.4 Cost of Quality (COQ)
Quality costs are the total costs incurred by investment in preventing nonconformance to requirements, appraising the product or service for conformance to requirements, and failing to meet requirements (rework). Failure costs are often categorized into internal and external. Failure costs are also called cost of poor quality.

.5 Additional Quality Planning Tools
Other quality planning tools are also often used to help better define the situation and help plan effective quality management activities. These include brainstorming, affinity diagrams, force field analysis, nominal group techniques, matrix diagrams, flowcharts, and prioritization matrices.

8.1.3 Quality Planning: Outputs

.1 Quality Management Plan
The quality management plan describes how the project management team will implement the performing organization’s quality policy. The quality management plan is a component or a subsidiary plan of the project management plan (Section 4.3).

The quality management plan provides input to the overall project management plan and must address quality control (QC), quality assurance (QA), and continuous process improvement for the project.

The quality management plan may be formal or informal, highly detailed or broadly framed, based on the requirements of the project. The quality management plan should include efforts at the front end of a project to ensure that the earlier decisions, for example on concepts, designs and tests, are correct. These efforts should be performed through an independent peer review and not include individuals that worked on the material being reviewed. The benefits of this review can include reduction of cost and schedule overruns caused by rework.

.2 Quality Metrics
A metric is an operational definition that describes, in very specific terms, what something is and how the quality control process measures it. A measurement is an actual value. For example, it is not enough to say that meeting the planned schedule dates is a measure of management quality. The project management team must also indicate whether every activity must start on time or only finish on time and whether individual activities will be measured, or only certain deliverables and if so, which ones. Quality metrics are used in the QA and QC processes. Some examples of quality metrics include defect density, failure rate, availability, reliability, and test coverage.
.3 Quality Checklists
A checklist is a structured tool, usually component-specific, used to verify that a set of required steps has been performed. Checklists may be simple or complex. They are usually phrased as imperatives (“Do this!”) or interrogatories (“Have you done this?”). Many organizations have standardized checklists available to ensure consistency in frequently performed tasks. In some application areas, checklists are also available from professional associations or commercial service providers. Quality checklists are used in the quality control process.

.4 Process Improvement Plan
The process improvement plan is a subsidiary of the project management plan (Section 4.3). The process improvement plan details the steps for analyzing processes that will facilitate the identification of waste and non-value added activity, thus increasing customer value, such as:

- **Process boundaries.** Describes the purpose, start, and end of processes, their inputs and outputs, data required, if any, and the owner and stakeholders of processes.
- **Process configuration.** A flowchart of processes to facilitate analysis with interfaces identified.
- **Process metrics.** Maintain control over status of processes.
- **Targets for improved performance.** Guides the process improvement activities.

.5 Quality Baseline
The quality baseline records the quality objectives of the project. The quality baseline is the basis for measuring and reporting quality performance as part of the performance measurement baseline.

.6 Project Management Plan (Updates)
The project management plan will be updated through the inclusion of a subsidiary quality management plan and process improvement plan (Section 4.3). Requested changes (additions, modifications, deletions) to the project management plan and its subsidiary plans are processed by review and disposition through the Integrated Change Control process (Section 4.6).

8.2 Perform Quality Assurance
Quality assurance (QA) is the application of planned, systematic quality activities to ensure that the project will employ all processes needed to meet requirements.

A quality assurance department, or similar organization, often oversees quality assurance activities. QA support, regardless of the unit’s title, may be provided to the project team, the management of the performing organization, the customer or sponsor, as well as other stakeholders not actively involved in the work of the project. QA also provides an umbrella for another important quality activity, continuous process improvement. Continuous process improvement provides an iterative means for improving the quality of all processes.
Continuous process improvement reduces waste and non-value-added activities, which allows processes to operate at increased levels of efficiency and effectiveness. Process improvement is distinguished by its identification and review of organizational business processes. It may be applied to other processes within an organization as well, from micro processes, such as the coding of modules within a software program, to macro processes, such as the opening of new markets.

Figure 8-4. Perform Quality Assurance: Inputs, Tools & Techniques, and Outputs

8.2.1 Perform Quality Assurance: Inputs

.1 Quality Management Plan
The quality management plan describes how QA will be performed within the project (Section 8.1.3.1).

.2 Quality Metrics
Described in Section 8.1.3.2.

.3 Process Improvement Plan
Described in Section 8.1.3.4.

.4 Work Performance Information
Work performance information (Section 4.4.3.7), including technical performance measures, project deliverables status, required corrective actions, and performance reports (Section 10.3.3.1) are important inputs to QA and can be used in areas such as audits, quality reviews, and process analyses.

.5 Approved Change Requests
Approved change requests (Section 4.4.1.4) can include modifications to work methods, product requirements, quality requirements, scope, and schedule. Approved changes need to be analyzed for any effects upon the quality management plan, quality metrics, or quality checklists. Approved changes are important inputs to QA and can be used in areas such as audits, quality reviews, and process analyses. All changes should be formally documented in writing and any verbally discussed, but undocumented, changes should not be processed or implemented.
.6 Quality Control Measurements
Quality control measurements (Section 8.3.3.1) are the results of quality control activities that are fed back to the QA process for use in re-evaluating and analyzing the quality standards and processes of the performing organization.

.7 Implemented Change Requests
Described in Section 4.4.3.3.

.8 Implemented Corrective Actions
Described in Section 4.4.3.4.

.9 Implemented Defect Repair
Described in Section 4.4.3.6.

.10 Implemented Preventive Actions
Described in Section 4.4.3.5.

8.2.2 Perform Quality Assurance: Tools and Techniques

.1 Quality Planning Tools and Techniques
The quality planning tools and techniques (Section 8.1.2) also can be used for QA activities.

.2 Quality Audits
A quality audit is a structured, independent review to determine whether project activities comply with organizational and project policies, processes, and procedures. The objective of a quality audit is to identify inefficient and ineffective policies, processes, and procedures in use on the project. The subsequent effort to correct these deficiencies should result in a reduced cost of quality and an increase in the percentage of acceptance of the product or service by the customer or sponsor within the performing organization. Quality audits may be scheduled or at random, and may be carried out by properly trained in-house auditors or by third parties, external to the performing organization.

Quality audits confirm the implementation of approved change requests, corrective actions, defect repairs, and preventive actions.

.3 Process Analysis
Process analysis follows the steps outlined in the process improvement plan to identify needed improvements from an organizational and technical standpoint. This analysis also examines problems experienced, constraints experienced, and non-value-added activities identified during process operation. Process analysis includes root cause analysis, a specific technique to analyze a problem/situation, determine the underlying causes that lead to it, and create preventive actions for similar problems.

.4 Quality Control Tools and Techniques
Described in Section 8.3.2.
8.2.3 **Perform Quality Assurance: Outputs**

1. **Requested Changes**
   
   Quality improvement includes taking action to increase the effectiveness and efficiency of the policies, processes, and procedures of the performing organization, which should provide added benefits to the stakeholders of all projects (Section 4.4.3.2).

2. **Recommended Corrective Actions**
   
   Quality improvement includes recommending actions to increase the effectiveness and efficiency of the performing organization. Corrective action is an action that is recommended immediately as a result of quality assurance activities, such as audits and process analyses.

3. **Organizational Process Assets (Updates)**
   
   Updated quality standards provide validation of the effectiveness and efficiency of the performing organization’s quality standards and processes to meet requirements. These quality standards are used during the Perform Quality Control process (Section 8.3).

4. **Project Management Plan (Updates)**
   
   The project management plan (Section 4.3) will be updated from changes to the quality management plan that result from changes to the Perform Quality Assurance process. These updates can include incorporation of processes that have been through continuous process improvement and are ready to repeat the cycle, and improvements to processes that have been identified and measured, and are ready to be implemented. Requested changes (additions, modifications, deletions) to the project management plan and its subsidiary plans are processed by review and disposition through the Integrated Change Control process (Section 4.6).

8.3 **Perform Quality Control**

Performing quality control (QC) involves monitoring specific project results to determine whether they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory results. It should be performed throughout the project. Quality standards include project processes and product goals. Project results include deliverables and project management results, such as cost and schedule performance. QC is often performed by a quality control department or similarly titled organizational unit. QC can include taking action to eliminate causes of unsatisfactory project performance.

The project management team should have a working knowledge of statistical quality control, especially sampling and probability, to help evaluate QC outputs. Among other subjects, the team may find it useful to know the differences between the following pairs of terms:
- Prevention (keeping errors out of the process) and inspection (keeping errors out of the hands of the customer).
- Attribute sampling (the result conforms, or it does not) and variables sampling (the result is rated on a continuous scale that measures the degree of conformity).
- Special causes (unusual events) and common causes (normal process variation). Common causes are also called random causes.
- Tolerances (the result is acceptable if it falls within the range specified by the tolerance) and control limits (the process is in control if the result falls within the control limits).

Figure 8-5. Perform Quality Control: Inputs, Tools & Techniques, and Outputs

### 8.3.1 Perform Quality Control: Inputs

1. **Quality Management Plan**
   Described in Section 8.1.3.1.

2. **Quality Metrics**
   Described in Section 8.1.3.2.

3. **Quality Checklists**
   Described in Section 8.1.3.3.

4. **Organizational Process Assets**
   Described in Section 4.1.1.4.

5. **Work Performance Information**
   Work performance information (Section 4.4.3.7), including technical performance measures, project deliverables completion status, and the implementation of required corrective actions, are important inputs to QC. Information from the project management plan about the planned or expected results should be available along with information about the actual results and implemented change requests.
.6 Approved Change Requests
Approved change requests (Section 4.4.1.4) can include modifications such as revised work methods and revised schedule. The timely correct implementation of approved changes needs to be verified.

.7 Deliverables
Described in Section 4.4.3.1.

8.3.2 Perform Quality Control: Tools and Techniques
The first seven of these are known as the Seven Basic Tools of Quality.

.1 Cause and Effect Diagram
Cause and effect diagrams, also called Ishikawa diagrams or fishbone diagrams, illustrate how various factors might be linked to potential problems or effects. Figure 8-6 is an example of a cause and effect diagram.

![Figure 8-6. Cause and Effect Diagram](image)

.2 Control Charts
A control chart's purpose is to determine whether or not a process is stable or has predictable performance. Control charts may serve as a data gathering tool to show when a process is subject to special cause variation, which creates an out-of-control condition. Control charts also illustrate how a process behaves over time. They are a graphic display of the interaction of process variables on a process to answer the question: Are the process variables within acceptable limits? Examination of the non-random pattern of data points on a control chart may reveal wildly fluctuating values, sudden process jumps or shifts, or a gradual trend in increased variation. By monitoring the output of a process over time, a control chart can be employed to assess whether the application of process changes resulted in the desired improvements. When a process is within acceptable limits, the process need not be adjusted. When a process is outside acceptable limits, the process should be adjusted. The upper control limit and lower control limit are usually set at +/- 3 sigma (i.e., standard deviation).
Control charts can be used for both project and product life cycle processes. An example of project use of control charts is determining whether cost variances or schedule variances are outside of acceptable limits (for example, +/- 10 percent). An example of product use of control charts is evaluating whether the number of defects found during testing are acceptable or unacceptable in relation to the organization’s standards for quality.

Control charts can be used to monitor any type of output variable. Although used most frequently to track repetitive activities, such as manufactured lots, control charts also can be used to monitor cost and schedule variances, volume and frequency of scope changes, errors in project documents, or other management results to help determine if the project management process is in control. Figure 8-7 is an example of a control chart of project schedule performance.

```
Upper Control Limit

\[\overline{x}\]

Lower Control Limit

The x axis of all control charts consists of sample numbers (usually the time of the sample).

Control charts have three common lines:
1. A center line, designated with an $\overline{x}$ which provides the average (x) of the process data.
2. An upper line designating the upper control limit (UCL), drawn at a calculated distance above the center line, showing the upper range of acceptable dates.
3. The lower line designating the lower control limit (LCL), which shows the lower range of an acceptable date. Points outside of the UCL and LCL are indicative that the process is out of control and/or unstable.
```

**Figure 8-7. Example of a Control Chart of Project Schedule Performance**

.3 Flowcharting

Flowcharting helps to analyze how problems occur. A flowchart is a graphical representation of a process. There are many styles, but all process flowcharts show activities, decision points, and the order of processing. Flowcharts show how various elements of a system interrelate. Figure 8-8 is an example of a process flowchart for design reviews. Flowcharting can help the project team anticipate what and where quality problems might occur and, thus, can help develop approaches for dealing with them.
Figure 8-8. Sample Process Flowchart

4 Histogram

A histogram is a bar chart showing a distribution of variables. Each column represents an attribute or characteristic of a problem/situation. The height of each column represents the relative frequency of the characteristic. This tool helps identify the cause of problems in a process by the shape and width of the distribution.
A Pareto chart is a specific type of histogram, ordered by frequency of occurrence, which shows how many defects were generated by type or category of identified cause (Figure 8-9). The Pareto technique is used primarily to identify and evaluate nonconformities.

In Pareto diagrams, rank ordering is used to guide corrective action. The project team should take action to fix the problems that are causing the greatest number of defects first. Pareto diagrams are conceptually related to Pareto’s Law, which holds that a relatively small number of causes will typically produce a large majority of the problems or defects. This is commonly referred to as the 80/20 principle, where 80 percent of the problems are due to 20 percent of the causes. Pareto diagrams also can be used to summarize all types of data for 80/20 analyses.
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.6 Run Chart
A run chart shows the history and pattern of variation. A run chart is a line graph that shows data points plotted in the order in which they occur. Run charts show trends in a process over time, variation over time, or declines or improvements in a process over time. Trend analysis is performed using run charts. Trend analysis involves using mathematical techniques to forecast future outcomes based on historical results. Trend analysis is often used to monitor:

- **Technical performance.** How many errors or defects have been identified, how many remain uncorrected?
- **Cost and schedule performance.** How many activities per period were completed with significant variances?

.7 Scatter Diagram
A scatter diagram shows the pattern of relationship between two variables. This tool allows the quality team to study and identify the possible relationship between changes observed in two variables. Dependent variables versus independent variables are plotted. The closer the points are to a diagonal line, the more closely they are related.

.8 Statistical Sampling
Statistical sampling involves choosing part of a population of interest for inspection (for example, selecting ten engineering drawings at random from a list of seventy-five). Appropriate sampling can often reduce the cost of quality control. There is a substantial body of knowledge on statistical sampling; in some application areas, it may be necessary for the project management team to be familiar with a variety of sampling techniques.

.9 Inspection
An inspection is the examination of a work product to determine whether it conforms to standards. Generally, the results of an inspection include measurements. Inspections can be conducted at any level. For example, the results of a single activity can be inspected, or the final product of the project can be inspected. Inspections are also called reviews, peer reviews, audits, and walkthroughs. In some application areas, these terms have narrow and specific meanings. Inspections are also used to validate defect repairs.

.10 Defect Repair Review
Defect repair review is an action taken by the quality control department or similarly titled organization to ensure that product defects are repaired and brought into compliance with requirements or specifications.
8.3.3 Perform Quality Control: Outputs

.1 Quality Control Measurements
Quality control measurements represent the results of QC activities that are fed back to QA (Section 8.2) to reevaluate and analyze the quality standards and processes of the performing organization.

.2 Validated Defect Repair
The repaired items are reinspected and will be either accepted or rejected before notification of the decision is provided (Section 4.4). Rejected items may require further defect repair.

.3 Quality Baseline (Updates)
Described in Section 8.1.3.5.

.4 Recommended Corrective Actions
Corrective action (Section 4.5.3.1) involves actions taken as a result of a QC measurement that indicates that the manufacturing or development process exceeds established parameters.

.5 Recommended Preventive Actions
Preventive action (Section 4.5.3.2) involves action taken to forestall a condition that may exceed established parameters in a manufacturing or development process, which may have been indicated through a QC measurement.

.6 Requested Changes
If the recommended corrective or preventive actions require a change to the project, a change request (Section 4.4.3.2) should be initiated in accordance with the defined Integrated Change Control process.

.7 Recommended Defect Repair
A defect is where a component does not meet its requirements or specifications, and needs to be repaired or replaced. Defects are identified and recommended for repair by the QC department or similarly titled organization. The project team should make every reasonable effort to minimize the errors that cause the need for defect repair. A defect log can be used to collect the set of recommended repairs. This is often implemented in an automated problem-tracking system.

.8 Organization Process Assets (Updates)
- Completed checklists. When checklists are used, the completed checklists should become part of the project’s records (Section 4.1.1.4).
- Lessons learned documentation. The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learned from quality control should be documented so that they become part of the historical database for both this project and the performing organization. Lessons learned are documented throughout the project life cycle, but, at a minimum, during project closure (Section 4.1.1.4).
Validated Deliverables
A goal of quality control is to determine the correctness of deliverables. The results of the execution quality control processes are validated deliverables.

Project Management Plan (Updates)
The project management plan is updated to reflect changes to the quality management plan that result from changes in performing the QC process. Requested changes (additions, modifications, or deletions) to the project management plan and its subsidiary plans are processed by review and disposition through the Integrated Change Control process (Section 4.6).
CHAPTER 9

Project Human Resource Management

Project Human Resource Management includes the processes that organize and manage the project team. The project team is comprised of the people who have assigned roles and responsibilities for completing the project. While it is common to speak of roles and responsibilities being assigned, team members should be involved in much of the project’s planning and decision-making. Early involvement of team members adds expertise during the planning process and strengthens commitment to the project. The type and number of project team members can often change as the project progresses. Project team members can be referred to as the project’s staff.

The project management team is a subset of the project team and is responsible for project management activities such as planning, controlling, and closing. This group can be called the core, executive, or leadership team. For smaller projects, the project management responsibilities can be shared by the entire team or administered solely by the project manager. The project sponsor works with the project management team, typically assisting with matters such as project funding, clarifying scope questions, and influencing others in order to benefit the project.

Figure 9-1 provides an overview of the Project Human Resource Management processes, and Figure 9-2 provides a process flow diagram of those processes and their inputs, outputs, and other related Knowledge Area processes. The Project Human Resource Management processes include the following:

9.1 **Human Resource Planning** – Identifying and documenting project roles, responsibilities, and reporting relationships, as well as creating the staffing management plan.

9.2 **Acquire Project Team** – Obtaining the human resources needed to complete the project.

9.3 **Develop Project Team** – Improving the competencies and interaction of team members to enhance project performance.

9.4 **Manage Project Team** – Tracking team member performance, providing feedback, resolving issues, and coordinating changes to enhance project performance.
These processes interact with each other and with processes in the other Knowledge Areas as well. Each process can involve effort from one or more persons or groups of persons based on the needs of the project. Each process occurs at least once in every project, and occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.

Figure 9-2 illustrates the primary ways that Project Human Resource Management interacts with other project processes. Examples of interactions that require additional planning include the following situations:

- After initial team members create a work breakdown structure, additional team members may need to be acquired
- As additional project team members are acquired, their experience level could increase or decrease project risk, creating the need for additional risk planning
- When activity durations are estimated before all project team members are known, actual competency levels of the acquired team members can cause the activity durations and schedule to change.
Figure 9-1. Project Human Resource Management Overview
9.1 Human Resource Planning

Human Resource Planning determines project roles, responsibilities, and reporting relationships, and creates the staffing management plan. Project roles can be designated for persons or groups. Those persons or groups can be from inside or outside the organization performing the project. The staffing management plan can include how and when project team members will be acquired, the criteria for releasing them from the project, identification of training needs, plans for recognition and rewards, compliance considerations, safety issues, and the impact of the staffing management plan on the organization.

Note: Not all process interactions and data flow among the processes are shown.

Figure 9-2. Project Human Resource Management Process Flow Diagram
9.1.1 Human Resource Planning: Inputs

.1 Enterprise Environmental Factors

The definition of project roles and responsibilities is developed with an understanding of the ways that existing organizations will be involved and how the technical disciplines and people currently interact with one another. Some of the relevant enterprise environmental factors (Section 4.1.1.3) involving organizational culture and structure are:

- **Organizational.** Which organizations or departments will be involved in the project? What are the current working arrangements among them? What formal and informal relationships exist among them?

- **Technical.** What are the different disciplines and specialties that will be needed to complete this project? Are there different types of software languages, engineering approaches, or kinds of equipment that will need to be coordinated? Do the transitions from one life cycle phase to the next present any unique challenges?

- **Interpersonal.** What types of formal and informal reporting relationships exist among people who are candidates for the project team? What are the candidates’ job descriptions? What are their supervisor-subordinate relationships? What are their supplier-customer relationships? What cultural or language differences will affect working relationships among team members? What levels of trust and respect currently exist?

- **Logistical.** How much distance separates the people and units that will be part of the project? Are people in different buildings, time zones, or countries?

- **Political.** What are the individual goals and agendas of the potential project stakeholders? Which groups and people have informal power in areas important to the project? What informal alliances exist?
In addition to the factors listed above, constraints limit the project team’s options. Examples of constraints that can limit flexibility in the Human Resource Planning process are:

- **Organizational structure.** An organization whose basic structure is a weak matrix means a relatively weaker role for the project manager (Section 2.3.3).
- **Collective bargaining agreements.** Contractual agreements with unions or other employee groups can require certain roles or reporting relationships.
- **Economic conditions.** Hiring freezes, reduced training funds, or a lack of travel budget are examples of economic conditions that can restrict staffing options.

