

Chapter 1

1.0 INTRODUCTION

Project managers use the Project Monitoring and Controlling Process and project teams to ensure the team is making satisfactory progress to the project goals. The purpose is to track all major project variables – cost, time, scope, and quality of deliverables. The overall objectives of the process are to:

- Track and review actual project accomplishments and results to project plans
- Revise the project plan to reflect accomplishments thus far, and to revise the plan for remaining work, if needed
- Provide visibility into progress as the project proceeds, so that the team and management can take corrective action early when project performance varies significantly from original plans

Deliverables from monitoring and controlling include

- Written status reports
- Updates to lists of action items, risks, problems, and issues
- Updates to the plan and schedule, to reflect actual progress
- Comparisons of actual costs to budgeted costs, as well as the cost/benefit analysis used when starting the project
- Audit and review reports of the activities and work products under development

1.1 DEFINITION

- **Planning** - Is both the organizational process of creating and maintaining a plan; and the psychological process of thinking about the activities required to create a desired future on some scale. As such, it is a fundamental property of intelligent behavior. This thought process is essential to the creation and refinement of a plan, or integration of it with other plans, that is, it combines forecasting of developments with the preparation of scenarios of how to react to them. The term is also used to describe the formal procedures used in such an endeavor, such as the creation of documents, diagrams, or meetings to discuss the important issues to be addressed, the objectives to be met, and the strategy to be followed.
- **Monitoring** - To monitor or monitoring generally means to be aware of the state of a system.
- **Controlling** - Control is used in a variety of contexts to express "mastery" or "proficiency": It may refer to management/finance, and science/technology.

1.2 PROJECT PLANNING

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.

The term "project plan" is used throughout the generic and specific practices in this process area to refer to the overall plan for controlling the project.

1.2.1 Requirements Development

This process area 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., acceptance testing criteria) and product attributes (e.g., safety, reliability, maintainability). Requirements also address constraints caused by the selection of design solutions (e.g., integration of commercial off-the-shelf products).

Requirements are the basis for design. The development of requirements includes the following activities:

- Elicitation, analysis, validation, and communication of customer needs, expectations, and constraints to obtain customer requirements that constitute an understanding of what will satisfy stakeholders
- Collection and coordination of stakeholder needs
- Development of the life-cycle requirements of the product
- Establishment of the customer requirements
- Establishment of initial product and product-component requirements consistent with customer requirements

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

Customer requirements are further refined into product and product-component requirements. In addition to customer requirements, product and product-component requirements are derived from the selected design solutions.

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 derived and allocated requirements.

The Requirements Development process area includes three specific goals. The Develop Customer Requirements specific goal addresses defining a set of customer requirements to use in the development of product requirements. The Develop Product Requirements specific goal addresses defining a set of product or product-component requirements to use in the design of products and product components. The Analyze and Validate Requirements specific goal addresses the necessary analysis of customer, product, and product-component requirements to define, derive, and understand the requirements. The specific practices of the third specific goal are intended to assist the specific practices in the first two specific goals. The processes associated with the Requirements Development process area and those associated with the Technical Solution process area may interact recursively with one another.

Analyses are used 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

The definition of functionality, also referred to as "functional analysis," is not the same as structured analysis in software development and does not presume a functionally oriented software design. In object-oriented software design, it relates to defining the services. The definition of functions, their logical groupings, and their association with requirements is referred to as a "functional architecture."

Analyses occur recursively at successively more detailed layers of a product's architecture until sufficient detail is available to enable detailed design, acquisition, 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 developer's unique business considerations, regulations, and laws

A hierarchy of logical entities (functions and sub-functions, object classes and subclasses) is established through iteration with the evolving operational concept. Requirements are refined, derived, and allocated to these logical entities. Requirements and logical entities are allocated to products, product components, people, associated processes, or services.

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

1.2.2 Requirement Management

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 bi-directional trace-ability between source requirements and all product and product-component requirements.

1.2.3 Risk Management

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 must 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. [PA148.N105]

Although the primary emphasis of the Risk Management process area is on the project, the concepts may also be applied to manage organizational risks.

1.2.4 Technical Solution

The Technical Solution process area is applicable at any level of the product architecture and to every product, product component, product-related life-cycle process, and service. The process area focuses on the following:

- Evaluating and selecting solutions (sometimes referred to as "design approaches," "design concepts," or "preliminary designs") that potentially satisfy an appropriate set of allocated requirements
- Developing detailed designs for the selected solutions (detailed in the context of containing all the information needed to manufacture, code, or otherwise implement the design as a product or product component)
- Implementing the designs as a product or product component

Typically, these activities interactively support each other. Some level of design, at times fairly detailed, may be needed to select solutions. Product-component prototypes may be used as a means of gaining sufficient knowledge to develop a technical data package or a complete set of requirements.

Technical Solution specific practices apply not only to the product and product components but also to services and product-related life-cycle processes. The product-related life-cycle processes are developed in concert with the product or product component. Such development may include selecting and adapting existing processes (including standard processes) for use as well as developing new processes.

Processes associated with the Technical Solution process area receive the product and product-component requirements from the requirements management processes. The requirements management processes place the requirements, which originate in requirements development processes, under appropriate configuration management and maintain their trace-ability to previous requirements.

For a maintenance or sustainment organization, the requirements in need of maintenance actions or redesign may be driven by user needs or latent defects in the product components. New requirements may arise from changes in the operating environment. Such requirements can be uncovered during verification of the product(s) where actual performance can be compared against the specified performance and unacceptable degradation can be identified. Processes associated with the Technical Solution process area should be used to perform the maintenance or sustainment design efforts.

1.3 DEVELOP A PROJECT PLAN

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

A project plan is a formal, approved document used to manage and control the execution of the project. It is based on the project requirements and the established estimates.

The project plan should consider all phases of the project life cycle. Project planning should ensure that all plans affecting the project are consistent with the overall project plan.

1. Establish the Budget and Schedule
2. Identify Project Risks
3. Plan for Data Management
4. Plan for Project Resources
5. Plan for Needed Knowledge and Skills
6. Plan Stakeholder Involvement
7. Establish the Project Plan

1.3.1 Obtain Commitment To The Plan

Commitments to the project plan are established and maintained.

To be effective, plans require commitment by those responsible for implementing and supporting the plan.

1. Review Plans that Affect the Project
2. Reconcile Work and Resource Levels
3. Obtain Plan Commitments

1.4 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.

Introductory Notes

A project's documented plan is the basis for monitoring activities, communicating status, and taking corrective action. Progress is primarily determined by comparing actual work product and task attributes, effort, cost, and schedule to the plan at prescribed milestones or control levels within the project schedule or work breakdown structure. 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.

1.4.1 Monitor Project Against Plan

Actual performance and progress of the project are monitored against the project plan.

1. Monitor Project Planning Parameters
2. Monitor Commitments
3. Monitor Project Risks
4. Monitor Data Management
5. Monitor Stakeholder Involvement
6. Conduct Progress Reviews
7. Conduct Milestone Reviews