complete the program? (2.13)

3 Have you defined your cost, schedule, and performance baselines?

3A How have the cost, schedule, and performance baselines been evaluated "independently" and from an integrated perspective? (2.9)

3B How do you know the baselines are realistic and executable? (2.9)

3C How have you ensured all the life-cycle costs are included (e.g., training and support costs)? (2.9, 2.14)

3D How do you use or how do you plan to use Earned Value Management? (2.5, 2.8, 2.13)

3E What is the role of management reserve on your program? (2.9)

3F What percentage of the cost baseline is set aside for risk and engineering changes? (2.9, 2.11, 2.12)

3G How do you control changes to the contractual requirements? (2.11, 2.13)

3H How do you accommodate cost and schedule impacts due to requirements changes to ongoing contractual development efforts? (2.8, 2.9, 2.11)

4 Have you validated your user requirements?

4A How do you intend to keep the user involved in the requirements process? (2.3, 2.9, 2.10, 2.11, 2.13, 2.15)

4B How do you ensure a clear understanding exists of what the user wants? (2.10, 2.11, 2.13, 2.15)

4C How do you ensure the contractor(s) and all relevant stakeholders maintain a clear understanding of what the user wants? (2.10, 2.11, 2.13, 2.15)

4D What baselined documents capture that understanding? (2.1, 2.10, 2.11, 2.13)

4E What role does your organization play in establishing the requirements? (2.3, 2.4, 2.10)

4F What is the strategy for keeping up with the evolving environment (e.g., threat, technology, process improvements). (2.10, 2.11, 2.12)

4G For government developed or furnished equipment or software, are the interfaces well defined? Is there agreement with the contractor on interface specifications and function? (2.10, 2.13)

5 How much software do you expect to be developed on this program?

(Note: The following topics address software specific issues and are appropriate for systems with significant software challenges. It is also appropriate to address these same generic issues for other program technology areas.)

5A How have you determined that the software can be developed within the allocated cost and schedule baselines? (2.9)

5B How will the status of software development be monitored? (2.10)

5C What indicators are being used to track progress and performance for software and systems engineering? (2.5, 2.10)

5D Describe your strategy for incorporating non-developmental software (e.g., COTS, Government off-the-shelf [GOTS], reuse, product lines) into the project. (2.3, 2.9, 2.10)

5E What percentage of the software is planned to be non-developmental software (NDS)? (2.9)

5F How have you determined that you can achieve the anticipated percentage of NDS on this project? (2.9)

5G How will you determine that the projected NDS will provide the desired functionality? (2.10, 2.15, 2.16)

5H How will the contractor demonstrate the performance and stability of the software development environment and tools? (2.13)

5I Is there a systems engineering process in place to define software requirements and software architectures? (2.10)

6 Do you have documented processes?

6A Describe the acquisition areas covered by these documented processes. (2. 9, 3.2, 3.11)

6B What mechanism do you use to monitor, control, and improve your processes? (2.7, 3.8, 3.9, 3.12)

6C Are your processes program specific or are they organizational processes? Explain. (3.1, 3.2, 3.11)

6D How do you know you are adhering to your processes? (2.7, 3.8, 3.9, 3.10)

7 How do you identify and manage risks?

7A How do you assess program risk? (2.8, 2.9, 2.12)

7B What risks have you identified related to your acquisition plan? (2.9, 2.12)

7C What are the risks associated with schedule? (2.8, 2.9, 2.12)

7D How have you ensured that you understand the cost risk of obtaining the required capability? (2.8, 2.9, 2.11, 2.12)

7E What risks have you identified related to contractor execution? (2.8, 2.12, 2.13)

7F What risks have you identified that are outside your control? (2.12)

7G How do you monitor mitigation efforts for identified risks? (2.8, 2.12)

7H Describe the risk management tool(s) you employ. (2.12, 3.3)

7I Who is involved in program risk assessment (e.g., independent subject matter experts)? (2.4, 2.12)

7J Explain how you have built in sufficient contingency to account for program risk? (2.2, 2.9, 2.12)

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13. ABSTRACT (MAXIMUM 200 WORDS)

Building on relevant best practices extracted from the Capability Maturity Model Integration (CMMI) Framework, this report defines effective and efficient practices for government acquisition organizations. Acquisition best practices are focused inside the acquisition organization to ensure the acquisition is conducted effectively, and outside the acquisition organization as it conducts project monitoring and control of its suppliers. These best practices provide a foundation for acquisition process discipline and rigor that enables product and service development to be repeatedly executed with high levels of ultimate acquisition success.

This report contains the acquisition practices that should be performed by government acquisition organizations acquiring systems and/or services. These practices, however, can also be used by non-government organizations to improve their acquisition practices. This report does not contain prescribed implementation approaches for achieving acquisition best practices. Instead, the proven content of the CMMI Framework is used as a base and amplifications specific to the acquisition process are added.

Questions related to CMMI process areas are provided in the appendix to help managers and executives understand the acquisition organization's documented acquisition practices and the consistent application of those practices. Descriptions of implementation details can be found in the source documents listed in the bibliography.

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