.2 **Organizational Process Assets**

As project management methodology matures within an organization, lessons learned from past Human Resource Planning experiences are available as organizational process assets (Section 4.1.1.4) to help plan the current project. Templates and checklists reduce the amount of planning time needed at the beginning of a project and reduce the likelihood of missing important responsibilities.

- **Templates.** Templates that can be helpful in Human Resource Planning include project organization charts, position descriptions, project performance appraisals, and a standard conflict management approach.
- **Checklists.** Checklists that can be helpful in Human Resource Planning include common project roles and responsibilities, typical competencies, training programs to consider, team ground rules, safety considerations, compliance issues, and reward ideas.

.3 **Project Management Plan**

The project management plan (Section 4.3) includes the activity resource requirements, plus descriptions of project management activities, such as quality assurance, risk management, and procurement, that will help the project management team identify all of the required roles and responsibilities.

- **Activity Resource Requirements.** Human Resource Planning uses activity resource requirements (Section 6.3.3.1) to determine the human resource needs for the project. The preliminary requirements regarding the required people and competencies for the project team members are refined as part of the Human Resource Planning process.
9.1.2 Human Resource Planning: Tools and Techniques

.1 Organization Charts and Position Descriptions

Various formats exist to document team member roles and responsibilities. Most of the formats fall into one of three types (Figure 9-4): hierarchical, matrix, and text-oriented. Additionally, some project assignments are listed in subsidiary project plans, such as the risk, quality, or communication plans. Whichever combination of methods is used, the objective is to ensure that each work package has an unambiguous owner and that all team members have a clear understanding of their roles and responsibilities.

**Figure 9-4. Roles and Responsibility Definition Formats**

- **Hierarchical-type charts.** The traditional organization chart structure can be used to show positions and relationships in a graphic, top-down format. Work breakdown structures (WBS) that are primarily designed to show how project deliverables are broken down into work packages become one way to show high-level areas of responsibility. The organizational breakdown structure (OBS) looks similar to the WBS, but instead of being arranged according to a breakdown of project deliverables, it is arranged according to an organization’s existing departments, units, or teams. The project activities or work packages are listed under each existing department. This way, an operational department such as information technology or purchasing can see all of its project responsibilities by looking at its portion of the OBS. The resource breakdown structure (RBS) is another hierarchical chart. It is used to break down the project by types of resources. For example, an RBS can depict all of the welders and welding equipment being used in different areas of a ship even though they can be scattered among different branches of the OBS and WBS. The RBS is helpful in tracking project costs, and can be aligned with the organization’s accounting system. The RBS can contain resource categories other than human resources.
• **Matrix-based charts.** A responsibility assignment matrix (RAM) is used to illustrate the connections between work that needs to be done and project team members. On larger projects, RAMs can be developed at various levels. For example, a high-level RAM can define what project team group or unit is responsible for each component of the WBS, while lower-level RAMs are used within the group to designate roles, responsibilities, and levels of authority for specific activities. The matrix format, sometimes called a table, allows a person to see all activities associated with one person or to see all people associated with one activity. The matrix shown in Figure 9-5 is a type of RAM called a RACI chart because the names of roles being documented are Responsible, Accountable, Consult, and Inform. The sample chart shows the work to be done in the left column as activities, but RAMs can show responsibilities at various levels of detail. The people can be shown as persons or groups.

![Figure 9-5. Responsibility Assignment Matrix (RAM) Using a RACI Format](image)

<table>
<thead>
<tr>
<th>RACI Chart</th>
<th>Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Ann</td>
</tr>
<tr>
<td>Define</td>
<td>A</td>
</tr>
<tr>
<td>Design</td>
<td>I</td>
</tr>
<tr>
<td>Develop</td>
<td>I</td>
</tr>
<tr>
<td>Test</td>
<td>A</td>
</tr>
</tbody>
</table>

R = Responsible  A = Accountable  C = Consult  I = Inform

• **Text-oriented formats.** Team member responsibilities that require detailed descriptions can be specified in text-oriented formats. Usually in outline form, the documents provide information such as responsibilities, authority, competencies, and qualifications. The documents are known by various names, including position descriptions and role-responsibility-authority forms. These descriptions and forms make excellent templates for future projects, especially when the information is updated throughout the current project by applying lessons learned.

• **Other sections of the project management plan.** Some responsibilities related to managing the project are listed and explained in other sections of the project management plan. For example, the risk register lists risk owners, the communication plan lists team members responsible for communication activities, and the quality plan designates people responsible for carrying out quality assurance and quality control activities.
.2 Networking
Informal interaction with others in an organization or industry is a constructive way to understand political and interpersonal factors that will impact the effectiveness of various staffing management options. Human resources networking activities include proactive correspondence, luncheon meetings, informal conversations, and trade conferences. While concentrated networking can be a useful technique at the beginning of a project, carrying out networking activities on a regular basis before a project begins is also effective.

.3 Organizational Theory
Organizational theory provides information regarding the ways that people, teams, and organizational units behave. Applying proven principles shortens the amount of time needed to create the Human Resource Planning outputs and improves the likelihood that the planning will be effective.

9.1.3 Human Resource Planning: Outputs

.1 Roles and Responsibilities
The following items should be addressed when listing the roles and responsibilities needed to complete the project:

- **Role.** The label describing the portion of a project for which a person is accountable. Examples of project roles are civil engineer, court liaison, business analyst, and testing coordinator. Role clarity concerning authority, responsibilities, and boundaries is essential for project success.

- **Authority.** The right to apply project resources, make decisions, and sign approvals. Examples of decisions that need clear authority include the selection of a method for completing an activity, quality acceptance, and how to respond to project variances. Team members operate best when their individual levels of authority matches their individual responsibilities.

- **Responsibility.** The work that a project team member is expected to perform in order to complete the project’s activities.

- **Competency.** The skill and capacity required to complete project activities. If project team members do not possess required competencies, performance can be jeopardized. When such mismatches are identified, proactive responses such as training, hiring, schedule changes, or scope changes are initiated.

.2 Project Organization Charts
A project organization chart is a graphic display of project team members and their reporting relationships. It can be formal or informal, highly detailed or broadly framed, based on the needs of the project. For example, the project organization chart for a 3,000-person disaster response team will have greater detail than a project organization chart for an internal, twenty-person project.
.3 **Staffing Management Plan**

The staffing management plan, a subset of the project management plan (Section 4.3), describes when and how human resource requirements will be met. The staffing management plan can be formal or informal, highly detailed or broadly framed, based on the needs of the project. The plan is updated continually during the project to direct ongoing team member acquisition and development actions. Information in the staffing management plan varies by application area and project size, but items to consider include:

- **Staff acquisition.** A number of questions arise when planning the acquisition of project team members. For example, will the human resources come from within the organization or from external, contracted sources? Will team members need to work in a central location or can they work from distant locations? What are the costs associated with each level of expertise needed for the project? How much assistance can the organization’s human resource department provide to the project management team?

- **Timetable.** The staffing management plan describes necessary time frames for project team members, either individually or collectively, as well as when acquisition activities such as recruiting should start. One tool for charting human resources is a resource histogram (Section 6.5.3.2). This bar chart illustrates the number of hours that a person, department, or entire project team will be needed each week or month over the course of the project. The chart can include a horizontal line that represents the maximum number of hours available from a particular resource. Bars that extend beyond the maximum available hours identify the need for a resource leveling strategy, such as adding more resources or extending the length of the schedule. A sample resource histogram is illustrated in Figure 9-6.

![Figure 9-6. Illustrative Resource Histogram](image-url)
- **Release criteria.** Determining the method and timing of releasing team members benefits both the project and team members. When team members are released from a project at the optimum time, payments made for people who are finished with their responsibilities can be eliminated and the costs reduced. Morale is improved when smooth transitions to upcoming projects are already planned.

- **Training needs.** If the team members to be assigned are not expected to have the required competencies, a training plan can be developed as part of the project. The plan can also include ways to help team members obtain certifications that would benefit the project.

- **Recognition and rewards.** Clear criteria for rewards and a planned system for their use will promote and reinforce desired behaviors. To be effective, recognition and rewards should be based on activities and performance under a person’s control. For example, a team member who is to be rewarded for meeting cost objectives should have an appropriate level of control over decisions that affect expenses. Creating a plan with established times for rewards ensures that recognition takes place and is not forgotten. Recognition and rewards are awarded as part of the Develop Project Team process (Section 9.3).

- **Compliance.** The staffing management plan can include strategies for complying with applicable government regulations, union contracts, and other established human resource policies.

- **Safety.** Policies and procedures that protect team members from safety hazards can be included in the staffing management plan as well as the risk register.

### 9.2 Acquire Project Team

Acquire Project Team is the process of obtaining the human resources needed to complete the project. The project management team may or may not have control over team members selected for the project.

![Figure 9-7. Acquire Project Team: Inputs, Tools & Techniques, and Outputs](image-url)
9.2.1 Acquire Project Team: Inputs

.1 Enterprise Environmental Factors
Project team members are drawn from all available sources, both internal and external. When the project management team is able to influence or direct staff assignments, characteristics to consider include:

- **Availability.** Who is available and when are they available?
- **Ability.** What competencies do people possess?
- **Experience.** Have the people done similar or related work? Have they done it well?
- **Interests.** Are the people interested in working on this project?
- **Cost.** How much will each team member be paid, particularly if they are contracted from outside the organization?

.2 Organizational Process Assets
One or more of the organizations involved in the project may have policies, guidelines, or procedures governing staff assignments (Section 4.1.1.4). The human resource departments also can assist with recruitment, hiring, and orientation of project team members.

.3 Roles and Responsibilities
Roles and responsibilities define the positions, skills, and competencies that the project demands (Section 9.1.3.1).

.4 Project Organization Charts
Project organization charts provide an overview regarding the number of people needed for the project (Section 9.1.3.2).

.5 Staffing Management Plan
The staffing management plan, along with the project schedule, identifies the time periods each project team member will be needed and other information important to acquiring the project team (Section 9.1.3.3).

9.2.2 Acquire Project Team: Tools and Techniques

.1 Pre-Assignment
In some cases, project team members are known in advance; that is, they are pre-assigned. This situation can occur if the project is the result of specific people being promised as part of a competitive proposal, if the project is dependent on the expertise of particular persons, or if some staff assignments are defined within the project charter.
.2 Negotiation

Staff assignments are negotiated on many projects. For example, the project management team may need to negotiate with:

- Functional managers to ensure that the project receives appropriately competent staff in the required time frame, and that project team members will be able to work on the project until their responsibilities are completed.
- Other project management teams within the performing organization to appropriately assign scarce or specialized resources.

The project management team’s ability to influence others plays an important role in negotiating staff assignments, as do the politics of the organizations involved (Section 2.3.3). For example, a functional manager will weigh the benefits and visibility of competing projects when determining where to assign exceptional performers that all project teams desire.

.3 Acquisition

When the performing organization lacks the in-house staff needed to complete the project, the required services can be acquired from outside sources (Section 12.4.3.1). This can involve hiring individual consultants or subcontracting work to another organization.

.4 Virtual Teams

The use of virtual teams creates new possibilities when acquiring project team members. Virtual teams can be defined as groups of people with a shared goal, who fulfill their roles with little or no time spent meeting face to face. The availability of electronic communication, such as e-mail and video conferencing, has made such teams feasible. The virtual team format makes it possible to:

- Form teams of people from the same company who live in widespread geographic areas.
- Add special expertise to a project team, even though the expert is not in the same geographic area.
- Incorporate employees who work from home offices.
- Form teams of people who work different shifts or hours.
- Include people with mobility handicaps.
- Move forward with projects that would have been ignored due to travel expenses.

Communications Planning (Section 10.1) becomes increasingly important in a virtual team environment. Additional time may be needed to set clear expectations, develop protocols for confronting conflict, include people in decision-making, and share credit in successes.
9.2.3 Acquire Project Team: Outputs

.1 Project Staff Assignments
The project is staffed when appropriate people have been assigned to work on it. Documentation can include a project team directory, memos to team members, and names inserted into other parts of the project management plan, such as project organization charts and schedules.

.2 Resource Availability
Resource availability documents the time periods each project team member can work on the project. Creating a reliable final schedule (Section 6.5.3.1) depends on having a good understanding of each person’s schedule conflicts, including vacation time and commitments to other projects.

.3 Staffing Management Plan (Updates)
As specific people fill the project roles and responsibilities, changes in the staffing management plan (Section 9.1.3.3) may be needed because people seldom fit the exact staffing requirements that are planned. Other reasons for changing the staffing management plan include promotions, retirements, illnesses, performance issues, and changing workloads.

9.3 Develop Project Team
Develop Project Team improves the competencies and interaction of team members to enhance project performance. Objectives include:

- Improve skills of team members in order to increase their ability to complete project activities
- Improve feelings of trust and cohesiveness among team members in order to raise productivity through greater teamwork.

Examples of effective teamwork include assisting one another when workloads are unbalanced, communicating in ways that fit individual preferences, and sharing information and resources. Team development efforts have greater benefit when conducted early, but should take place throughout the project life cycle.

Figure 9-8. Develop Project Team: Inputs, Tools & Techniques, and Outputs
9.3.1 Develop Project Team: Inputs

.1 Project Staff Assignments
Team development starts with a list of the project team members. Project staff assignment documents (Section 9.2.3.1) identify the people who are on the team.

.2 Staffing Management Plan
The staffing management plan (Section 9.1.3.3) identifies training strategies and plans for developing the project team. As the project progresses, items such as rewards, feedback, additional training, and disciplinary actions are added to the plan as a result of ongoing team performance assessments (Section 9.3.3.1) and other forms of project team management (Section 9.4.2).

.3 Resource Availability
Resource availability information (Section 9.2.3.2) identifies times that project team members can participate in team development activities.

9.3.2 Develop Project Team: Tools and Techniques

.1 General Management Skills
Interpersonal skills (Section 1.5.5), sometimes known as “soft skills,” are particularly important to team development. By understanding the sentiments of project team members, anticipating their actions, acknowledging their concerns, and following up on their issues, the project management team can greatly reduce problems and increase cooperation. Skills such as empathy, influence, creativity, and group facilitation are valuable assets when managing the project team.

.2 Training
Training includes all activities designed to enhance the competencies of the project team members. Training can be formal or informal. Examples of training methods include classroom, online, computer-based, on-the-job training from another project team member, mentoring, and coaching.

If project team members lack necessary management or technical skills, such skills can be developed as part of the project work. Scheduled training takes place as stated in the staffing management plan. Unplanned training takes place as a result of observation, conversation, and project performance appraisals conducted during the controlling process of managing the project team.
.3 Team-Building Activities
Team-building activities can vary from a five-minute agenda item in a status review meeting to an off-site, professionally facilitated experience designed to improve interpersonal relationships. Some group activities, such as developing the WBS, may not be explicitly designed as team-building activities, but can increase team cohesiveness when that planning activity is structured and facilitated well. It also is important to encourage informal communication and activities because of their role in building trust and establishing good working relationships. Team-building strategies are particularly valuable when team members operate virtually from remote locations, without the benefit of face-to-face contact.

.4 Ground Rules
Ground rules establish clear expectations regarding acceptable behavior by project team members. Early commitment to clear guidelines decreases misunderstandings and increases productivity. The process of discussing ground rules allows team members to discover values that are important to one another. All project team members share responsibility for enforcing the rules once they are established.

.5 Co-Location
Co-location involves placing many or all of the most active project team members in the same physical location to enhance their ability to perform as a team. Co-location can be temporary, such as at strategically important times during the project, or for the entire project. Co-location strategy can include a meeting room, sometimes called a war room, with electronic communication devices, places to post schedules, and other conveniences that enhance communication and a sense of community. While co-location is considered good strategy, the use of virtual teams will reduce the frequency that team members are located together.

.6 Recognition and Rewards
Part of the team development process involves recognizing and rewarding desirable behavior. The original plans concerning ways to reward people are developed during Human Resource Planning (Section 9.1). Award decisions are made, formally or informally, during the process of managing the project team through performance appraisals (Section 9.4.2.2).

Only desirable behavior should be rewarded. For example, the willingness to work overtime to meet an aggressive schedule objective should be rewarded or recognized; needing to work overtime as the result of poor planning should not be rewarded. Win-lose (zero sum) rewards that only a limited number of project team members can achieve, such as team member of the month, can hurt team cohesiveness. Rewarding win-win behavior that everyone can achieve, such as turning in progress reports on time, tends to increase support among team members.

Recognition and rewards should consider cultural differences. For example, developing appropriate team rewards in a culture that encourages individualism can be difficult.
9.3.3 Develop Project Team: Outputs

.1 Team Performance Assessment
As development efforts such as training, team building, and co-location are implemented, the project management team makes informal or formal assessments of the project team’s effectiveness. Effective team development strategies and activities are expected to increase the team’s performance, which increases the likelihood of meeting project objectives. The evaluation of a team’s effectiveness can include indicators such as:
- Improvements in skills that allow a person to perform assigned activities more effectively
- Improvements in competencies and sentiments that help the team perform better as a group
- Reduced staff turnover rate.

9.4 Manage Project Team
Manage Project Team involves tracking team member performance, providing feedback, resolving issues, and coordinating changes to enhance project performance. The project management team observes team behavior, manages conflict, resolves issues, and appraises team member performance. As a result of managing the project team, the staffing management plan is updated, change requests are submitted, issues are resolved, input is given to organizational performance appraisals, and lessons learned are added to the organization’s database.

Management of the project team is complicated when team members are accountable to both a functional manager and the project manager within a matrix organization (Section 2.3.3). Effective management of this dual reporting relationship is often a critical success factor for the project, and is generally the responsibility of the project manager.

Figure 9-9. Manage Project Team: Inputs, Tools & Techniques, and Outputs
Chapter 9 – Project Human Resource Management

9.4.1 Manage Project Team: Inputs

.1 Organizational Process Assets
The project management team should utilize an organization’s policies, procedures, and systems for rewarding employees during the course of a project (Section 4.1.1.4). Organizational recognition dinners, certificates of appreciation, newsletters, bulletin boards, Web sites, bonus structures, corporate apparel, and other organizational perquisites should be available to the project management team as part of the project management process.

.2 Project Staff Assignments
Project staff assignments (Section 9.2.3.1) provide a list of the project team members to be evaluated during this monitoring and controlling process.

.3 Roles and Responsibilities
A list of the staff’s roles and responsibilities is used to monitor and evaluate performance (Section 9.1.3.1).

.4 Project Organization Charts
Project organization charts provide a picture of the reporting relationships among project team members (Section 9.1.3.2).

.5 Staffing Management Plan
The staffing management plan lists the time periods that team members are expected to work on the project, along with information such as training plans, certification requirements, and compliance issues (Section 9.1.3.3).

.6 Team Performance Assessment
The project management team makes ongoing formal or informal assessments of the project team’s performance (Section 9.3.3.1). By continually assessing the project team’s performance, actions can be taken to resolve issues, modify communication, address conflict, and improve team interaction.

.7 Work Performance Information
As part of the Direct and Manage Project Execution process (Section 4.4), the project management team directly observes team member performance as it occurs. Observations related to areas such as a team member’s meeting participation, follow-up on action items, and communication clarity are considered when managing the project team.

.8 Performance Reports
Performance reports (Section 10.3.3.1) provide documentation about performance against the project management plan. Examples of performance areas that can help with project team management include results from schedule control, cost control, quality control, scope verification, and procurement audits. The information from performance reports and related forecasts assists in determining future human resource requirements, recognition and rewards, and updates to the staffing management plan.
9.4.2 **Manage Project Team: Tools and Techniques**

.1 **Observation and Conversation**
Observation and conversation are used to stay in touch with the work and attitudes of project team members. The project management team monitors indicators such as progress toward project deliverables, accomplishments that are a source of pride for team members, and interpersonal issues.

.2 **Project Performance Appraisals**
The need for formal or informal project performance appraisals depends on the length of the project, complexity of the project, organizational policy, labor contract requirements, and the amount and quality of regular communication. Project team members receive feedback from the people who supervise their project work. Evaluation information also can be gathered from people who interact with project team members by using 360-degree feedback principles. The term “360-degree” means that feedback regarding performance is provided to the person being evaluated from many sources, including superiors, peers, and subordinates.

Objectives for conducting performance appraisals during the course of a project can include reclarification of roles and responsibilities, structured time to ensure team members receive positive feedback in what might otherwise be a hectic environment, discovery of unknown or unresolved issues, development of individual training plans, and the establishment of specific goals for future time periods.

.3 **Conflict Management**
Successful conflict management results in greater productivity and positive working relationships. Sources of conflict include scarce resources, scheduling priorities, and personal work styles. Team ground rules, group norms, and solid project management practices, like communication planning and role definition, reduce the amount of conflict. When managed properly, differences of opinion are healthy, and can lead to increased creativity and better decision-making. When the differences become a negative factor, project team members are initially responsible for resolving their own conflicts. If conflict escalates, the project manager should help facilitate a satisfactory resolution. Conflict should be addressed early and usually in private, using a direct, collaborative approach. If disruptive conflict continues, increasingly formal procedures will need to be used, including the possible use of disciplinary actions.
.4 Issue Log
As issues arise in the course of managing the project team, a written log can document persons responsible for resolving specific issues by a target date. The log helps the project team monitor issues until closure. Issue resolution addresses obstacles that can block the team from achieving its goals. These obstacles can include factors such as differences of opinion, situations to be investigated, and emerging or unanticipated responsibilities that need to be assigned to someone on the project team.

9.4.3 Manage Project Team: Outputs

.1 Requested Changes
Staffing changes, whether by choice or by uncontrollable events, can affect the rest of the project plan. When staffing issues are going to disrupt the project plan, such as causing the schedule to be extended or the budget to be exceeded, a change request can be processed through the Integrated Change Control process (Section 4.6).

.2 Recommended Corrective Actions
Corrective action for human resource management includes items such as staffing changes, additional training, and disciplinary actions. Staffing changes can include moving people to different assignments, outsourcing some work, and replacing team members who leave. The project management team also determines how and when to give out recognition and rewards based on the team’s performance.

.3 Recommended Preventive Actions
When the project management team identifies potential or emerging human resource issues, preventive action can be developed to reduce the probability and/or impact of problems before they occur. Preventive actions can include cross-training in order to reduce problems during project team member absences, additional role clarification to ensure all responsibilities are fulfilled, and added personal time in anticipation of extra work that may be needed in the near future to meet project deadlines.

.4 Organizational Process Assets (Updates)
  • Input to organizational performance appraisals. Project staff generally should be prepared to provide input for regular organizational performance appraisals of any project team member with whom they interact in a significant way.
• **Lessons learned documentation.** All knowledge learned during the project should be documented so it becomes part of the historical database of the organization. Lessons learned in the area of human resources can include:
  ♦ Project organization charts, position descriptions, and staffing management plans that can be saved as templates
  ♦ Ground rules, conflict management techniques, and recognition events that were particularly useful
  ♦ Procedures for virtual teams, co-location, negotiation, training, and team building that proved to be successful
  ♦ Special skills or competencies by team members that were discovered during the project
  ♦ Issues and solutions documented in the project issue log.

.5 **Project Management Plan (Updates)**
Approved change requests and corrective actions can result in updates to the staffing management plan, a part of the project management plan. Examples of plan update information include new project team member roles, additional training, and reward decisions.
CHAPTER 10

Project Communications Management

Project Communications Management is the Knowledge Area that employs the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information. The Project Communications Management processes provide the critical links among people and information that are necessary for successful communications. Project managers can spend an inordinate amount of time communicating with the project team, stakeholders, customer, and sponsor. Everyone involved in the project should understand how communications affect the project as a whole. Figure 10-1 provides an overview of the Project Communications Management processes, and Figure 10-2 provides a process flow diagram of those processes and their inputs, outputs, and other related Knowledge Area processes. The Project Communications Management processes include the following:

10.1 Communications Planning – determining the information and communications needs of the project stakeholders.

10.2 Information Distribution – making needed information available to project stakeholders in a timely manner.

10.3 Performance Reporting – collecting and distributing performance information. This includes status reporting, progress measurement, and forecasting.

10.4 Manage Stakeholders – managing communications to satisfy the requirements of and resolve issues with project stakeholders.

These processes interact with each other and with the processes in the other Knowledge Areas as well. Each process can involve effort from one or more persons or groups of persons based on the needs of the project. Each process occurs at least once in every project and occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.
Chapter 10 – Project Communications Management

Figure 10-1. Project Communications Management Overview
Communications skills are related to, but are not the same as, project management communications. The art of communications is a broad subject and involves a substantial body of knowledge including:

- **Sender-receiver models.** Feedback loops and barriers to communication.
- **Choice of media.** When to communicate in writing versus orally, when to write an informal memo versus a formal report, and when to communicate face-to-face versus by e-mail. The media chosen for communication activities will depend upon the situation.
- **Writing style.** Active versus passive voice, sentence structure, and word choice.
• **Presentation techniques.** Body language and design of visual aids.
• **Meeting management techniques.** Preparing an agenda and dealing with conflict.

A basic model of communication, shown in Figure 10-3, demonstrates how ideas or information is sent and received between two parties, defined as the sender and the receiver. The key components of the model include:

• **Encode.** To translate thoughts or ideas into a language that is understood by others.
• **Message.** The output of encoding.
• **Medium.** The method used to convey the message.
• **Noise.** Anything that interferes with the transmission and understanding of the message (e.g., distance).
• **Decode.** To translate the message back into meaningful thoughts or ideas.

Inherent in the model shown in Figure 10-3 is an action to acknowledge a message. Acknowledgement means that the receiver signals receipt of the message, but not necessarily agreement with the message. Another action is the response to a message, which means that the receiver has decoded, understands, and is replying to the message.

![Figure 10-3. Communication – Basic Model](image)

The components in the communications model need to be taken into account when discussing project communications. There are many challenges in using these components to effectively communicate with project stakeholders. Consider a highly technical, multi-national project team. For one team member to successfully communicate a technical concept to another team member in a different country can involve encoding the message in the appropriate language, sending the message using a variety of technologies, and having the receiver decode the message. Any noise introduced along the way compromises the original meaning of the message. A breakdown in communications can negatively impact the project.
10.1 Communications Planning

The Communications Planning process determines the information and communications needs of the stakeholders; for example, who needs what information, when they will need it, how it will be given to them, and by whom. While all projects share the need to communicate project information, the informational needs and methods of distribution vary widely. Identifying the informational needs of the stakeholders and determining a suitable means of meeting those needs is an important factor for project success.

On most projects, the majority of Communications Planning is done as part of the earliest project phases. However, the results of this planning process are reviewed regularly throughout the project and revised as needed to ensure continued applicability.

Communications Planning is often tightly linked with enterprise environmental factors (Section 4.1.1.3) and organizational influences (Section 2.3), since the project’s organizational structure will have a major effect on the project’s communications requirements.

10.1.1 Communications Planning: Inputs

.1 Enterprise Environmental Factors

All the factors described in Section 4.1.1.3 are used as inputs for this process.

.2 Organizational Process Assets

While all of the assets described in Section 4.1.1.4 are used as inputs for this process, lessons learned and historical information are of particular importance. Lessons learned and historical information can provide both decisions and results based on previous similar projects concerning communications issues.
.3 Project Scope Statement
The project scope statement (Section 5.2.3.1) provides a documented basis for future project decisions and for confirming a common knowledge of project scope among the stakeholders. Stakeholder analysis is completed as part of the Scope Definition process.

.4 Project Management Plan
The project management plan (Section 4.3) provides background information about the project, including dates and constraints that may be relevant to Communications Planning.

- **Constraints.** Constraints are factors that can limit the project management team’s options. Examples of constraints include team members situated in different geographic locations, incompatible communication software versions, or limited communications technical capabilities.

- **Assumptions.** Specific assumptions that affect Communications Planning will depend upon the particular project.

10.1.2 Communications Planning: Tools and Techniques

.1 Communications Requirements Analysis
The analysis of the communications requirements results in the sum of the information needs of the project stakeholders. These requirements are defined by combining the type and format of information needed with an analysis of the value of that information. Project resources are expended only on communicating information that contributes to success, or where a lack of communication can lead to failure. This does not mean that “bad news” should not be shared; rather, the intent is to prevent overwhelming stakeholders with minutiae.

The project manager should consider the number of potential communication channels or paths as an indicator of the complexity of a project's communications.

The total number of communication channels is $n(n-1)/2$, where $n$ = number of stakeholders. Thus, a project with 10 stakeholders has 45 potential communication channels. A key component of planning the project's communications, therefore, is to determine and limit who will communicate with whom and who will receive what information. Information typically required to determine project communications requirements includes:

- Organization charts
- Project organization and stakeholder responsibility relationships
- Disciplines, departments, and specialties involved in the project
- Logistics of how many persons will be involved with the project and at which locations
- Internal information needs (e.g., communicating across organizations)
- External information needs (e.g., communicating with the media or contractors)
- Stakeholder information.
.2 Communications Technology

The methodologies used to transfer information among project stakeholders can vary significantly. For example, a project management team may include brief conversations all the way through to extended meetings, or simple written documents to material (e.g., schedules and databases) that is accessible online as methods of communication.

Communications technology factors that can affect the project include:

- **The urgency of the need for information.** Is project success dependent upon having frequently updated information available on a moment’s notice, or would regularly issued written reports suffice?
- **The availability of technology.** Are the systems already in place appropriate, or do project needs warrant change?
- **The expected project staffing.** Are the proposed communications systems compatible with the experience and expertise of the project participants, or is extensive training and learning required?
- **The length of the project.** Is the available technology likely to change before the project is over?
- **The project environment.** Does the team meet and operate on a face-to-face basis or in a virtual environment?

10.1.3 Communications Planning: Outputs

.1 Communications Management Plan

The communications management plan is contained in, or is a subsidiary plan of, the project management plan (Section 4.3). The communications management plan provides:

- Stakeholder communication requirements
- Information to be communicated, including format, content, and level of detail
- Person responsible for communicating the information
- Person or groups who will receive the information
- Methods or technologies used to convey the information, such as memoranda, e-mail, and/or press releases
- Frequency of the communication, such as weekly
- Escalation process-identifying time frames and the management chain (names) for escalation of issues that cannot be resolved at a lower staff level
- Method for updating and refining the communications management plan as the project progresses and develops
- Glossary of common terminology.
The communications management plan can also include guidelines for project status meetings, project team meetings, e-meetings, and e-mail. The communications management plan can be formal or informal, highly detailed or broadly framed, and based on the needs of the project. The communications management plan is contained in, or is a subsidiary plan of, the overall project management plan (Section 4.3). Sample attributes of a communications management plan can include:

- **Communications item.** The information that will be distributed to stakeholders.
- **Purpose.** The reason for the distribution of that information.
- **Frequency.** How often that information will be distributed.
- **Start/end dates.** The time frame for the distribution of the information.
- **Format/medium.** The layout of the information and the method of transmission.
- **Responsibility.** The team member charged with the distribution of information.

Communication Planning often entails creation of additional deliverables that, in turn, require additional time and effort. Thus, the project’s work breakdown structure, project schedule, and project budget are updated accordingly.

### 10.2 Information Distribution

Information Distribution involves making information available to project stakeholders in a timely manner. Information distribution includes implementing the communications management plan, as well as responding to unexpected requests for information.

![Figure 10-5. Information Distribution: Inputs, Tools & Techniques, and Outputs](image-url)
10.2.1 Information Distribution: Inputs

.1 Communications Management Plan
Described in Section 10.1.3.1.

10.2.2 Information Distribution: Tools and Techniques

.1 Communications Skills
Communications skills are part of general management skills and are used to exchange information. General management skills related to communications include ensuring that the right persons get the right information at the right time, as defined in the communications management plan. General management skills also include the art of managing stakeholder requirements.

As part of the communications process, the sender is responsible for making the information clear and complete so that the receiver can receive it correctly, and for confirming that it is properly understood. The receiver is responsible for making sure that the information is received in its entirety and understood correctly. Communicating has many dimensions:

- Written and oral, listening, and speaking
- Internal (within the project) and external (customer, the media, the public)
- Formal (reports, briefings) and informal (memos, ad hoc conversations)
- Vertical (up and down the organization) and horizontal (with peers).

.2 Information Gathering and Retrieval Systems
Information can be gathered and retrieved through a variety of media including manual filing systems, electronic databases, project management software, and systems that allow access to technical documentation, such as engineering drawings, design specifications, and test plans.

.3 Information Distribution Methods
Information Distribution is information collection, sharing, and distribution to project stakeholders in a timely manner across the project life cycle. Project information can be distributed using a variety of methods, including:

- Project meetings, hard-copy document distribution, manual filing systems, and shared-access electronic databases
- Electronic communication and conferencing tools, such as e-mail, fax, voice mail, telephone, video and Web conferencing, and Web publishing
- Electronic tools for project management, such as Web interfaces to scheduling and project management software, meeting and virtual office support software, portals, and collaborative work management tools.
.4 Lessons Learned Process
A lessons learned session focuses on identifying project successes and project failures, and includes recommendations to improve future performance on projects. During the project life cycle, the project team and key stakeholders identify lessons learned concerning the technical, managerial, and process aspects of the project. The lessons learned are compiled, formalized, and stored through the project’s duration.

The focus of lessons learned meetings can vary. In some cases, the focus is on strong technical or product development processes, while in other cases, the focus is on the processes that aided or hindered performance of the work. Teams can gather information more frequently if they feel that the increased quantity of data merits the additional investment of time and money. Lessons learned provide future project teams with the information that can increase effectiveness and efficiency of project management. In addition, phase-end lessons learned sessions provide a good team-building exercise. Project managers have a professional obligation to conduct lessons learned sessions for all projects with key internal and external stakeholders, particularly if the project yielded less than desirable results. Some specific results from lessons learned include:

- Update of the lessons learned knowledge base
- Input to knowledge management system
- Updated corporate policies, procedures, and processes
- Improved business skills
- Overall product and service improvements
- Updates to the risk management plan.

10.2.3 Information Distribution: Outputs
.1 Organizational Process Assets (Updates)

- **Lessons learned documentation.** Documentation includes the causes of issues, reasoning behind the corrective action chosen, and other types of lessons learned about Information Distribution. Lessons learned are documented so that they become part of the historical database for both this project and the performing organization.

- **Project records.** Project records can include correspondence, memos, and documents describing the project. This information should, to the extent possible and appropriate, be maintained in an organized fashion. Project team members can also maintain records in a project notebook.

- **Project reports.** Formal and informal project reports detail project status, and include lessons learned, issues logs, project closure reports, and outputs from other Knowledge Areas (Chapters 4–12).
• **Project presentations.** The project team provides information formally or informally to any or all of the project stakeholders. The information is relevant to the needs of the audience, and the method of presentation is appropriate.

• **Feedback from stakeholders.** Information received from stakeholders concerning project operations can be distributed and used to modify or improve future performance of the project.

• **Stakeholder notifications.** Information may be provided to stakeholders about resolved issues, approved changes, and general project status.

.2 **Requested Changes**
Changes to the Information Distribution process should trigger changes to the project management plan and the communications management plan. Requested changes (additions, modifications, revisions) to the project management plan and its subsidiary plans are reviewed, and the disposition is managed through the Integrated Change Control process (Section 4.6).

**10.3 Performance Reporting**

The performance reporting process involves the collection of all baseline data, and distribution of performance information to stakeholders. Generally, this performance information includes how resources are being used to achieve project objectives. Performance reporting should generally provide information on scope, schedule, cost, and quality. Many projects also require information on risk and procurement. Reports may be prepared comprehensively or on an exception basis.

![Figure 10-6. Performance Reporting: Inputs, Tools & Techniques, and Outputs](image-url)
10.3.1 Performance Reporting: Inputs

1. Work Performance Information
   Work performance information on the completion status of the deliverables and what has been accomplished is collected as part of project execution, and is fed into the Performance Reporting process. Collecting the work performance information is discussed in further detail in the Direct and Manage Project Execution process (Section 4.4).

2. Performance Measurements
   Described in Section 6.6.3.3 and Section 7.3.3.3.

3. Forecasted Completion
   Described in Section 7.3.3.4.

4. Quality Control Measurements
   Described in Section 8.3.3.1.

5. Project Management Plan
   The project management plan provides baseline information (Section 4.3).
   - Performance measurement baseline. An approved plan for the project work against which project execution is compared, and deviations are measured for management control. The performance measurement baseline typically integrates scope, schedule, and cost parameters of a project, but may also include technical and quality parameters.

6. Approved Change Requests
   Approved change requests (Section 4.6.3.1) are requested changes to expand or contract project scope, to modify the estimated cost, or to revise activity duration estimates that have been approved and are ready for implementation by the project team.

7. Deliverables
   Deliverables (Section 4.4.3.1) are any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. The term is often used more narrowly in reference to an external deliverable that is subject to approval by the project sponsor or customer.

10.3.2 Performance Reporting: Tools and Techniques

1. Information Presentation Tools
   Software packages that include table reporting, spreadsheet analysis, presentations, or graphic capabilities can be used to create presentation-quality images of project performance data.
.2 Performance Information Gathering and Compilation
Information can be gathered and compiled from a variety of media including manual filing systems, electronic databases, project management software, and systems that allow access to technical documentation, such as engineering drawings, design specifications and test plans, to produce forecasts as well as performance, status and progress reports.

.3 Status Review Meetings
Status review meetings are regularly scheduled events to exchange information about the project. On most projects, status review meetings will be held at various frequencies and on different levels. For example, the project management team can meet weekly by itself and monthly with the customer.

.4 Time Reporting Systems
Time reporting systems record and provide time expended for the project.

.5 Cost Reporting Systems
Cost reporting systems record and provide the cost expended for the project.

10.3.3 Performance Reporting: Outputs

.1 Performance Reports
Performance reports organize and summarize the information gathered, and present the results of any analysis as compared to the performance measurement baseline. Reports should provide the status and progress information, and the level of detail required by various stakeholders, as documented in the communications management plan. Common formats for performance reports include bar charts, S-curves, histograms, and tables. Earned value analysis data is often included as part of performance reporting. While S-curves, such as those in Figure 7-7, can display one view of earned value analysis data, Figure 10-7 gives a tabular view of earned value data.
### Figure 10-7 Tabular Performance Report Sample

#### 2. Forecasts
Forecasts are updated and reissued based on work performance information provided as the project is executed. This information is about the project’s past performance that could impact the project in the future, for example, estimate at completion and estimate to complete.

#### 3. Requested Changes
Analysis of project performance often generates requested changes (Section 4.4.3.2) to some aspect of the project. These requested changes are processed and dispositioned through the Integrated Change Control process (Section 4.6).

#### 4. Recommended Corrective Actions
Recommended corrective actions (Section 4.5.3.1) include changes that bring the expected future performance of the project in line with the project management plan.

#### 5. Organizational Process Assets (Updates)
Lessons learned documentation includes the causes of issues, reasoning behind the corrective action chosen, and other types of lessons learned about performance reporting. Lessons learned are documented so that they become part of the historical database for both this project and the performing organization.
10.4 Manage Stakeholders

Stakeholder management refers to managing communications to satisfy the needs of, and resolve issues with, project stakeholders. Actively managing stakeholders increases the likelihood that the project will not veer off track due to unresolved stakeholder issues, enhances the ability of persons to operate synergistically, and limits disruptions during the project. The project manager is usually responsible for stakeholder management.

![Figure 10-8. Manage Stakeholders: Inputs, Tools & Techniques, and Outputs](image)

10.4.1 Manage Stakeholders: Inputs

.1 Communications Management Plan
Stakeholder requirements and expectations provide an understanding of stakeholder goals, objectives, and level of communication during the project. The needs and expectations are identified, analyzed, and documented in the communications management plan (Section 10.1.3.1), which is a subsidiary of the project management plan.

.2 Organizational Process Assets
As project issues arise, the project manager should address and resolve them with the appropriate project stakeholders.

10.4.2 Manage Stakeholders: Tools and Techniques

.1 Communications Methods
The methods of communications identified for each stakeholder in the communications management plan are utilized during stakeholder management.

Face-to-face meetings are the most effective means for communicating and resolving issues with stakeholders. When face-to-face meetings are not warranted or practical (such as on international projects), telephone calls, electronic mail, and other electronic tools are useful for exchanging information and dialoguing.
2 Issue Logs
An issue log or action-item log is a tool that can be used to document and monitor the resolution of issues. Issues do not usually rise to the importance of becoming a project or activity, but are usually addressed in order to maintain good, constructive working relationships among various stakeholders, including team members.

An issue is clarified and stated in a way that it can be resolved. An owner is assigned and a target date is usually established for closure. Unresolved issues can be a major source of conflict and project delays.

10.4.3 Manage Stakeholders: Outputs

.1 Resolved Issues
As stakeholder requirements are identified and resolved, the issues log will document concerns that have been addressed and closed. Examples include:

- Customers agree to a follow-on contract, which ends protracted discussion of whether requested changes to project scope are within or outside the scope of the current project
- More staff is added to the project, thus closing the issue that the project is short on required skills
- Negotiations with functional managers in the organization competing for scarce human resources end in a mutually satisfactory solution before causing project delays
- Issues raised by board members about the financial viability of the project have been answered, allowing the project to move forward as planned.

.2 Approved Change Requests
Approved change requests (Section 4.6.3.1) include stakeholder issue status changes in the staffing management plan, which are necessary to reflect changes to how communications with stakeholders will occur.

.3 Approved Corrective Actions
Approved corrective actions (Section 4.6.3.5) include changes that bring the expected future performance of the project in line with the project management plan.

.4 Organizational Process Assets (Updates)
Lessons learned documentation includes the causes of issues, the reasoning behind the corrective action chosen, and other types of lessons learned about stakeholder management. Lessons learned are documented so that they become part of the historical database for both this project and the performing organization.

.5 Project Management Plan (Updates)
The project management plan is updated to reflect the changes made to the communications plan.
CHAPTER 11

Project Risk Management

Project Risk Management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project; most of these processes are updated throughout the project. The objectives of Project Risk Management are to increase the probability and impact of positive events, and decrease the probability and impact of events adverse to the project. Figure 11-1 provides an overview of the Project Risk Management processes, and Figure 11-2 provides a process flow diagram of those processes and their inputs, outputs, and other related Knowledge Area processes. The Project Risk Management processes include the following:

11.1 Risk Management Planning – deciding how to approach, plan, and execute the risk management activities for a project.

11.2 Risk Identification – determining which risks might affect the project and documenting their characteristics.

11.3 Qualitative Risk Analysis – prioritizing risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact.

11.4 Quantitative Risk Analysis – numerically analyzing the effect on overall project objectives of identified risks.

11.5 Risk Response Planning – developing options and actions to enhance opportunities, and to reduce threats to project objectives.

11.6 Risk Monitoring and Control – tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.

These processes interact with each other and with the processes in the other Knowledge Areas as well. Each process can involve effort from one or more persons or groups of persons based on the needs of the project. Each process occurs at least once in every project and occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.
Project risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality (i.e., where the project time objective is to deliver in accordance with the agreed-upon schedule; where the project cost objective is to deliver within the agreed-upon cost; etc.). A risk may have one or more causes and, if it occurs, one or more impacts. For example, a cause may be requiring an environmental permit to do work, or having limited personnel assigned to design the project. The risk event is that the permitting agency may take longer than planned to issue a permit, or the design personnel available and assigned may not be adequate for the activity. If either of these uncertain events occurs, there may be an impact on the project cost, schedule, or performance. Risk conditions could include aspects of the project’s or organization’s environment that may contribute to project risk, such as poor project management practices, lack of integrated management systems, concurrent multiple projects, or dependency on external participants who cannot be controlled.
Figure 11-1. Project Risk Management Overview
Project risk has its origins in the uncertainty that is present in all projects. Known risks are those that have been identified and analyzed, and it may be possible to plan for those risks using the processes described in this chapter. Unknown risks cannot be managed proactively, and a prudent response by the project team can be to allocate general contingency against such risks, as well as against any known risks for which it may not be cost-effective or possible to develop a proactive response.

Organizations perceive risk as it relates to threats to project success, or to opportunities to enhance chances of project success. Risks that are threats to the project may be accepted if the risk is in balance with the reward that may be gained by taking the risk. For example, adopting a fast track schedule (Section 6.5.2.3) that may be overrun is a risk taken to achieve an earlier completion date. Risks that are opportunities, such as work acceleration that may be gained by assigning additional staff, may be pursued to benefit the project’s objectives.

Persons and, by extension, organizations have attitudes toward risk that affect both the accuracy of the perception of risk and the way they respond. Attitudes about risk should be made explicit wherever possible. A consistent approach to risk that meets the organization’s requirements should be developed for each project, and communication about risk and its handling should be open and honest. Risk responses reflect an organization’s perceived balance between risk-taking and risk-avoidance.

To be successful, the organization should be committed to addressing the management of risk proactively and consistently throughout the project.
Note: Not all process interactions and data flow among the processes are shown.

Figure 11-2. Project Risk Management Process Flow Diagram
11.1 Risk Management Planning

Careful and explicit planning enhances the possibility of success of the five other risk management processes. Risk Management Planning is the process of deciding how to approach and conduct the risk management activities for a project. Planning of risk management processes is important to ensure that the level, type, and visibility of risk management are commensurate with both the risk and importance of the project to the organization, to provide sufficient resources and time for risk management activities, and to establish an agreed-upon basis for evaluating risks. The Risk Management Planning process should be completed early during project planning, since it is crucial to successfully performing the other processes described in this chapter.

![Figure 11-3. Risk Management Planning: Inputs, Tools & Techniques, and Outputs](image)

11.1.1 Risk Management Planning: Inputs

1. **Enterprise Environmental Factors**
   The attitudes toward risk and the risk tolerance of organizations and people involved in the project will influence the project management plan (Section 4.3). Risk attitudes and tolerances may be expressed in policy statements or revealed in actions (Section 4.1.1.3).

2. **Organizational ProcessAssets**
   Organizations may have predefined approaches to risk management such as risk categories, common definition of concepts and terms, standard templates, roles and responsibilities, and authority levels for decision-making.

3. **Project Scope Statement**
   Described in Section 5.2.3.1.

4. **Project Management Plan**
   Described in Section 4.3.
11.1.2 Risk Management Planning: Tools and Techniques

.1 Planning Meetings and Analysis
Project teams hold planning meetings to develop the risk management plan. Attendees at these meetings may include the project manager, selected project team members and stakeholders, anyone in the organization with responsibility to manage the risk planning and execution activities, and others, as needed.

Basic plans for conducting the risk management activities are defined in these meetings. Risk cost elements and schedule activities will be developed for inclusion in the project budget and schedule, respectively. Risk responsibilities will be assigned. General organizational templates for risk categories and definitions of terms such as levels of risk, probability by type of risk, impact by type of objectives, and the probability and impact matrix will be tailored to the specific project. The outputs of these activities will be summarized in the risk management plan.

11.1.3 Risk Management Planning: Outputs

.1 Risk Management Plan
The risk management plan describes how risk management will be structured and performed on the project. It becomes a subset of the project management plan (Section 4.3). The risk management plan includes the following:

• **Methodology.** Defines the approaches, tools, and data sources that may be used to perform risk management on the project.

• **Roles and responsibilities.** Defines the lead, support, and risk management team membership for each type of activity in the risk management plan, assigns people to these roles, and clarifies their responsibilities.

• **Budgeting.** Assigns resources and estimates costs needed for risk management for inclusion in the project cost baseline (Section 7.2.3.1).

• **Timing.** Defines when and how often the risk management process will be performed throughout the project life cycle, and establishes risk management activities to be included in the project schedule (Section 6.5.3.1).

• **Risk categories.** Provides a structure that ensures a comprehensive process of systematically identifying risk to a consistent level of detail and contributes to the effectiveness and quality of Risk Identification. An organization can use a previously prepared categorization of typical risks. A risk breakdown structure (RBS) (Figure 11-4) is one approach to providing such a structure, but it can also be addressed by simply listing the various aspects of the project. The risk categories may be revisited during the Risk Identification process. A good practice is to review the risk categories during the Risk Management Planning process prior to their use in the Risk Identification process. Risk categories based on prior projects may need to be tailored, adjusted, or extended to new situations before those categories can be used on the current project.
• **Definitions of risk probability and impact.** The quality and credibility of the Qualitative Risk Analysis process requires that different levels of the risks’ probabilities and impacts be defined. General definitions of probability levels and impact levels are tailored to the individual project during the Risk Management Planning process for use in the Qualitative Risk Analysis process (Section 11.3).

![Figure 11-4. Example of a Risk Breakdown Structure (RBS)](image)

The Risk Breakdown Structure (RBS) lists the categories and sub-categories within which risks may arise for a typical project. Different RBSs will be appropriate for different types of projects and different types of organizations. One benefit of this approach is to remind participants in a risk identification exercise of the many sources from which project risk may arise.

**Figure 11-4. Example of a Risk Breakdown Structure (RBS)**

A relative scale representing probability values from “very unlikely” to “almost certainty” could be used. Alternatively, assigned numerical probabilities on a general scale (e.g., 0.1, 0.3, 0.5, 0.7, 0.9) can be used. Another approach to calibrating probability involves developing descriptions of the state of the project that relate to the risk under consideration (e.g., the degree of maturity of the project design).
The impact scale reflects the significance of impact, either negative for threats or positive for opportunities, on each project objective if a risk occurs. Impact scales are specific to the objective potentially impacted, the type and size of the project, the organization’s strategies and financial state, and the organization’s sensitivity to particular impacts. Relative scales for impact are simply rank-ordered descriptors such as “very low,” “low,” “moderate,” “high,” and “very high,” reflecting increasingly extreme impacts as defined by the organization. Alternatively, numeric scales assign values to these impacts. These values may be linear (e.g., 0.1, 0.3, 0.5, 0.7, 0.9) or nonlinear (e.g., 0.05, 0.1, 0.2, 0.4, 0.8). Nonlinear scales may represent the organization’s desire to avoid high-impact threats or exploit high-impact opportunities, even if they have relatively low probability. In using nonlinear scales, it is important to understand what is meant by the numbers and their relationship to each other, how they were derived, and the effect they may have on the different objectives of the project.

Figure 11-5 is an example of negative impacts of definitions that might be used in evaluating risk impacts related to four project objectives. That figure illustrates both relative and numeric (in this case, nonlinear) approaches. The figure is not intended to imply that the relative and numeric terms are equivalent, but to show the two alternatives in one figure rather than two.

- **Probability and impact matrix.** Risks are prioritized according to their potential implications for meeting the project’s objectives. The typical approach to prioritizing risks is to use a look-up table or a Probability and Impact Matrix (Figure 11-8 and Section 11.3.2.2). The specific combinations of probability and impact that lead to a risk being rated as “high,” “moderate,” or “low” importance—with the corresponding importance for planning responses to the risk (Section 11.5)—are usually set by the organization. They are reviewed and can be tailored to the specific project during the Risk Management Planning process.

<table>
<thead>
<tr>
<th>Project Objective</th>
<th>Relative or numerical scales are shown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Very low / .05</td>
</tr>
<tr>
<td>Insignificant cost increase</td>
<td>&lt;10% cost increase</td>
</tr>
<tr>
<td>Insignificant time increase</td>
<td>&lt;5% time increase</td>
</tr>
<tr>
<td>Scope</td>
<td>Minor areas of scope affected</td>
</tr>
<tr>
<td>Quality</td>
<td>Quality degradation barely noticeable</td>
</tr>
</tbody>
</table>

This table presents examples of risk impact definitions for four different project objectives. They should be tailored to the Risk Management Planning process to the individual project and to the organization’s risk thresholds. Impact definitions can be developed for opportunities in a similar way.

**Figure 11-5. Definition of Impact Scales for Four Project Objectives**
- **Revised stakeholders’ tolerances.** Stakeholders’ tolerances may be revised in the Risk Management Planning process, as they apply to the specific project.

- **Reporting formats.** Describes the content and format of the risk register (Sections 11.2, 11.3, 11.4, and 11.5) as well as any other risk reports required. Defines how the outcomes of the risk management processes will be documented, analyzed, and communicated.

- **Tracking.** Documents how all facets of risk activities will be recorded for the benefit of the current project, future needs, and lessons learned. Documents whether and how risk management processes will be audited.

## 11.2 Risk Identification

Risk Identification determines which risks might affect the project and documents their characteristics. Participants in risk identification activities can include the following, where appropriate: project manager, project team members, risk management team (if assigned), subject matter experts from outside the project team, customers, end users, other project managers, stakeholders, and risk management experts. While these personnel are often key participants for risk identification, all project personnel should be encouraged to identify risks.

Risk Identification is an iterative process because new risks may become known as the project progresses through its life cycle (Section 2.1). The frequency of iteration and who participates in each cycle will vary from case to case. The project team should be involved in the process so that they can develop and maintain a sense of ownership of, and responsibility for, the risks and associated risk response actions. Stakeholders outside the project team may provide additional objective information. The Risk Identification process usually leads to the Qualitative Risk Analysis process (Section 11.3). Alternatively, it can lead directly to the Quantitative Risk Analysis process (Section 11.4) when conducted by an experienced risk manager. On some occasions, simply the identification of a risk may suggest its response, and these should be recorded for further analysis and implementation in the Risk Response Planning process (Section 11.5).

![Figure 11-6. Risk Identification: Inputs, Tools & Techniques, and Outputs](image-url)
11.2.1 Risk Identification: Inputs

.1 Enterprise Environmental Factors
Published information, including commercial databases, academic studies, benchmarking, or other industry studies, may also be useful in identifying risks (Section 4.1.1.3).

.2 Organizational Process Assets
Information on prior projects may be available from previous project files, including actual data and lessons learned (Section 4.1.1.4).

.3 Project Scope Statement
Project assumptions are found in the project scope statement (Section 5.2.3.1). Uncertainty in project assumptions should be evaluated as potential causes of project risk.

.4 Risk Management Plan
Key inputs from the risk management plan to the Risk Identification process are the assignments of roles and responsibilities, provision for risk management activities in the budget and schedule, and categories of risk (Section 11.1.3.1), which are sometimes expressed in an RBS (Figure 11-4).

.5 Project Management Plan
The Risk Identification process also requires an understanding of the schedule, cost, and quality management plans found in the project management plan (Section 4.3). Outputs of other Knowledge Area processes should be reviewed to identify possible risks across the entire project.

11.2.2 Risk Identification: Tools and Techniques

.1 Documentation Reviews
A structured review may be performed of project documentation, including plans, assumptions, prior project files, and other information. The quality of the plans, as well as consistency between those plans and with the project requirements and assumptions, can be indicators of risk in the project.

.2 Information Gathering Techniques
Examples of information gathering techniques used in identifying risk can include:

- **Brainstorming.** The goal of brainstorming is to obtain a comprehensive list of project risks. The project team usually performs brainstorming, often with a multidisciplinary set of experts not on the team. Ideas about project risk are generated under the leadership of a facilitator. Categories of risk (Section 11.1), such as a risk breakdown structure, can be used as a framework. Risks are then identified and categorized by type of risk and their definitions are sharpened.
Chapter 11 – Project Risk Management

- **Delphi technique.** The Delphi technique is a way to reach a consensus of experts. Project risk experts participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project risks. The responses are summarized and are then recirculated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome.

- **Interviewing.** Interviewing experienced project participants, stakeholders, and subject matter experts can identify risks. Interviews are one of the main sources of risk identification data gathering.

- **Root cause identification.** This is an inquiry into the essential causes of a project’s risks. It sharpens the definition of the risk and allows grouping risks by causes. Effective risk responses can be developed if the root cause of the risk is addressed.

- **Strengths, weaknesses, opportunities, and threats (SWOT) analysis.** This technique ensures examination of the project from each of the SWOT perspectives, to increase the breadth of considered risks.

.3 Checklist Analysis
Risk identification checklists can be developed based on historical information and knowledge that has been accumulated from previous similar projects and from other sources of information. The lowest level of the RBS can also be used as a risk checklist. While a checklist can be quick and simple, it is impossible to build an exhaustive one. Care should be taken to explore items that do not appear on the checklist. The checklist should be reviewed during project closure to improve it for use on future projects.

.4 Assumptions Analysis
Every project is conceived and developed based on a set of hypotheses, scenarios, or assumptions. Assumptions analysis is a tool that explores the validity of assumptions as they apply to the project. It identifies risks to the project from inaccuracy, inconsistency, or incompleteness of assumptions.

.5 Diagramming Techniques
Risk diagramming techniques may include:
- **Cause-and-effect diagrams** (Section 8.3.2.1). These are also known as Ishikawa or fishbone diagrams, and are useful for identifying causes of risks.
- **System or process flow charts.** These show how various elements of a system interrelate, and the mechanism of causation (Section 8.3.2.3).
- **Influence diagrams.** These are graphical representations of situations showing causal influences, time ordering of events, and other relationships among variables and outcomes.
11.2.3 Risk Identification: Outputs

The outputs from Risk Identification are typically contained in a document that can be called a risk register.

.1 Risk Register

The primary outputs from Risk Identification are the initial entries into the risk register, which becomes a component of the project management plan (Section 4.3). The risk register ultimately contains the outcomes of the other risk management processes as they are conducted. The preparation of the risk register begins in the Risk Identification process with the following information, and then becomes available to other project management and Project Risk Management processes.

- **List of identified risks.** The identified risks, including their root causes and uncertain project assumptions, are described. Risks can cover nearly any topic, but a few examples include the following: A few large items with long lead times are on critical path. There could be a risk that industrial relations disputes at the ports will delay the delivery and, subsequently, delay completion of the construction phase. Another example is a project management plan that assumes a staff size of ten, but there are only six resources available. The lack of resources could impact the time required to complete the work and the activities would be late.

- **List of potential responses.** Potential responses to a risk may be identified during the Risk Identification process. These responses, if identified, may be useful as inputs to the Risk Response Planning process (Section 11.5).

- **Root causes of risk.** These are the fundamental conditions or events that may give rise to the identified risk.

- **Updated risk categories.** The process of identifying risks can lead to new risk categories being added to the list of risk categories. The RBS developed in the Risk Management Planning process may have to be enhanced or amended, based on the outcomes of the Risk Identification process.

11.3 Qualitative Risk Analysis

Qualitative Risk Analysis includes methods for prioritizing the identified risks for further action, such as Quantitative Risk Analysis (Section 11.4) or Risk Response Planning (Section 11.5). Organizations can improve the project’s performance effectively by focusing on high-priority risks. Qualitative Risk Analysis assesses the priority of identified risks using their probability of occurring, the corresponding impact on project objectives if the risks do occur, as well as other factors such as the time frame and risk tolerance of the project constraints of cost, schedule, scope, and quality.

Definitions of the levels of probability and impact, and expert interviewing, can help to correct biases that are often present in the data used in this process. The time criticality of risk-related actions may magnify the importance of a risk. An evaluation of the quality of the available information on project risks also helps understand the assessment of the risk’s importance to the project.
Qualitative Risk Analysis is usually a rapid and cost-effective means of establishing priorities for Risk Response Planning, and lays the foundation for Quantitative Risk Analysis, if this is required. Qualitative Risk Analysis should be revisited during the project’s life cycle to stay current with changes in the project risks. Qualitative Risk Analysis requires outputs of the Risk Management Planning (Section 11.1) and Risk Identification (Section 11.2) processes. This process can lead into Quantitative Risk Analysis (Section 11.4) or directly into Risk Response Planning (Section 11.5).

11.3.1 Qualitative Risk Analysis: Inputs

.1 Organizational Process Assets
Data about risks on past projects and the lessons learned knowledge base can be used in the Qualitative Risk Analysis process.

.2 Project Scope Statement
Projects of a common or recurrent type tend to have more well-understood risks. Projects using state-of-the-art or first-of-its-kind technology, and highly complex projects, tend to have more uncertainty. This can be evaluated by examining the project scope statement (Section 5.2.3.1).

.3 Risk Management Plan
Key elements of the risk management plan for Qualitative Risk Analysis include roles and responsibilities for conducting risk management, budgets, and schedule activities for risk management, risk categories, definition of probability and impact, the probability and impact matrix, and revised stakeholders’ risk tolerances (also enterprise environmental factors in Section 4.1.1.3). These inputs are usually tailored to the project during the Risk Management Planning process. If they are not available, they can be developed during the Qualitative Risk Analysis process.

.4 Risk Register
A key item from the risk register for Qualitative Risk Analysis is the list of identified risks (Section 11.2.3.1).
11.3.2 Qualitative Risk Analysis: Tools and Techniques

1. Risk Probability and Impact Assessment

Risk probability assessment investigates the likelihood that each specific risk will occur. Risk impact assessment investigates the potential effect on a project objective such as time, cost, scope, or quality, including both negative effects for threats and positive effects for opportunities.

Probability and impact are assessed for each identified risk. Risks can be assessed in interviews or meetings with participants selected for their familiarity with the risk categories on the agenda. Project team members and, perhaps, knowledgeable persons from outside the project, are included. Expert judgment is required, since there may be little information on risks from the organization’s database of past projects. An experienced facilitator may lead the discussion, since the participants may have little experience with risk assessment.

The level of probability for each risk and its impact on each objective is evaluated during the interview or meeting. Explanatory detail, including assumptions justifying the levels assigned, is also recorded. Risk probabilities and impacts are rated according to the definitions given in the risk management plan (Section 11.1.3.1). Sometimes, risks with obviously low ratings of probability and impact will not be rated, but will be included on a watchlist for future monitoring.

2. Probability and Impact Matrix

Risks can be prioritized for further quantitative analysis (Section 11.4) and response (Section 11.5), based on their risk rating. Ratings are assigned to risks based on their assessed probability and impact (Section 11.3.2.2). Evaluation of each risk’s importance and, hence, priority for attention is typically conducted using a look-up table or a probability and impact matrix (Figure 11-8). Such a matrix specifies combinations of probability and impact that lead to rating the risks as low, moderate, or high priority. Descriptive terms or numeric values can be used, depending on organizational preference.

The organization should determine which combinations of probability and impact result in a classification of high risk (“red condition”), moderate risk (“yellow condition”), and low risk (“green condition”). In a black-and-white matrix, these conditions can be denoted by different shades of gray. Specifically, in Figure 11-8, the dark gray area (with the largest numbers) represents high risk; the medium gray area (with the smallest numbers) represents low risk; and the light gray area (with in-between numbers) represents moderate risk. Usually, these risk-rating rules are specified by the organization in advance of the project, and included in organizational process assets (Section 4.1.1.4). Risk rating rules can be tailored in the Risk Management Planning process (Section 11.1) to the specific project.

A probability and impact matrix, such as the one shown in Figure 11-8, is often used.
As illustrated in Figure 11-8, an organization can rate a risk separately for each objective (e.g., cost, time, and scope). In addition, it can develop ways to determine one overall rating for each risk. Finally, opportunities and threats can be handled in the same matrix using definitions of the different levels of impact that are appropriate for each.

The risk score helps guide risk responses. For example, risks that have a negative impact on objectives if they occur (threats), and that are in the high-risk (dark gray) zone of the matrix, may require priority action and aggressive response strategies. Threats in the low-risk (medium gray) zone may not require proactive management action beyond being placed on a watchlist or adding a contingency reserve.

Similarly for opportunities, those in the high-risk (dark gray) zone that can be obtained most easily and offer the greatest benefit should, therefore, be targeted first. Opportunities in the low-risk (medium gray) zone should be monitored.

### 3 Risk Data Quality Assessment

A qualitative risk analysis requires accurate and unbiased data if it is to be credible. Analysis of the quality of risk data is a technique to evaluate the degree to which the data about risks is useful for risk management. It involves examining the degree to which the risk is understood and the accuracy, quality, reliability, and integrity of the data about the risk.

The use of low-quality risk data may lead to a qualitative risk analysis of little use to the project. If data quality is unacceptable, it may be necessary to gather better data. Often, collection of information about risks is difficult, and consumes time and resources beyond that originally planned.
.4 Risk Categorization
Risks to the project can be categorized by sources of risk (e.g., using the RBS), the area of the project affected (e.g., using the WBS), or other useful category (e.g., project phase) to determine areas of the project most exposed to the effects of uncertainty. Grouping risks by common root causes can lead to developing effective risk responses.

.5 Risk Urgency Assessment
Risks requiring near-term responses may be considered more urgent to address. Indicators of priority can include time to effect a risk response, symptoms and warning signs, and the risk rating.

11.3.3 Qualitative Risk Analysis: Outputs

.1 Risk Register (Updates)
The risk register is initiated during the Risk Identification process. The risk register is updated with information from Qualitative Risk Analysis and the updated risk register is included in the project management plan. The risk register updates from Qualitative Risk Analysis include:

- **Relative ranking or priority list of project risks.** The probability and impact matrix can be used to classify risks according to their individual significance. The project manager can then use the prioritized list to focus attention on those items of high significance to the project, where responses can lead to better project outcomes. Risks may be listed by priority separately for cost, time, scope, and quality, since organizations may value one objective over another. A description of the basis for the assessed probability and impact should be included for risks assessed as important to the project.

- **Risks grouped by categories.** Risk categorization can reveal common root causes of risk or project areas requiring particular attention. Discovering concentrations of risk may improve the effectiveness of risk responses.

- **List of risks requiring response in the near-term.** Those risks that require an urgent response and those that can be handled at a later date may be put into different groups.

- **List of risks for additional analysis and response.** Some risks might warrant more analysis, including Quantitative Risk Analysis, as well as response action.

- **Watchlists of low priority risks.** Risks that are not assessed as important in the Qualitative Risk Analysis process can be placed on a watchlist for continued monitoring.

- **Trends in qualitative risk analysis results.** As the analysis is repeated, a trend for particular risks may become apparent, and can make risk response or further analysis more or less urgent/important.
11.4 Quantitative Risk Analysis

Quantitative Risk Analysis is performed on risks that have been prioritized by the Qualitative Risk Analysis process as potentially and substantially impacting the project’s competing demands. The Quantitative Risk Analysis process analyzes the effect of those risk events and assigns a numerical rating to those risks. It also presents a quantitative approach to making decisions in the presence of uncertainty. This process uses techniques such as Monte Carlo simulation and decision tree analysis to:

- Quantify the possible outcomes for the project and their probabilities
- Assess the probability of achieving specific project objectives
- Identify risks requiring the most attention by quantifying their relative contribution to overall project risk
- Identify realistic and achievable cost, schedule, or scope targets, given the project risks
- Determine the best project management decision when some conditions or outcomes are uncertain.

Quantitative Risk Analysis generally follows the Qualitative Risk Analysis process, although experienced risk managers sometimes perform it directly after Risk Identification. In some cases, Quantitative Risk Analysis may not be required to develop effective risk responses. Availability of time and budget, and the need for qualitative or quantitative statements about risk and impacts, will determine which method(s) to use on any particular project. Quantitative Risk Analysis should be repeated after Risk Response Planning, as well as part of Risk Monitoring and Control, to determine if the overall project risk has been satisfactorily decreased. Trends can indicate the need for more or less risk management action. It is an input to the Risk Response Planning process.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Tools &amp; Techniques</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>.1 Organizational process assets</td>
<td>.1 Data gathering and representation techniques</td>
<td>.1 Risk register (updates)</td>
</tr>
<tr>
<td>.2 Project scope statement</td>
<td>.2 Quantitative risk analysis and modeling techniques</td>
<td></td>
</tr>
<tr>
<td>.3 Risk management plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.4 Risk register</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.5 Project management plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Project schedule management plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Project cost management plan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11-9. Quantitative Risk Analysis: Inputs, Tools & Techniques, and Outputs
11.4.1 Quantitative Risk Analysis: Inputs

.1 Organizational Process Assets
Information on prior, similar completed projects, studies of similar projects by risk
specialists, and risk databases that may be available from industry or proprietary
sources.

.2 Project Scope Statement
Described in Section 5.2.3.1.

.3 Risk Management Plan
Key elements of the risk management plan for Quantitative Risk Analysis include
roles and responsibilities for conducting risk management, budgets, and schedule
activities for risk management, risk categories, the RBS, and revised stakeholders’
risk tolerances.

.4 Risk Register
Key items from the risk register for Quantitative Risk Analysis include the list of
identified risks, the relative ranking or priority list of project risks, and the risks
grouped by categories.

.5 Project Management Plan
The project management plan includes:

- Project schedule management plan. The project schedule management plan
  sets the format and establishes criteria for developing and controlling the
  project schedule (described in the Chapter 6 introductory material).
- Project cost management plan. The project cost management plan sets the
  format and establishes criteria for planning, structuring, estimating,
  budgeting, and controlling project costs (described in the Chapter 7
  introductory material).

11.4.2 Quantitative Risk Analysis: Tools and Techniques

.1 Data Gathering and Representation Techniques

- Interviewing. Interviewing techniques are used to quantify the probability
  and impact of risks on project objectives. The information needed depends
  upon the type of probability distributions that will be used. For instance,
  information would be gathered on the optimistic (low), pessimistic (high),
  and most likely scenarios for some commonly used distributions, and the
  mean and standard deviation for others. Examples of three-point estimates for
  a cost estimate are shown in Figure 11-10. Documenting the rationale of the
  risk ranges is an important component of the risk interview, because it can
  provide information on reliability and credibility of the analysis.
• **Probability distributions.** Continuous probability distributions represent the uncertainty in values, such as durations of schedule activities and costs of project components. Discrete distributions can be used to represent uncertain events, such as the outcome of a test or a possible scenario in a decision tree. Two examples of widely used continuous distributions are shown in Figure 11-11. These asymmetrical distributions depict shapes that are compatible with the data typically developed during the project risk analysis. Uniform distributions can be used if there is no obvious value that is more likely than any other between specified high and low bounds, such as in the early concept stage of design.

![Beta Distribution](image1)

![Triangular Distribution](image2)

Beta and triangular distributions are frequently used in quantitative risk analysis. The data shown here is one example of a family of such distributions determined by two "shape parameters". Other commonly used distributions include the uniform, normal and lognormal. In these charts the horizontal (X) axes represent possible values of time or cost and the vertical (Y) axes represent relative likelihood.

**Figure 11-10. Range of Project Cost Estimates Collected During the Risk Interview**

<table>
<thead>
<tr>
<th>WBS Element</th>
<th>Low</th>
<th>Most Likely</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Build</td>
<td>16</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>Test</td>
<td>11</td>
<td>15</td>
<td>23</td>
</tr>
<tr>
<td>Total Project</td>
<td></td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

The risk interview determines the three-point estimates for each WBS element for triangular or other asymmetrical distributions. In this example, the likelihood of completing the project at or below the traditional estimate of $41 is relatively small as shown in the simulation results (Figure 11-13).

**Figure 11-11. Examples of Commonly Used Probability Distributions**
• **Expert judgment.** Subject matter experts internal or external to the organization, such as engineering or statistical experts, validate data and techniques.

### 11.2 Quantitative Risk Analysis and Modeling Techniques

Commonly used techniques in Quantitative Risk Analysis include:

- **Sensitivity analysis.** Sensitivity analysis helps to determine which risks have the most potential impact on the project. It examines the extent to which the uncertainty of each project element affects the objective being examined when all other uncertain elements are held at their baseline values. One typical display of sensitivity analysis is the tornado diagram, which is useful for comparing relative importance of variables that have a high degree of uncertainty to those that are more stable.

- **Expected monetary value analysis.** Expected monetary value (EMV) analysis is a statistical concept that calculates the average outcome when the future includes scenarios that may or may not happen (i.e., analysis under uncertainty). The EMV of opportunities will generally be expressed as positive values, while those of risks will be negative. EMV is calculated by multiplying the value of each possible outcome by its probability of occurrence, and adding them together. A common use of this type of analysis is in decision tree analysis (Figure 11-12). Modeling and simulation are recommended for use in cost and schedule risk analysis, because they are more powerful and less subject to misuse than EMV analysis.

- **Decision tree analysis.** Decision tree analysis is usually structured using a decision tree diagram (Figure 11-12) that describes a situation under consideration, and the implications of each of the available choices and possible scenarios. It incorporates the cost of each available choice, the probabilities of each possible scenario, and the rewards of each alternative logical path. Solving the decision tree provides the EMV (or other measure of interest to the organization) for each alternative, when all the rewards and subsequent decisions are quantified.
• **Modeling and simulation.** A project simulation uses a model that translates the uncertainties specified at a detailed level of the project into their potential impact on project objectives. Simulations are typically performed using the Monte Carlo technique. In a simulation, the project model is computed many times (iterated), with the input values randomized from a probability distribution function (e.g., cost of project elements or duration of schedule activities) chosen for each iteration from the probability distributions of each variable. A probability distribution (e.g., total cost or completion date) is calculated.

For a cost risk analysis, a simulation can use the traditional project WBS (Section 5.3.3.2) or a cost breakdown structure as its model. For a schedule risk analysis, the precedence diagramming method (PDM) schedule is used (Section 6.2.2.1). A cost risk simulation is shown in Figure 11-13.
11.4.3 Quantitative Risk Analysis: Outputs

1. Risk Register (Updates)

The risk register is initiated in the Risk Identification process (Section 11.2) and updated in Qualitative Risk Analysis (Section 11.3). It is further updated in Quantitative Risk Analysis. The risk register is a component of the project management plan. Updates include the following main components:

- **Probabilistic analysis of the project.** Estimates are made of potential project schedule and cost outcomes, listing the possible completion dates and costs with their associated confidence levels. This output, typically expressed as a cumulative distribution, is used with stakeholder risk tolerances to permit quantification of the cost and time contingency reserves. Such contingency reserves are needed to bring the risk of overrunning stated project objectives to a level acceptable to the organization. For instance, in Figure 11-13, the cost contingency to the 75th percentile is $9, or about 22% versus the $41 sum of the most likely estimates.

- **Probability of achieving cost and time objectives.** With the risks facing the project, the probability of achieving project objectives under the current plan can be estimated using quantitative risk analysis results. For instance, in Figure 11-13, the likelihood of achieving the cost estimate of $41 (from Figure 11-10) is about 12%.

\[\text{Figure 11-13 Cost Risk Simulation Results}\]
• **Prioritized list of quantified risks.** This list of risks includes those that pose the greatest threat or present the greatest opportunity to the project. These include the risks that require the greatest cost contingency and those that are most likely to influence the critical path.

• **Trends in quantitative risk analysis results.** As the analysis is repeated, a trend may become apparent that leads to conclusions affecting risk responses.

### 11.5 Risk Response Planning

Risk Response Planning is the process of developing options, and determining actions to enhance opportunities and reduce threats to the project’s objectives. It follows the Qualitative Risk Analysis and Quantitative Risk Analysis processes. It includes the identification and assignment of one or more persons (the “risk response owner”) to take responsibility for each agreed-to and funded risk response. Risk Response Planning addresses the risks by their priority, inserting resources and activities into the budget, schedule, and project management plan, as needed.

Planned risk responses must be appropriate to the significance of the risk, cost effective in meeting the challenge, timely, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. Selecting the best risk response from several options is often required.

The Risk Response Planning section presents commonly used approaches to planning responses to the risks. Risks include threats and opportunities that can affect project success, and responses are discussed for each.

![Figure 11-14. Risk Response Planning: Inputs, Tools & Techniques, and Outputs](image)

#### 11.5.1 Risk Response Planning: Inputs

1. **Risk Management Plan**

   Important components of the risk management plan include roles and responsibilities, risk analysis definitions, risk thresholds for low, moderate, and high risks, and the time and budget required to conduct Project Risk Management.
Outputs from the Risk Management Planning process that are important inputs to Risk Response Planning can include probabilistic analysis of the project, probability of achieving the cost and time objectives, prioritized list of quantified risks, and trends in quantitative risk analysis results.

.2 Risk Register
The risk register is first developed in the Risk Identification process, and is updated during the Qualitative and Quantitative Risk Analysis processes. The Risk Response Planning process may have to refer back to identified risks, root causes of risks, lists of potential responses, risk owners, symptoms, and warning signs in developing risk responses.

Important inputs to Risk Response Planning include the relative rating or priority list of project risks, a list of risks requiring response in the near term, a list of risks for additional analysis and response, trends in qualitative risk analysis results, root causes, risks grouped by categories, and a watchlist of low priority risks. The risk register is further updated during the Quantitative Risk Analysis process.

11.5.2 Risk Response Planning: Tools and Techniques
Several risk response strategies are available. The strategy or mix of strategies most likely to be effective should be selected for each risk. Risk analysis tools, such as decision tree analysis, can be used to choose the most appropriate responses. Then, specific actions are developed to implement that strategy. Primary and backup strategies may be selected. A fallback plan can be developed for implementation if the selected strategy turns out not to be fully effective, or if an accepted risk occurs. Often, a contingency reserve is allocated for time or cost. Finally, contingency plans can be developed, along with identification of the conditions that trigger their execution.

.1 Strategies for Negative Risks or Threats
Three strategies typically deal with threats or risks that may have negative impacts on project objectives if they occur. These strategies are to avoid, transfer, or mitigate:

- Avoid. Risk avoidance involves changing the project management plan to eliminate the threat posed by an adverse risk, to isolate the project objectives from the risk’s impact, or to relax the objective that is in jeopardy, such as extending the schedule or reducing scope. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise.
• **Transfer.** Risk transference requires shifting the negative impact of a threat, along with ownership of the response, to a third party. Transferring the risk simply gives another party responsibility for its management; it does not eliminate it. Transferring liability for risk is most effective in dealing with financial risk exposure. Risk transference nearly always involves payment of a risk premium to the party taking on the risk. Transference tools can be quite diverse and include, but are not limited to, the use of insurance, performance bonds, warranties, guarantees, etc. Contracts may be used to transfer liability for specified risks to another party. In many cases, use of a cost-type contract may transfer the cost risk to the buyer, while a fixed-price contract may transfer risk to the seller, if the project’s design is stable.

• **Mitigate.** Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk occurring on the project is often more effective than trying to repair the damage after the risk has occurred. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions. Mitigation may require prototype development to reduce the risk of scaling up from a bench-scale model of a process or product. Where it is not possible to reduce probability, a mitigation response might address the risk impact by targeting linkages that determine the severity. For example, designing redundancy into a subsystem may reduce the impact from a failure of the original component.

.2 Strategies for Positive Risks or Opportunities

Three responses are suggested to deal with risks with potentially positive impacts on project objectives. These strategies are to exploit, share, or enhance.

• **Exploit.** This strategy may be selected for risks with positive impacts where the organization wishes to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with a particular upside risk by making the opportunity definitely happen. Directly exploiting responses include assigning more talented resources to the project to reduce the time to completion, or to provide better quality than originally planned.

• **Share.** Sharing a positive risk involves allocating ownership to a third party who is best able to capture the opportunity for the benefit of the project. Examples of sharing actions include forming risk-sharing partnerships, teams, special-purpose companies, or joint ventures, which can be established with the express purpose of managing opportunities.

• **Enhance.** This strategy modifies the “size” of an opportunity by increasing probability and/or positive impacts, and by identifying and maximizing key drivers of these positive-impact risks. Seeking to facilitate or strengthen the cause of the opportunity, and proactively targeting and reinforcing its trigger conditions, might increase probability. Impact drivers can also be targeted, seeking to increase the project’s susceptibility to the opportunity.
.3 Strategy for Both Threats and Opportunities

Acceptance: A strategy that is adopted because it is seldom possible to eliminate all risk from a project. This strategy indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy. It may be adopted for either threats or opportunities. This strategy can be either passive or active. Passive acceptance requires no action, leaving the project team to deal with the threats or opportunities as they occur. The most common active acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle known—or even sometimes potential, unknown—threats or opportunities.

.4 Contingent Response Strategy

Some responses are designed for use only if certain events occur. For some risks, it is appropriate for the project team to make a response plan that will only be executed under certain predefined conditions, if it is believed that there will be sufficient warning to implement the plan. Events that trigger the contingency response, such as missing intermediate milestones or gaining higher priority with a supplier, should be defined and tracked.

11.5.3 Risk Response Planning: Outputs

.1 Risk Register (Updates)

The risk register is developed in Risk Identification, and is updated during Qualitative Risk Analysis and Quantitative Risk Analysis. In the Risk Response Planning process, appropriate responses are chosen, agreed-upon, and included in the risk register. The risk register should be written to a level of detail that corresponds with the priority ranking and the planned response. Often, the high and moderate risks are addressed in detail. Risks judged to be of low priority are included in a “watchlist” for periodic monitoring. Components of the risk register at this point can include:

- Identified risks, their descriptions, area(s) of the project (e.g., WBS element) affected, their causes (e.g., RBS element), and how they may affect project objectives
- Risk owners and assigned responsibilities
- Outputs from the Qualitative and Quantitative Risk Analysis processes, including prioritized lists of project risks and probabilistic analysis of the project
- Agreed-upon response strategies
- Specific actions to implement the chosen response strategy
- Symptoms and warning signs of risks’ occurrence
- Budget and schedule activities required to implement the chosen responses
- Contingency reserves of time and cost designed to provide for stakeholders’ risk tolerances
• Contingency plans and triggers that call for their execution
• Fallback plans for use as a reaction to a risk that has occurred, and the primary response proves to be inadequate
• Residual risks that are expected to remain after planned responses have been taken, as well as those that have been deliberately accepted
• Secondary risks that arise as a direct outcome of implementing a risk response
• Contingency reserves that are calculated based on the quantitative analysis of the project and the organization’s risk thresholds.

.2 Project Management Plan (Updates)
The project management plan is updated as response activities are added after review and disposition through the Integrated Change Control process (Section 4.6). Integrated change control is applied in the Direct and Manage Project Execution process (Section 4.4) to ensure that agreed-upon actions are implemented and monitored as part of the ongoing project. Risk response strategies, once agreed to, must be fed back into the appropriate processes in other Knowledge Areas, including the project’s budget and schedule.

.3 Risk-Related Contractual Agreements
Contractual agreements, such as agreements for insurance, services, and other items as appropriate, can be prepared to specify each party’s responsibility for specific risks, should they occur.

11.6 Risk Monitoring and Control
Planned risk responses (Section 11.5) that are included in the project management plan are executed during the life cycle of the project, but the project work should be continuously monitored for new and changing risks.

Risk Monitoring and Control (Section 4.4) is the process of identifying, analyzing, and planning for newly arising risks, keeping track of the identified risks and those on the watchlist, reanalyzing existing risks, monitoring trigger conditions for contingency plans, monitoring residual risks, and reviewing the execution of risk responses while evaluating their effectiveness. The Risk Monitoring and Control process applies techniques, such as variance and trend analysis, which require the use of performance data generated during project execution. Risk Monitoring and Control, as well as the other risk management processes, is an ongoing process for the life of the project. Other purposes of Risk Monitoring and Control are to determine if:

• Project assumptions are still valid
• Risk, as assessed, has changed from its prior state, with analysis of trends
• Proper risk management policies and procedures are being followed
• Contingency reserves of cost or schedule should be modified in line with the risks of the project.
Risk Monitoring and Control can involve choosing alternative strategies, executing a contingency or fallback plan, taking corrective action, and modifying the project management plan. The risk response owner reports periodically to the project manager on the effectiveness of the plan, any unanticipated effects, and any mid-course correction needed to handle the risk appropriately. Risk Monitoring and Control also includes updating the organizational process assets (Section 4.1.1.4), including project lessons-learned databases and risk management templates for the benefit of future projects.

**Figure 11-15. Risk Monitoring and Control: Inputs, Tools & Techniques, and Outputs**

**11.6.1 Risk Monitoring and Control: Inputs**

**1. Risk Management Plan**
This plan has key inputs that include the assignment of people, including the risk owners, time, and other resources to project risk management.

**2. Risk Register**
The risk register has key inputs that include identified risks and risk owners, agreed-upon risk responses, specific implementation actions, symptoms and warning signs of risk, residual and secondary risks, a watchlist of low priority risks, and the time and cost contingency reserves.

**3. Approved Change Requests**
Approved change requests (Section 4.6.3.1) can include modifications such as work methods, contract terms, scope, and schedule. Approved changes can generate risks or changes in identified risks, and those changes need to be analyzed for any effects upon the risk register, risk response plan, or risk management plan. All changes should be formally documented. Any verbally discussed, but undocumented, changes should not be processed or implemented.

**4. Work Performance Information**
Work performance information (Section 4.4.3.7), including project deliverables’ status, corrective actions, and performance reports, are important inputs to Risk Monitoring and Control.
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.5 Performance Reports
Performance reports (Section 10.3.3.1) provide information on project work performance, such as an analysis that may influence the risk management processes.

11.6.2 Risk Monitoring and Control: Tools and Techniques

.1 Risk Reassessment
Risk Monitoring and Control often requires identification of new risks and reassessment of risks, using the processes of this chapter as appropriate. Project risk reassessments should be regularly scheduled. Project Risk Management should be an agenda item at project team status meetings. The amount and detail of repetition that is appropriate depends on how the project progresses relative to its objectives. For instance, if a risk emerges that was not anticipated in the risk register or included on the watchlist, or if its impact on objectives is different from what was expected, the planned response may not be adequate. It will then be necessary to perform additional response planning to control the risk.

.2 Risk Audits
Risk audits examine and document the effectiveness of risk responses in dealing with identified risks and their root causes, as well as the effectiveness of the risk management process.

.3 Variance and Trend Analysis
Trends in the project’s execution should be reviewed using performance data. Earned value analysis (Section 7.3.2.4) and other methods of project variance and trend analysis may be used for monitoring overall project performance. Outcomes from these analyses may forecast potential deviation of the project at completion from cost and schedule targets. Deviation from the baseline plan may indicate the potential impact of threats or opportunities.

.4 Technical Performance Measurement
Technical performance measurement compares technical accomplishments during project execution to the project management plan’s schedule of technical achievement. Deviation, such as demonstrating more or less functionality than planned at a milestone, can help to forecast the degree of success in achieving the project’s scope.

.5 Reserve Analysis
Throughout execution of the project, some risks may occur, with positive or negative impacts on budget or schedule contingency reserves (Section 11.5.2.4). Reserve analysis compares the amount of the contingency reserves remaining to the amount of risk remaining at any time in the project, in order to determine if the remaining reserve is adequate.
.6 Status Meetings
Project risk management can be an agenda item at periodic status meetings. That item may take no time or a long time, depending on the risks that have been identified, their priority, and difficulty of response. Risk management becomes easier the more often it is practiced, and frequent discussions about risk make talking about risks, particularly threats, easier and more accurate.

11.6.3 Risk Monitoring and Control: Outputs

.1 Risk Register (Updates)
An updated risk register contains:
- Outcomes of risk reassessments, risk audits, and periodic risk reviews. These outcomes may include updates to probability, impact, priority, response plans, ownership, and other elements of the risk register. Outcomes can also include closing risks that are no longer applicable.
- The actual outcomes of the project’s risks, and of risk responses that can help project managers plan for risk throughout the organization, as well as on future projects. This completes the record of risk management on the project, is an input to the Close Project process (Section 4.7), and becomes part of the project closure documents.

.2 Requested Changes
Implementing contingency plans or workarounds frequently results in a requirement to change the project management plan to respond to risks. Requested changes are prepared and submitted to the Integrated Change Control process (Section 4.6) as an output of the Risk Monitoring and Control process. Approved change requests are issued and become inputs to the Direct and Manage Project Execution process (Section 4.4) and to the Risk Monitoring and Control process.

.3 Recommended Corrective Actions
Recommended corrective actions include contingency plans and workaround plans. The latter are responses that were not initially planned, but are required to deal with emerging risks that were previously unidentified or accepted passively. Workarounds should be properly documented and included in both the Direct and Manage Project Execution (Section 4.4) and Monitor and Control Project Work (Section 4.5) processes. Recommended corrective actions are inputs to the Integrated Change Control process (Section 4.6).

.4 Recommended Preventive Actions
Recommended preventive actions are used to bring the project into compliance with the project management plan.
.5 Organizational Process Assets (Updates)
The six Project Risk Management processes produce information that can be used for future projects, and should be captured in the organizational process assets (Section 4.1.1.4). The templates for the risk management plan, including the probability and impact matrix, and risk register, can be updated at project closure. Risks can be documented and the RBS updated. Lessons learned from the project risk management activities can contribute to the lessons learned knowledge database of the organization. Data on the actual costs and durations of project activities can be added to the organization’s databases. The final versions of the risk register and the risk management plan templates, checklists, and RBSs are included.

.6 Project Management Plan (Updates)
If the approved change requests have an effect on the risk management processes, then the corresponding component documents of the project management plan are revised and reissued to reflect the approved changes.
CHAPTER 12

Project Procurement Management

Project Procurement Management includes the processes to purchase or acquire the products, services, or results needed from outside the project team to perform the work. This chapter presents two perspectives of procurement. The organization can be either the buyer or seller of the product, service, or results under a contract.

Project Procurement Management includes the contract management and change control processes required to administer contracts or purchase orders issued by authorized project team members.

Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project from the performing organization (the seller), and administering contractual obligations placed on the project team by the contract.

Figure 12-1 provides an overview of the Project Procurement Management processes, and Figure 12-2 provides a process flow view of the processes and their inputs, outputs, and related processes from other Knowledge Areas.

The Project Procurement Management processes include the following:

12.1 Plan Purchases and Acquisitions – determining what to purchase or acquire and determining when and how.

12.2 Plan Contracting – documenting products, services, and results requirements and identifying potential sellers.

12.3 Request Seller Responses – obtaining information, quotations, bids, offers, or proposals, as appropriate.

12.4 Select Sellers – reviewing offers, choosing among potential sellers, and negotiating a written contract with each seller.

12.5 Contract Administration – managing the contract and relationship between the buyer and seller, reviewing and documenting how a seller is performing or has performed to establish required corrective actions and provide a basis for future relationships with the seller, managing contract-related changes and, when appropriate, managing the contractual relationship with the outside buyer of the project.

12.6 Contract Closure – completing and settling each contract, including the resolution of any open items, and closing each contract applicable to the project or a project phase.
These processes interact with each other and with the processes in the other Knowledge Areas as well. Each process can involve effort from one or more persons or groups of persons, based on the requirements of the project. Each process occurs at least once in every project and occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete components with well-defined interfaces, in practice they overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.

The Project Procurement Management processes involve contracts that are legal documents between a buyer and a seller. A contract is a mutually binding agreement that obligates the seller to provide the specified products, services, or results, and obligates the buyer to provide monetary or other valuable consideration. A contract is a legal relationship subject to remedy in the courts. The agreement can be simple or complex, and can reflect the simplicity or complexity of the deliverables. A contract includes terms and conditions, and can include other items such as the seller's proposal or marketing literature, and any other documentation that the buyer is relying upon to establish what the seller is to perform or provide. It is the project management team's responsibility to help tailor the contract to the specific needs of the project. Depending upon the application area, contracts can also be called an agreement, subcontract, or purchase order. Most organizations have documented policies and procedures specifically defining who can sign and administer such agreements on behalf of the organization.

Although all project documents are subject to some form of review and approval, the legally binding nature of a contract usually means that it will be subjected to a more extensive approval process. In all cases, the primary focus of the review and approval process ensures that the contract language describes products, services, or results that will satisfy the identified project need. In the case of major projects undertaken by public agencies, the review process can include public review of the agreement.

The project management team may seek support early from specialists in the disciplines of contracting, purchasing, and law. Such involvement can be mandated by an organization’s policy.

The various activities involved in the Project Procurement Management processes form the life cycle of a contract. By actively managing the contract life cycle and carefully wording the terms and conditions of the contract, some identifiable project risks can be avoided or mitigated. Entering into a contract for products or services is one method of allocating the responsibility for managing or assuming potential risks.
A complex project can involve managing multiple contracts or subcontracts simultaneously or in sequence. In such cases, each contract life cycle can end during any phase of the project life cycle (see Chapter 2). Project Procurement Management is discussed within the perspective of the buyer-seller relationship. The buyer-seller relationship can exist at many levels on any one project, and between organizations internal to and external to the acquiring organization. Depending on the application area, the seller can be called a contractor, subcontractor, vendor, service provider, or supplier. Depending on the buyer’s position in the project acquisition cycle, the buyer can be called a client, customer, prime contractor, contractor, acquiring organization, governmental agency, service requestor, or purchaser. The seller can be viewed during the contract life cycle first as a bidder, then as the selected source, and then as the contracted supplier or vendor.

The seller will typically manage the work as a project if the acquisition is not just for materiel, goods, or common products. In such cases:

- Buyer becomes the customer, and is thus a key project stakeholder for the seller
- Seller’s project management team is concerned with all the processes of project management, not just with those of this Knowledge Area
- Terms and conditions of the contract become key inputs to many of the seller’s management processes. The contract can actually contain the inputs (e.g., major deliverables, key milestones, cost objectives), or it can limit the project team’s options (e.g., buyer approval of staffing decisions is often required on design projects).

This chapter assumes that the buyer of items for the project is within the project team and that the seller is external to the project team. This relationship is true if the performing organization is the seller of a project to a customer. This relationship is also true if the performing organization is the buyer from other vendors or suppliers of products, services, results, or subproject components used on a project.

This chapter assumes that a formal contractual relationship is developed and exists between the buyer and the seller. However, most of the discussion in this chapter is equally applicable to non-contractual formal agreements entered into with other units of the project team’s organizations.
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Figure 12-1. Project Procurement Management Overview
Note: Not all process interactions and data flow among the processes are shown.

Figure 12-2. Project Procurement Management Process Flow Diagram
12.1 Plan Purchases and Acquisitions

The Plan Purchases and Acquisitions process identifies which project needs can best be met by purchasing or acquiring products, services, or results outside the project organization, and which project needs can be accomplished by the project team during project execution. This process involves consideration of whether, how, what, how much, and when to acquire.

When the project obtains products, services, and results required for project performance from outside the performing organization, the processes from Plan Purchases and Acquisitions through Contract Closure are performed for each item to be purchased or acquired.

The Plan Purchases and Acquisitions process also includes consideration of potential sellers, particularly if the buyer wishes to exercise some degree of influence or control over contracting decisions. Consideration should also be given to who is responsible for obtaining or holding any relevant permits and professional licenses that may be required by legislation, regulation, or organizational policy in executing the project.

The project schedule can significantly influence the Plan Purchases and Acquisitions process. Decisions made in developing the procurement management plan can also influence the project schedule and are integrated with Schedule Development (Section 6.5), Activity Resource Estimating (Section 6.3), and make-or-buy decisions.

The Plan Purchases and Acquisitions process includes reviewing the risks involved in each make-or-buy decision; it also includes reviewing the type of contract planned to be used with respect to mitigating risks and transferring risks to the seller.

Figure 12-3. Plan Purchases and Acquisitions: Inputs, Tools & Techniques, and Outputs
12.1.1 Plan Purchases and Acquisitions: Inputs

.1 Enterprise Environmental Factors
Enterprise environmental factors (Section 4.1.1.3) that are considered include the conditions of the marketplace and what products, services, and results are available in the marketplace, from whom and under what terms and conditions. If the performing organization does not have formal purchasing or contracting groups, then the project team will have to supply both the resources and the expertise to perform project procurement activities.

.2 Organizational Process Assets
Organizational process assets (Section 4.1.1.4) provide the existing formal and informal procurement-related policies, procedures, guidelines, and management systems that are considered in developing the procurement management plan and selecting the contract types to be used. Organizational policies frequently constrain procurement decisions. These policy constraints can include limiting the use of simple purchase orders and requiring all purchases above a certain value to use a longer form of contract, requiring specific forms of contracts, limiting the ability to make specific make-or-buy decisions, and limiting, or requiring, specific types or sizes of sellers.

Organizations in some application areas also have an established multi-tier supplier system of selected and pre-qualified sellers to reduce the number of direct sellers to the organization and establish an extended supply chain.

.3 Project Scope Statement
The project scope statement (Section 5.2.3.1) describes the project boundaries, requirements, constraints, and assumptions related to the project scope. Constraints are specific factors that can limit both the buyer’s and seller’s options. One of the most common constraints for many projects is availability of funds. Other constraints can involve required delivery dates, available skilled resources, and organizational policies. Assumptions are factors that will be considered to be true, and which can include items such as the assumed availability of multiple sellers or a sole-source seller. Requirements with contractual and legal implications can include health, safety, security, performance, environmental, insurance, intellectual property rights, equal employment opportunity, licenses, and permits.

The project scope statement provides important information about project needs and strategies that are considered during the Plan Purchases and Acquisitions process. The project scope statement also provides the list of deliverables and acceptance criteria for the project and its products, services, and results. Consideration is given to all such factors that may need to be included in the procurement documentation and flowed down within a contract to sellers.

The product scope description component of the project scope statement provides important information about any technical issues or concerns related to the products, services, and results of the project that are considered during the Plan Purchases and Acquisitions process.
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The work breakdown structure (WBS) and WBS dictionary components of the project scope statement provide the structured and detailed plan for the project scope:

.4 Work Breakdown Structure
The Work Breakdown Structure (Section 5.3.3.2) provides the relationship among all the components of the project and the project deliverables (Section 4.4).

.5 WBS Dictionary
The WBS dictionary (Section 5.3.3.3) provides detailed statements of work that provide an identification of the deliverables and a description of the work within each WBS component required to produce each deliverable.

.6 Project Management Plan
The project management plan (Section 4.3) provides the overall plan for managing the project and includes subsidiary plans such as a scope management plan, procurement management plan, quality management plan, and contract management plans, which provide guidance and direction for procurement management planning. To the extent that other planning outputs are available, those other planning outputs are considered during the Plan Purchases and Acquisitions process. Other planning outputs that are often considered include:

- Risk register (Section 11.2.3.1). Contains risk-related information such as the identified risks, risk owners, and risk responses.
- Risk-related contractual agreements (Section 11.5.3.3). Includes agreements for insurance, services, and other items as appropriate, that are prepared to specify each party’s responsibility for specific risks, should they occur.
- Activity resource requirements (Section 6.3.3.1).
- Project schedule (Section 6.5.3.1).
- Activity cost estimates (Section 7.1.3.1).
- Cost baseline (Section 7.2.3.1).

12.1.2 Plan Purchases and Acquisitions: Tools and Techniques

.1 Make-or-Buy Analysis
The make-or-buy analysis is a general management technique and a part of the project Plan Purchases and Acquisition process that can be used to determine whether a particular product or service can be produced by the project team or can be purchased. Any project budget constraints are factored in the make-or-buy decisions. If a buy decision is to be made, then a further decision of whether to purchase or rent is also made. The analysis includes both indirect as well as direct costs. For example, the buy-side of the analysis includes both the actual out-of-pocket costs to purchase the product as well as the indirect costs of managing the purchasing process.
In a make-or-buy analysis, if a buy decision is to be made, it also reflects the perspective of the project team’s organization as well as the immediate needs of the project. For example, purchasing an item (anything from a construction crane to a personal computer) rather than renting or leasing it may or may not be cost effective from the perspective of the project. However, if the project team’s organization has an ongoing need for the item, the portion of the purchase cost allocated to the project could be less than the cost of the rental. The cost allocation could be based upon a margin analysis.

The long-range strategy of the project team’s organization is also a component in the make-or-buy analysis. Items needed for the performance of the project may not be available within the organization. However, the organization may anticipate future requirements for those items and the organization’s plans may also be based on making the items in the future. Such considerations can lead to a make decision in spite of the current project constraints and requirements. When this occurs, the costs charged to the project can be less than the actual costs, with the difference representing the organization’s investment for the future.

.2 Expert Judgment
Expert technical judgment will often be required to assess the inputs to and outputs from this process. Expert purchasing judgment can also be used to develop or modify the criteria that will be used to evaluate offers or proposals made by sellers. Expert legal judgment may involve the services of a lawyer to assist with non-standard procurement terms and conditions. Such judgment and expertise, including business expertise and technical expertise, can be applied to both the technical details of the procured products, services, or results and to various aspects of the procurement management processes.

.3 Contract Types
Different types of contracts are more or less appropriate for different types of purchases. The type of contract used and the specific contract terms and conditions set the degree of risk being assumed by both the buyer and seller. Contracts generally fall into one of three broad categories:

• Fixed-price or lump-sum contracts. This category of contract involves a fixed total price for a well-defined product. Fixed-price contracts can also include incentives for meeting or exceeding selected project objectives, such as schedule targets. The simplest form of a fixed-price contract is a purchase order for a specified item to be delivered by a specified date for a specified price.
• **Cost-reimbursable contracts.** This category of contract involves payment (reimbursement) to the seller for seller’s actual costs, plus a fee typically representing seller profit. Costs are usually classified as direct costs or indirect costs. Direct costs are costs incurred for the exclusive benefit of the project (e.g., salaries of full-time project staff). Indirect costs, also called overhead and general and administrative costs, are costs allocated to the project by the project team as a cost of doing business (e.g., salaries of management indirectly involved in the project, cost of electric utilities for the office). Indirect costs are usually calculated as a percentage of direct costs. Cost-reimbursable contracts often include incentive clauses where if the seller meets or exceeds selected project objectives, such as schedule targets or total cost, then the seller receives an incentive or bonus payment. Three common types of cost-reimbursable contracts are CPF, CPFF, and CPIF.

  a. **Cost-Plus-Fee (CPF) or Cost-Plus-Percentage of Cost (CPPC).** Seller is reimbursed for allowable costs for performing the contract work and receives a fee calculated as an agreed-upon percentage of the costs. The fee varies with the actual cost.

  b. **Cost-Plus-Fixed-Fee (CPFF).** Seller is reimbursed for allowable costs for performing the contract work and receives a fixed fee payment calculated as a percentage of the estimated project costs. The fixed fee does not vary with actual costs unless the project scope changes.

  c. **Cost-Plus-Incentive-Fee (CPIF).** Seller is reimbursed for allowable costs for performing the contract work and receives a predetermined fee, an incentive bonus, based upon achieving certain performance objective levels set in the contract. In some CPIF contracts, if the final costs are less than the expected costs, then both the buyer and seller benefit from the cost savings based upon a pre-negotiated sharing formula.

• **Time and Material (T&M) contracts.** T&M contracts are a hybrid type of contractual arrangement that contains aspects of both cost-reimbursable and fixed-price type arrangements. These types of contracts resemble cost-reimbursable type arrangements in that they are open ended. The full value of the agreement and the exact quantity of items to be delivered are not defined by the buyer at the time of the contract award. Thus, T&M contracts can grow in contract value as if they were cost-reimbursable type arrangements. Conversely, T&M arrangements can also resemble fixed-price arrangements. For example, unit rates can be preset by the buyer and seller when both parties agree on the rates for a specific resource category.
The requirements (e.g., standard or custom product version, performance reporting, cost data submittals) that a buyer imposes on a seller, along with other planning considerations such as the degree of market competition and degree of risk, will also determine which type of contract will be used. In addition, the seller can consider some of those specific requirements as items that have additional costs. Another consideration relates to the future potential purchase of the product or service being acquired by the project team. Where such potential can be significant, sellers may be inclined or induced to charge prices that are less than would be the case without such future sale potential. While this can reduce the costs to the project, there are legal ramifications if the buyer promises such potential and it is not, in fact, realized.

12.1.3 Plan Purchases and Acquisitions: Outputs

.1 Procurement Management Plan
The procurement management plan describes how the procurement processes will be managed from developing procurement documentation through contract closure. The procurement management plan can include:

- Types of contracts to be used
- Who will prepare independent estimates and if they are needed as evaluation criteria
- Those actions the project management team can take on its own, if the performing organization has a procurement, contracting, or purchasing department
- Standardized procurement documents, if they are needed
- Managing multiple providers
- Coordinating procurement with other project aspects, such as scheduling and performance reporting
- Constraints and assumptions that could affect planned purchases and acquisitions
- Handling the lead times required to purchase or acquire items from sellers and coordinating them with the project schedule development
- Handling the make-or-buy decisions and linking them into the Activity Resource Estimating and Schedule Development processes
- Setting the scheduled dates in each contract for the contract deliverables and coordinating with the schedule development and control processes
- Identifying performance bonds or insurance contracts to mitigate some forms of project risk
- Establishing the direction to be provided to the sellers on developing and maintaining a contract work breakdown structure
- Establishing the form and format to be used for the contract statement of work
- Identifying pre-qualified selected sellers, if any, to be used
- Procurement metrics to be used to manage contracts and evaluate sellers.
A procurement management plan can be formal or informal, can be highly detailed or broadly framed, and is based upon the needs of the project. The procurement management plan is a subsidiary component of the project management plan (Section 4.3).

.2 Contract Statement of Work
Each contract statement of work defines, for those items being purchased or acquired, just the portion of the project scope that is included within the related contract. The statement of work (SOW) for each contract is developed from the project scope statement, the project work breakdown structure (WBS), and WBS dictionary. The contract SOW describes the procurement item in sufficient detail to allow prospective sellers to determine if they are capable of providing the item. Sufficient detail can vary, based on the nature of the item, the needs of the buyer, or the expected contract form. A contract SOW describes the products, services, or results to be supplied by the seller. Information included in a contract SOW can include specifications, quantity desired, quality levels, performance data, period of performance, work location, and other requirements.

The contract SOW is written to be clear, complete, and concise. It includes a description of any collateral services required, such as performance reporting or post-project operational support for the procured item. In some application areas, there are specific content and format requirements for a contract SOW. Each individual procurement item requires a contract SOW. However, multiple products or services can be grouped as one procurement item within a single contract SOW.

The contract SOW can be revised and refined as required as it moves through the procurement process until incorporated into a signed contract. For example, a prospective seller can suggest a more efficient approach or a less costly product than that originally specified.

.3 Make-or-Buy Decisions
The documented decisions of what project products, services, or results will be either be acquired or will be developed by the project team. This may include decisions to buy insurance policies or performance bonds contracts to address some of the identified risks. The make-or-buy decisions document can be as simple as a listing that includes a short justification for the decision. These decisions can be iterative as subsequent procurement activities indicate a need for a different approach.

.4 Requested Changes
Requested changes (Section 4.4) to the project management plan and its subsidiary plans and other components may result from the Plan Purchases and Acquisition process. Requested changes are processed for review and disposition through the Integrated Change Control process (Section 4.6).
12.2 Plan Contracting

The Plan Contracting process prepares the documents needed to support the Request Seller Responses process and Select Sellers process.

![Figure 12-4. Plan Contracting: Inputs, Tools & Techniques, and Outputs](image)

12.2.1 Plan Contracting: Inputs

1. **Procurement Management Plan**
   - Described in Section 12.1.3.1.

2. **Contract Statement of Work**
   - Described in Section 12.1.

3. **Make-or-Buy Decisions**
   - The make-or-buy decisions (Section 12.1) are documented in the issued list of items to be purchased or acquired and those items to be produced by the project team.

4. **Project Management Plan**
   - The project management plan (Section 4.3) provides other planning output documents, which may have been modified and may need to be reviewed again as part of the procurement documentation development. In particular, development of procurement documentation is closely aligned with scheduled delivery dates in the project schedule (Section 6.5).

   - **Risk register.** Contains risk-related information such as the identified risks, root causes of risks, risk owners, risk analyses results, risk prioritization, risk categorization, and risk responses generated by the risk management processes.

   - **Risk-related contractual agreements** (Section 11.5.3.3). Includes agreements for insurance, services, and other items as appropriate that are prepared to specify each party’s responsibility for specific risks, should they occur.
• **Activity resource requirements** (Section 6.3.3.1).
• **Project schedule** (Section 6.5.3.1).
• **Activity cost estimates** (Section 7.1.3.1).
• **Cost baseline** (Section 7.2.3.1).

### 12.2.2 Plan Contracting: Tools and Techniques

#### .1 Standard Forms
Standard forms include standard contracts, standard descriptions of procurement items, non-disclosure agreements, proposal evaluation criteria checklists, or standardized versions of all parts of the needed bid documents. Organizations that perform substantial amounts of procurement can have many of these documents standardized. Buyer and seller organizations performing intellectual property transactions ensure that non-disclosure agreements are approved and accepted before disclosing any project specific intellectual property information to the other party.

#### .2 Expert Judgment
Described in Section 12.1.2.2.

### 12.2.3 Plan Contracting: Outputs

#### .1 Procurement Documents
Procurement documents are used to seek proposals from prospective sellers. A term such as bid, tender, or quotation is generally used when the seller selection decision will be based on price (as when buying commercial or standard items), while a term such as proposal is generally used when other considerations, such as technical skills or technical approach, are paramount. However, the terms are often used interchangeably and care is taken not to make unwarranted assumptions about the implications of the term used. Common names for different types of procurement documents include invitation for bid, request for proposal, request for quotation, tender notice, invitation for negotiation, and contractor initial response.

The buyer structures procurement documents to facilitate an accurate and complete response from each prospective seller and to facilitate easy evaluation of the bids. These documents include a description of the desired form of the response, the relevant contract statement of work and any required contractual provisions (e.g., a copy of a model contract, non-disclosure provisions). With government contracting, some or all of the content and structure of procurement documents can be defined by regulation.

The complexity and level of detail of the procurement documents should be consistent with the value of, and risk associated with, the planned purchase or acquisition. Procurement documents are rigorous enough to ensure consistent, comparable responses, but flexible enough to allow consideration of seller suggestions for better ways to satisfy the requirements. Inviting the sellers to submit a proposal that is wholly responsive to the request for bid and to provide a proposed alternative solution in a separate proposal can do this.
Issuing a request to potential sellers to submit a proposal or bid is done formally in accordance with the policies of the buyer’s organization, which can include publication of the request in public newspapers, in magazines, in public registries, or on the Internet.

.2 Evaluation Criteria
Evaluation criteria are developed and used to rate or score proposals. They can be objective (e.g., “The proposed project manager needs to be a certified Project Management Professional, PMP®”) or subjective (e.g., “The proposed project manager needs to have documented previous experience with similar projects”). Evaluation criteria are often included as part of the procurement documents.

Evaluation criteria can be limited to purchase price if the procurement item is readily available from a number of acceptable sellers. Purchase price in this context includes both the cost of the item and ancillary expenses such as delivery.

Other selection criteria can be identified and documented to support an assessment for a more complex product or service. For example:

- **Understanding of need.** How well does the seller’s proposal address the contract statement of work?
- **Overall or life-cycle cost.** Will the selected seller produce the lowest total cost (purchase cost plus operating cost)?
- **Technical capability.** Does the seller have, or can the seller be reasonably expected to acquire, the technical skills and knowledge needed?
- **Management approach.** Does the seller have, or can the seller be reasonably expected to develop, management processes and procedures to ensure a successful project?
- **Technical approach.** Do the seller’s proposed technical methodologies, techniques, solutions, and services meet the procurement documentation requirements or are they likely to provide more than the expected results?
- **Financial capacity.** Does the seller have, or can the seller reasonably be expected to obtain, the necessary financial resources?
- **Production capacity and interest.** Does the seller have the capacity and interest to meet potential future requirements?
- **Business size and type.** Does the seller’s enterprise meet a specific type or size of business, such as small business, women-owned, or disadvantaged small business, as defined by the buyer or established by governmental agency and set as a condition of being award a contract?
- **References.** Can the seller provide references from prior customers verifying the seller’s work experience and compliance with contractual requirements?
- **Intellectual property rights.** Does the seller assert intellectual property rights in the work processes or services they will use or in the products they will produce for the project?
- **Proprietary rights.** Does the seller assert proprietary rights in the work processes or services they will use or in the products they will produce for the project?
3 **Contract Statement of Work (Updates)**

Modifications to one or more contract statements of work (Section 12.1.3.2) can be identified during procurement documentation development.

### 12.3 Request Seller Responses

The Request Seller Responses process obtains responses, such as bids and proposals, from prospective sellers on how project requirements can be met. The prospective sellers, normally at no direct cost to the project or buyer, expend most of the actual effort in this process.

**Figure 12-5. Request Seller Responses: Inputs, Tools & Techniques, and Outputs**

#### 12.3.1 Request Seller Responses: Inputs

1 **Organizational Process Assets**

Some organizations, as part of their organizational process assets, maintain lists or files with information on prospective and previously qualified sellers, sometimes called bidders, who can be asked to bid, propose, or quote on work. These lists will generally have information on relevant past experience and other characteristics of the prospective sellers. Some organizations maintain preferred sellers lists that include only sellers already selected through some qualification methodology.

2 **Procurement Management Plan**

Described in Section 12.1.3.1.

3 **Procurement Documents**

Described in Section 12.2.3.1.
12.3.2 Request Seller Responses: Tools and Techniques

.1 Bidder Conferences
Bidder conferences (also called contractor conferences, vendor conferences, and pre-bid conferences) are meetings with prospective sellers prior to preparation of a bid or proposal. They are used to ensure that all prospective sellers have a clear, common understanding of the procurement (e.g., technical requirements and contract requirements). Responses to questions can be incorporated into the procurement documents as amendments. All potential sellers are given equal standing during this initial buyer and seller interaction to produce the best bid.

.2 Advertising
Existing lists of potential sellers can often be expanded by placing advertisements in general circulation publications such as newspapers or in specialty publications such as professional journals. Some government jurisdictions require public advertising of certain types of procurement items; most government jurisdictions require public advertising of pending government contracts.

.3 Develop Qualified Sellers List
Qualified sellers lists can be developed from the organizational assets if such lists or information are readily available. Whether or not that data is available, the project team can also develop its own sources. General information is widely available through the Internet, library directories, relevant local associations, trade catalogs, and similar sources. Detailed information on specific sources can require more extensive effort, such as site visits or contact with previous customers. Procurement documents (Section 12.2.3.1) can also be sent to determine if some or all of the prospective sellers have an interest in becoming a qualified potential seller.

12.3.3 Request Seller Responses: Outputs

.1 Qualified Sellers List
The qualified sellers list are those sellers who are asked to submit a proposal or quotation.

.2 Procurement Document Package
The procurement document package is a buyer-prepared formal request sent to each seller and is the basis upon which a seller prepares a bid for the requested products, services, or results that are defined and described in the procurement documentation.
Proposals

Proposals are seller-prepared documents that describe the seller’s ability and willingness to provide the requested products, services, or results described in the procurement documentation. Proposals are prepared in accordance with the requirements of the relevant procurement documents and reflect the application of applicable contract principles. The seller’s proposal constitutes a formal and legal offer in response to a buyer’s request. After a proposal is formally submitted, the buyer sometimes requests the seller to supplement its proposals with an oral presentation. The oral presentation is meant to provide additional information with respect to the seller’s proposed staff, management proposal, and technical proposal, which can be used by the buyer in evaluating the seller’s proposal.

Select Sellers

The Select Sellers process receives bids or proposals and applies evaluation criteria, as applicable, to select one or more sellers who are both qualified and acceptable as a seller. Many factors such as the following can be evaluated in the seller selection decision process:

- Price or cost can be the primary determinant for an off-the-shelf item, but the lowest proposed price may not be the lowest cost if the seller proves unable to deliver the products, services, or results in a timely manner.
- Proposals are often separated into technical (approach) and commercial (price) sections, with each evaluated separately. Sometimes, management sections are required as part of the proposal and also have to be evaluated.
- Multiple sources could be required for critical products, services, and results to mitigate risks that can be associated with issues such as delivery schedules and quality requirements. The potentially higher cost associated with such multiple sellers, including any loss of possible quantity discounts, and replacement and maintenance issues, are considered.

The tools and techniques described here can be used alone or in combination to select sellers. For example, a weighting system can be used to:

- Select a single seller that will be asked to sign a standard contract.
- Establish a negotiating sequence by ranking all proposals by the weighed evaluation scores assigned to each proposal.

On major procurement items, the overall process of requesting responses from sellers and evaluating sellers’ responses can be repeated. A short list of qualified sellers can be established based on a preliminary proposal. A more detailed evaluation can then be conducted based on a more detailed and comprehensive proposal that is requested from the sellers on the short list.
12.4.1 Select Sellers: Inputs

1. **Organizational Process Assets**
   The organizational process assets of the organizations involved in project procurement typically have formal policies that affect the evaluation of proposals.

2. **Procurement Management Plan**
   Described in Section 12.1.3.1.

3. **Evaluation Criteria**
   Evaluation criteria (Section 12.2.3.2) can include samples of the supplier’s previously produced products, services, or results for the purpose of providing a way to evaluate the supplier’s capabilities and quality of products. Evaluation criteria also can include a review of the supplier’s history with the contracting organization and others.

4. **Procurement Document Package**
   Described in Section 12.3.3.2.

5. **Proposals**
   Seller proposals prepared in response to a procurement document package (Section 12.3.3.3) form the basic set of information that will be used by an evaluation body to select one or more successful bidders (sellers).

6. **Qualified Sellers List**
   Described in Section 12.3.3.1.

7. **Project Management Plan**
   The project management plan provides the overall plan for managing the project and includes subsidiary plans and other components. To the extent that other component documents are available, they are considered during the Select Sellers process. Other documents that are often considered include:
   - **Risk register** (Section 11.5.1.2).
   - **Risk-related contractual agreements** (Section 11.5.3.3).
12.4.2 Select Sellers: Tools and Techniques

.1 Weighting System
A weighting system is a method for quantifying qualitative data to minimize the effect of personal prejudice on seller selection. Most such systems involve assigning a numerical weight to each of the evaluation criteria, rating the prospective sellers on each criterion, multiplying the weight by the rating, and totaling the resultant products to compute an overall score.

.2 Independent Estimates
For many procurement items, the procuring organization can either prepare its own independent estimates or have prepared an independent estimate of the costs as a check on proposed pricing. This independent estimate is sometimes referred to as a “should-cost” estimate. Significant differences from these cost estimates can be an indication that the contract statement of work was not adequate, that the prospective seller either misunderstood or failed to respond fully to the contract statement of work, or that the marketplace changed.

.3 Screening System
A screening system involves establishing minimum requirements of performance for one or more of the evaluation criteria, and can employ a weighting system and independent estimates. For example, a prospective seller might be required to propose a project manager who has specific qualifications before the remainder of the proposal would be considered. These screening systems are used to provide a weighted ranking from best to worst for all sellers who submitted a proposal.

.4 Contract Negotiation
Contract negotiation clarifies the structure and requirements of the contract so that mutual agreement can be reached prior to signing the contract. Final contract language reflects all agreements reached. Subjects covered include responsibilities and authorities, applicable terms and law, technical and business management approaches, proprietary rights, contract financing, technical solution, overall schedule, payments, and price. Contract negotiations conclude with a document that can be signed by both buyer and seller, that is, the contract. The final contract can be a revised offer by the seller or a counter offer by the buyer.

For complex procurement items, contract negotiation can be an independent process with inputs (e.g., an issues or open items list) and outputs (e.g., documented decisions) of its own. For simple procurement items, the terms and conditions of the contract can be fixed and non-negotiable, and only need to be accepted by the seller.

The project manager may not be the lead negotiator on the contract. The project manager and other members of the project management team may be present during negotiations to provide, if needed, any clarification of the project’s technical, quality, and management requirements.
.5 Seller Rating Systems
Seller rating systems are developed by many organizations and use information such as the seller’s past performance, quality ratings, delivery performance, and contractual compliance. The seller performance evaluation documentation generated during the Contract Administration process for previous sellers is one source of relevant information. These rating systems are used in addition to the proposal evaluations screening system to select sellers.

.6 Expert Judgment
Expert judgment is used in evaluating seller proposals. The evaluation of proposals is accomplished by a multi-discipline review team with expertise in each of the areas covered by the procurement documents and proposed contract. This can include expertise from functional disciplines, such as contracts, legal, finance, accounting, engineering, design, research, development, sales, and manufacturing.

.7 Proposal Evaluation Techniques
Many different techniques can be used to rate and score proposals, but all will use some expert judgment and some form of evaluation criteria (Section 12.2.3.2). The evaluation criteria can involve both objective and subjective components. Evaluation criteria, when used for a formalized proposal evaluation, are usually assigned predefined weightings with respect to each other. The proposal evaluation then uses inputs from multiple reviewers that are obtained during the Select Sellers process, and any significant differences in scoring are resolved. An overall assessment and comparison of all proposals can then be developed using a weighting system that determines the total weighted score for each proposal. These proposal evaluation techniques also can employ a screening system and use data from a seller rating system.

12.4.3 Select Sellers: Outputs

.1 Selected Sellers
The sellers selected are those sellers who have been judged to be in a competitive range based upon the outcome of the proposal or bid evaluation, and who have negotiated a draft contract, which will be the actual contract when an award is made.

.2 Contract
A contract is awarded to each selected seller. The contract can be in the form of a complex document or a simple purchase order. Regardless of the document’s complexity, a contract is a mutually binding legal agreement that obligates the seller to provide the specified products, services, or results, and obligates the buyer to pay the seller. A contract is a legal relationship subject to remedy in the courts. The major components in a contract document generally include, but are not limited to, section headings, statement of work, schedule, period of performance, roles and responsibilities, pricing and payment, inflation adjustments, acceptance criteria, warranty, product support, limitation of liability, fees, retainage, penalties, incentives, insurance, performance bonds, subcontractor approval, change request handling, and a termination and disputes resolution mechanism.
Chapter 12 – Project Procurement Management

.3 Contract Management Plan
For significant purchases or acquisitions, a plan to administer the contract is prepared based upon the specific buyer-specified items within the contract such as documentation, and delivery and performance requirements that the buyer and seller must meet. The plan covers the contract administration activities throughout the life of the contract. Each contract management plan is a subset of the project management plan.

.4 Resource Availability
The quantity and availability of resources and those dates on which each specific resource can be active or idle are documented.

.5 Procurement Management Plan (Updates)
The procurement management plan (Section 12.1.3.1) is updated to reflect any approved change requests (Section 4.4.1.4) that affect procurement management.

.6 Requested Changes
Requested changes to the project management plan and its subsidiary plans and other components, such as the project schedule (Section 6.5.3.1) and procurement management plan, may result from the Select Sellers process. Requested changes are processed for review and disposition through the Integrated Change Control process (Section 4.6).

12.5 Contract Administration
Both the buyer and the seller administer the contract for similar purposes. Each party ensures that both it and the other party meet their contractual obligations and that their own legal rights are protected. The Contract Administration process ensures that the seller’s performance meets contractual requirements and that the buyer performs according to the terms of the contract. On larger projects with multiple products, services, and results providers, a key aspect of contract administration is managing interfaces among the various providers.

The legal nature of the contractual relationship makes it imperative that the project management team is acutely aware of the legal implications of actions taken when administering any contract. Because of the legal considerations, many organizations treat contract administration as an administrative function separate from the project organization. While a contract administrator may be on the project team, this individual typically reports to a supervisor from a different department. This is usually true if the performing organization is also the seller of the project to an external customer.

Contract Administration includes application of the appropriate project management processes to the contractual relationship(s), and integration of the outputs from these processes into overall management of the project. This integration will often occur at multiple levels when there are multiple sellers and multiple products, services, or results involved. The project management processes that are applied include, but are not limited to:
• Direct and Manage Project Execution (Section 4.4) to authorize the contractor’s work at the appropriate time
• Performance Reporting (Section 10.3) to monitor contractor cost, schedule, and technical performance
• Perform Quality Control (Section 8.3) to inspect and verify the adequacy of the contractor’s product
• Integrated Change Control (Section 4.6) to assure that changes are properly approved, and that all those with a need to know are aware of such changes
• Risk Monitoring and Control (Section 11.6) to ensure that risks are mitigated.

Contract administration also has a financial management component that involves monitoring of payments to the seller. This ensures that payment terms defined within the contract are met and that seller compensation is linked to seller progress, as defined in the contract.

The Contract Administration process reviews and documents how well a seller is performing or has performed based on the contract and established corrective actions. Also, the performance is documented as a basis for future relationships with the seller. Seller performance evaluation by the buyer is primarily carried out to confirm the competency or lack of competency of the seller, relative to performing similar work on the project or other projects. Similar evaluations are also carried out when it is necessary to confirm that a seller is not meeting the seller’s contractual obligations, and when the buyer contemplates corrective actions. Contract administration includes managing any early termination (Section 12.6) of the contracted work (for cause, convenience, or default) in accordance with the termination clause of the contract.

Contracts can be amended any time prior to contract closure by mutual consent, in accordance with the change control terms of the contract. Such amendments may not always be equally beneficial to both the seller and the buyer.
12.5.1 Contract Administration: Inputs

.1 Contract
Described in Section 12.4.3.2.

.2 Contract Management Plan
Described in Section 12.4.3.3.

.3 Selected Sellers
Described in Section 12.4.3.1.

.4 Performance Reports
Seller performance-related documentation includes:
- Seller-developed technical documentation and other deliverables information provided in accordance with the terms of the contract
- Seller performance reports (Section 10.3.3.1).

.5 Approved Change Requests
Approved changes requests can include modifications to the terms and conditions of the contract, including the contract statement of work, pricing, and description of the products, services, or results to be provided. All changes are formally documented in writing and approved before being implemented. Any verbally discussed, but undocumented, changes do not need to be processed or implemented.

.6 Work Performance Information
Work performance information (Section 4.4.3.7), including the extent to which quality standards are being met, what costs have been incurred or committed, seller invoices, etc., is collected as part of project execution. The seller’s performance reports indicate which deliverables have been completed and which have not. The seller must also submit invoices (sometimes called bills or requests for payment) on a timely basis to request payment for work performed. Invoicing requirements, including necessary supporting documentation, are defined within the contract.

12.5.2 Contract Administration: Tools and Techniques

.1 Contract Change Control System
A contract change control system defines the process by which the contract can be modified. It includes the paperwork, tracking systems, dispute resolution procedures, and approval levels necessary for authorizing changes. The contract change control system is integrated with the integrated change control system.
.2 **Buyer-Conducted Performance Review**  
A procurement performance review is a structured review of the seller’s progress to deliver project scope and quality, within cost and on schedule, as compared to the contract. It can include a review of seller-prepared documentation and buyer inspections, as well as quality audits conducted during seller’s execution of the work. The objective of a performance review is to identify performance successes or failures, progress with respect to the contract statement of work, and contract non-compliance that allows the buyer to quantify the seller’s demonstrated ability or inability to perform work.

.3 **Inspections and Audits**  
Inspections and audits (Section 8.2.2.2), required by the buyer and supported by the seller as specified in the contract documentation, can be conducted during execution of the project to identify any weaknesses in the seller’s work processes or deliverables. If authorized by contract, some inspection and audit teams can include buyer procurement personnel.

.4 **Performance Reporting**  
Performance reporting provides management with information about how effectively the seller is achieving the contractual objectives. Contract performance reporting is integrated into performance reporting (Section 10.3.3.1).

.5 **Payment System**  
Payments to the seller are usually handled by the accounts payable system of the buyer. On larger projects with many or complex procurement requirements, the project can develop its own payment system. In either case, the payment system includes appropriate reviews and approvals by the project management team, and payments are made in accordance with the terms of the contract (Section 12.4.3.2).

.6 **Claims Administration**  
Contested changes and constructive changes are those requested changes (Section 4.4.3.2) where the buyer and seller cannot agree on compensation for the change, or cannot agree that a change has even occurred. These contested changes are variously called claims, disputes, or appeals. Claims are documented, processed, monitored, and managed throughout the contract life cycle, usually in accordance with the terms of the contract. If the parties themselves do not resolve a claim, it may have to be handled in accordance with the dispute resolution procedures established in the contract. These contract clauses can involve arbitration or litigation, and can be invoked prior to or after contract closure.

.7 **Records Management System**  
A records management system is a specific set of processes, related control functions, and automation tools that are consolidated and combined into a whole, as part of the project management information system (Section 4.2.2.2). A records management system is used by the project manager to manage contract documentation and records. The system is used to maintain an index of contract documents and correspondence, and assist with retrieving and archiving that documentation.
.8 Information Technology
The use of information and communication technologies can enhance the efficiency and effectiveness of contract administration by automating portions of the records management system, payment system, claims administration, or performance reporting and providing electronic data interchange between the buyer and seller.

12.5.3 Contract Administration: Outputs

.1 Contract Documentation
Contract documentation includes, but is not limited to, the contract (Section 12.4.3.2), along with all supporting schedules, requested unapproved contract changes, and approved change requests. Contract documentation also includes any seller-developed technical documentation and other work performance information, such as deliverables, seller performance reports, warranties, financial documents including invoices and payment records, and the results of contract-related inspections.

.2 Requested Changes
Requested changes to the project management plan and its subsidiary plans and other components, such as the project schedule (Section 6.5.3.1) and procurement management plan (Section 12.1.3.1), may result from the Contract Administration process. Requested changes are processed for review and approval through the Integrated Change Control process (Section 4.6).

  Requested changes can include direction provided by the buyer, or actions taken by the seller, that the other party considers a constructive change to the contract. Since any of these constructive changes may be disputed by one party and can lead to a claim against the other party, such changes are uniquely identified and documented by project correspondence.

.3 Recommended Corrective Actions
A recommended corrective action is anything that needs to be done to bring the seller in compliance with the terms of the contract.

.4 Organizational Process Assets (Updates)
• Correspondence. Contract terms and conditions often require written documentation of certain aspects of buyer/seller communications, such as warnings of unsatisfactory performance and requests for contract changes or clarifications. This can include the reported results of buyer audits and inspections that indicate weaknesses the seller needs to correct. In addition to specific contract requirements for documentation, a complete and accurate written record of all written and oral contract communications, as well as actions taken and decisions made, are maintained by both parties.

• Payment schedules and requests. This assumes that the project is using an external payment system. If the project has its own internal system, the output here would simply be payments.
• **Seller performance evaluation documentation.** Seller performance evaluation documentation is prepared by the buyer. Such performance evaluations document the seller’s ability to continue to perform work on the current contract, indicate if the seller can be allowed to perform work on future projects, or rate how well the seller is performing the project work. These documents can form the basis for early termination of the seller’s contract, or determining how contract penalties, fees, or incentives are administered. The results of these performance evaluations can also be included in the appropriate qualified seller lists (Section 12.3.3.1).

.5 **Project Management Plan (Updates)**

• **Procurement management plan.** The procurement management plan (Section 12.1.3.1) is updated to reflect any approved change requests that affect procurement management.

• **Contract management plan.** Each contract management plan (Section 12.4.3.3) is updated to reflect any approved change requests that affect contract administration.

### 12.6 Contract Closure

The Contract Closure process supports the Close Project process (Section 4.7), since it involves verification that all work and deliverables were acceptable. The Contract Closure process also involves administrative activities, such as updating records to reflect final results and archiving such information for future use. Contract closure addresses each contract applicable to the project or a project phase. In multi-phase projects, the term of a contract may only be applicable to a given phase of the project. In these cases, the Contract Closure process closes the contract(s) applicable to that phase of the project. Unresolved claims may be subject to litigation after contract closure. The contract terms and conditions can prescribe specific procedures for contract closure.

Early termination of a contract is a special case of contract closure, and can result from a mutual agreement of the parties or from the default of one of the parties. The rights and responsibilities of the parties in the event of an early termination are contained in a terminations clause of the contract. Based upon those contract terms and conditions, the buyer may have the right to terminate the whole contract or a portion of the project, for cause or convenience, at any time. However, based upon those contract terms and conditions, the buyer may have to compensate the seller for seller’s preparations and for any completed and accepted work related to the terminated part of the contract.
### 12.6.1 Contract Closure: Inputs

1. **Procurement Management Plan**  
   Described in Section 12.1.3.1

2. **Contract Management Plan**  
   Described in Section 12.4.3.3.

3. **Contract Documentation**  
   Described in Section 12.5.3.1.

4. **Contract Closure Procedure**  
   Described in Section 4.7.3.2.

### 12.6.2 Contract Closure: Tools and Techniques

1. **Procurement Audits**  
   A procurement audit is a structured review of the procurement process from the Plan Purchases and Acquisitions process (Section 12.1) through Contract Administration (Section 12.5). The objective of a procurement audit is to identify successes and failures that warrant recognition in the preparation or administration of other procurement contracts on the project, or on other projects within the performing organization.

2. **Records Management System**  
   Described in Section 12.5.
12.6.3 Contract Closure: Outputs

.1 Closed Contracts
The buyer, usually through its authorized contract administrator, provides the seller with formal written notice that the contract has been completed. Requirements for formal contract closure are usually defined in the terms of the contract, and would be included in the contract management plan, if one was prepared.

.2 Organizational Process Assets (Updates)
- Contract file. A complete set of indexed contract documentation, including the closed contract, is prepared for inclusion with the final project files (Section 4.7.3.4).
- Deliverable acceptance. The buyer, usually through its authorized contract administrator, provides the seller with formal written notice that the deliverables have been accepted or rejected. Requirements for formal deliverable acceptance, and how to address non-conforming deliverables, are usually defined in the contract.
- Lessons learned documentation. Lessons learned analysis and process improvement recommendations are developed for future purchasing and acquisition planning and implementation.
Appendices

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<th>Description</th>
</tr>
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<td>Appendix C</td>
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<td>Appendix F</td>
<td>Summary of Project Management Knowledge Areas</td>
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APPENDIX A – THIRD EDITION

CHANGES


Structural Changes

One of the most pronounced changes to the Third Edition of the PMBOK® Guide is the structure. The Third Edition is structured to emphasize the importance of the Process Groups as described in Table 1, which displays a side-by-side comparison of the changes. Chapter 3 is renamed “Project Management Processes for a Project” and has been moved from Section I to a new Section II, which is now called “The Standard for Project Management of a Project.” As part of this change, Chapter 3 has been extensively revised to clearly indicate that the processes, inputs, and outputs called out in the chapter are the basis of the standard for project management of a single project.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>Section I - The Project Management Framework Chapters 1 and 2</td>
</tr>
<tr>
<td>Section II - The Project Management Knowledge Areas Chapters 4 through 12</td>
<td>Section II - The Standard for Project Management of a Project Chapter 3 - Project Management Processes for a Project</td>
</tr>
<tr>
<td>Section III - Appendices Appendix D - Notes Appendix E - Application Area Extensions</td>
<td>Section III - The Project Management Knowledge Areas Chapters 4 through 12</td>
</tr>
<tr>
<td>Section IV - Glossary and Index</td>
<td>Section IV - Appendices Appendix D - Application Area Extensions</td>
</tr>
<tr>
<td></td>
<td>Section V – References, Glossary, and Index</td>
</tr>
</tbody>
</table>

Table 1 – Structural Changes
Appendix A – Third Edition Changes

Process Name Changes

In the Third Edition, seven processes have been added, thirteen renamed, and two deleted for a net gain of five processes.

The names of processes in the various chapters of the PMBOK® Guide – 2000 Edition are in different formats and styles. Inconsistent naming styles can cause confusion for project management students and experienced individuals as well. As an example, the processes in the Scope Knowledge Area are Initiation, Scope Planning, Scope Definition, Scope Verification, and Scope Change Control. Some of these are active voice; some are present participles. The effect of these different styles is that readers are unable, at a glance, to determine whether a term is an activity (a process) or a deliverable (a work-product or artifact). The project team proposed a wholesale change of all process names to the verb-object format in the PMBOK® Guide – Third Edition. However, PMI was concerned that changing all of the names would be too large a change; therefore, PMI authorized only an incremental change in the PMBOK® Guide – Third Edition to include only those approved new processes and a small number of other processes for specific reasons explained later in this appendix.

Elimination of Facilitating and Core Process Designations

The terms “Facilitating Processes” and “Core Processes” are no longer used. These terms have been eliminated to ensure that all project management processes in the Project Management Process Groups have the same level of importance. The project management processes are still grouped within the Project Management Process Groups, as indicated in Figure 3-5 Initiating Process Group; Figure 3-6 Planning Process Group; Figure 3-7 Executing Process Group; Figure 3-8 Monitoring and Controlling Process Group; and Figure 3-9 Closing Process Group. The 44 project management processes are mapped into both the Project Management Process Groups and the Knowledge Areas, as shown in Table 3-45.

Writing Styles

A Style Guide was developed and used by the project team to create and finalize the input. Attention was focused on using active voice language and content consistency throughout the document to prevent an occurrence of different writing styles.
Chapter 1 - Introduction Changes

Chapter 1 changes clarify and improve organization within the chapter. Chapter 1 clarifies the differences between a project and operations. The changes provide standard definitions for program and program management, portfolio and portfolio management, and include a more detailed discussion of project management office (PMO) variations. Additional revisions include the following:

- General management skills have been moved to Chapter 1
- A section identifying the many areas of expertise needed by the project team has been added.

Chapter 2 - Project Life Cycle and Organization Changes

Chapter 2 changes clarify the distinctions between project life cycles and product life cycles, and explain project phases. Stakeholders are defined in relation to the project team. A PMO’s role and responsibility in the organization are defined, and the concept of a project management system is introduced.

Chapter 3 - Project Management Processes for a Project Changes

Chapter 3 has been completely rewritten and expanded to focus on the Project Management Process Groups and processes within the Knowledge Areas. For emphasis, Chapter 3 has been renamed “Project Management Processes for a Project” and moved into a new Section II, “The Standard for Project Management of a Project.” Chapter 3 has been extensively revised to serve as a standard for managing a single project and clearly indicates the five required Project Management Process Groups and their constituent processes. The Initiating Process Group and the Closing Process Group are given more emphasis than in previous editions. The Controlling Process Group has been expanded to include Monitoring and is retitled the “Monitoring and Controlling Process Group.” Material has been added to clarify the distinction between the Project Management Process Groups and project phases, which have sometimes mistakenly been viewed as one and the same.

Chapter 4 - Project Integration Management Changes

Chapter 4 has been completely rewritten and enhances the discussion of integrating project management processes and activities. The chapter describes integration from the aspect of the Project Management Process Groups, and provides a clear description of integration across all Project Management Process Groups and among all project management processes. Four new processes are included in the chapter and two processes have been renamed:
• Develop Project Charter process formally authorizes a project.
• Develop Preliminary Project Scope Statement process provides a high-level scope narrative.
• Develop Project Management Plan process documents the actions necessary to define, prepare, integrate, and coordinate all subsidiary plans into the project management plan.
• Direct and Manage Project Execution process executes the work defined in the project management plan to achieve the project’s objectives.
• Monitor and Control Project Work process defines the processes to monitor and control the project activities needed to initiate, plan, execute, and close a project.
• Close Project process finalizes all activities across all of the Process Groups to formally close the project.

The following table summarizes the Chapter 4 changes:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>4.1 Develop Project Charter</td>
<td>4.1 Develop Project Charter</td>
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<tr>
<td>4.2 Develop Preliminary Project Scope Statement</td>
<td>4.2 Develop Preliminary Project Scope Statement</td>
</tr>
<tr>
<td>4.1 Project Plan Development</td>
<td>4.3 Develop Project Management Plan</td>
</tr>
<tr>
<td>4.2 Project Plan Execution</td>
<td>4.4 Direct and Manage Project Execution</td>
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<tr>
<td>4.3 Integrated Change Control</td>
<td>4.5 Monitor and Control Project Work</td>
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<td></td>
<td>4.6 Integrated Change Control</td>
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<td></td>
<td>4.7 Close Project</td>
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</tbody>
</table>

Table 2 – Chapter 4 Changes

Chapter 5 - Project Scope Management Changes

Chapter 5 has been modified to clarify the role of the project scope management plan in developing the project scope statement. The chapter expands the discussion and clarifies the importance of a work breakdown structure (WBS), with the addition of a new section on creating the WBS. The Initiation section has been rewritten and moved to Chapter 4. The following table summarizes the Chapter 5 changes:

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>5.1 Initiation</td>
<td>Rewritten and moved to Chapter 4</td>
</tr>
<tr>
<td>5.2 Scope Planning</td>
<td>5.1 Scope Planning</td>
</tr>
<tr>
<td>5.3 Scope Definition</td>
<td>5.2 Scope Definition</td>
</tr>
<tr>
<td></td>
<td>5.3 Create WBS</td>
</tr>
<tr>
<td>5.4 Scope Verification</td>
<td>5.4 Scope Verification</td>
</tr>
<tr>
<td>5.5 Scope Change Control</td>
<td>5.5 Scope Control</td>
</tr>
</tbody>
</table>

Table 3 – Chapter 5 Changes
Chapter 6 - Project Time Management Changes

Chapter 6 changes include moving the Resource Planning section into the chapter and renaming it Activity Resource Estimating. Several figures have been deleted (e.g., PERT) and other figures reworked to clarify the use and meaning (e.g., bar or Gantt chart, milestone chart). Another figure has been added to show the difference between a milestone schedule, summary schedule, and detailed schedule. The chapter introduction describes the need for a schedule management plan, a subsidiary component of the project management plan. Subsections have also been added to provide information on project cost estimates, resource leveling, and progress reporting to reflect how these processes influence the project’s schedule. The following table summarizes the Chapter 6 changes:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>6.1 Activity Definition</td>
<td>6.1 Activity Definition</td>
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<tr>
<td>6.2 Activity Sequencing</td>
<td>6.2 Activity Sequencing</td>
</tr>
<tr>
<td>6.4 Activity Duration Estimating</td>
<td>6.4 Activity Duration Estimating</td>
</tr>
<tr>
<td>6.5 Schedule Development</td>
<td>6.5 Schedule Development</td>
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<tr>
<td>6.6 Schedule Control</td>
<td>6.6 Schedule Control</td>
</tr>
</tbody>
</table>

Table 4 – Chapter 6 Changes

Chapter 7 - Project Cost Management Changes

Chapter 7 processes have been expanded to integrate project budget directly with the WBS and to cover controlling costs. There are significant structural changes to the inputs, tools and techniques, as well. The chapter introduction describes the need for a cost management plan, a subsidiary component of the project management plan. The Resource Planning process has been moved to Chapter 6 and renamed Activity Resource Estimating. This chapter contains the majority of the information on Earned Value Management. The following table summarizes the Chapter 7 changes:

<table>
<thead>
<tr>
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<tr>
<td>7.1 Resource Planning</td>
<td>Moved to Project Time Management (Chapter 6)</td>
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<tr>
<td>7.2 Cost Estimating</td>
<td>7.1 Cost Estimating</td>
</tr>
<tr>
<td>7.3 Cost Budgeting</td>
<td>7.2 Cost Budgeting</td>
</tr>
<tr>
<td>7.4 Cost Control</td>
<td>7.3 Cost Control</td>
</tr>
</tbody>
</table>

Table 5 – Chapter 7 Changes
Chapter 8 - Project Quality Management Changes

Chapter 8 includes two revised project management process names to better reflect the activities of those processes. An emphasis has been made to integrate quality activities with the overall Monitoring and Controlling process, as defined in Chapter 4. The following table summarizes the Chapter 8 changes:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>8.1 Quality Planning</td>
<td>8.1 Quality Planning</td>
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<tr>
<td>8.2 Quality Assurance</td>
<td>8.2 Perform Quality Assurance</td>
</tr>
<tr>
<td>8.3 Quality Control</td>
<td>8.3 Perform Quality Control</td>
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</tbody>
</table>

Table 6 – Chapter 8 Changes

Chapter 9 - Project Human Resource Management Changes

Chapter 9 identifies several aspects of human resource planning, as well as the staffing management plan. Manage Project Team has been added as a Monitoring and Controlling process. Several key explanations have also been added, including organizational charts and position descriptions. The figures in this chapter now reflect current project management techniques, such as virtual teams, ground rules, and issues log. The following table summarizes the Chapter 9 changes:

<table>
<thead>
<tr>
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<tr>
<td>9.1 Organizational Planning</td>
<td>9.1 Human Resource Planning</td>
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<td>9.2 Staff Acquisition</td>
<td>9.2 Acquire Project Team</td>
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<td>9.3 Team Development</td>
<td>9.3 Develop Project Team</td>
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<td>9.4 Manage Project Team</td>
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</tbody>
</table>

Table 7 – Chapter 9 Changes

Chapter 10 - Project Communications Management Changes

Chapter 10 has been updated with the addition of a Manage Stakeholders process. The Manage Stakeholders process manages communications to satisfy the needs of, and resolve issues with, project stakeholders. The following table summarizes the Chapter 10 changes:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>10.1 Communications Planning</td>
<td>10.1 Communications Planning</td>
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<td>10.2 Information Distribution</td>
<td>10.2 Information Distribution</td>
</tr>
<tr>
<td>10.3 Performance Reporting</td>
<td>10.3 Performance Reporting</td>
</tr>
<tr>
<td>10.4 Administrative Closure</td>
<td>10.4 Manage Stakeholders</td>
</tr>
</tbody>
</table>

Table 8 – Chapter 10 Changes
Chapter 11 - Project Risk Management Changes

Chapter 11 has been updated to increase focus on opportunities (versus threats). It includes options based on project complexity, enhances Risk Management Planning activities, adds the risk register, and provides closer integration with other processes. The following table summarizes the Chapter 11 changes:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>11.1 Risk Management Planning</td>
<td>11.1 Risk Management Planning</td>
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<tr>
<td>11.2 Risk Identification</td>
<td>11.2 Risk Identification</td>
</tr>
<tr>
<td>11.3 Qualitative Risk Analysis</td>
<td>11.3 Qualitative Risk Analysis</td>
</tr>
<tr>
<td>11.4 Quantitative Risk Analysis</td>
<td>11.4 Quantitative Risk Analysis</td>
</tr>
<tr>
<td>11.5 Risk Response Planning</td>
<td>11.5 Risk Response Planning</td>
</tr>
<tr>
<td>11.6 Risk Monitoring and Control</td>
<td>11.6 Risk Monitoring and Control</td>
</tr>
</tbody>
</table>

Table 9 – Chapter 11 Changes (no name changes were made)

Chapter 12 - Project Procurement Management Changes

Chapter 12 has been updated to include a consistent use of the terms “buyer” and “seller.” The chapter now clarifies the difference between the project team as a buyer of products and services, and as the seller of products and services. The chapter now includes a process on seller performance evaluation to contract administration, and has removed the words “procure,” “solicit,” and “solicitation” to recognize the negative connotation of these words in various areas around the world. The following table summarizes the Chapter 12 changes:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12.1 Procurement Planning</td>
<td>12.1 Plan Purchases and Acquisitions</td>
</tr>
<tr>
<td>12.2 Solicitation Planning</td>
<td>12.2 Plan Contracting</td>
</tr>
<tr>
<td>12.3 Solicitation</td>
<td>12.3 Request Seller Responses</td>
</tr>
<tr>
<td>12.4 Source Selection</td>
<td>12.4 Select Sellers</td>
</tr>
<tr>
<td>12.5 Contract Administration</td>
<td>12.5 Contract Administration</td>
</tr>
<tr>
<td>12.6 Contract Closeout</td>
<td>12.6 Contract Closure</td>
</tr>
</tbody>
</table>

Table 10 – Chapter 12 Changes

Glossary

The glossary has been expanded and updated to:

- Include those terms within the *PMBOK® Guide* that need to be defined to support an understanding of the document’s contents
- Clarify meaning and improve the quality and accuracy of any translations
APPENDIX B

Evolution of PMI’s A Guide to the Project Management Body of Knowledge

B.1 Initial Development

The Project Management Institute (PMI) was founded in 1969 on the premise that there were many management practices that were common to projects in application areas as diverse as construction and pharmaceuticals. By the time of the PMI Montreal Seminars/Symposium in 1976, the idea that such common practices might be documented as standards began to be widely discussed. This led, in turn, to consideration of project management as a distinct profession.

It was not until 1981, however, that the PMI Board of Directors approved a project to develop the procedures and concepts necessary to support the profession of project management. The project proposal suggested three areas of focus:

- The distinguishing characteristics of a practicing professional (ethics)
- The content and structure of the profession’s body of knowledge (standards)
- Recognition of professional attainment (accreditation).

The project team thus came to be known as the Ethics, Standards, and Accreditation (ESA) Management Group. The ESA Management Group consisted of the following individuals:

Matthew H. Parry, Chair
David C. Aird
Frederick R. Fisher
David Haeney
Harvey Kolodney
Charles E. Oliver
William H. Robinson
Douglas J. Ronson
Paul Sims
Eric W. Smythe
Appendix B – Evolution of PMI’s A Guide to the Project Management Body of Knowledge

More than twenty-five volunteers in several local chapters assisted this group. The Ethics statement was developed and submitted by a committee in Washington, DC, chaired by Lew Ireland. The Time Management statement was developed through extensive meetings of a group in Southern Ontario, including Dave MacDonald, Dave Norman, Bob Spence, Bob Hall, and Matt Parry. The Cost Management statement was developed through extensive meetings within the cost department of Stelco, under the direction of Dave Haeney and Larry Harrison. Other statements were developed by the ESA Management Group. Accreditation was taken up by John Adams and his group at Western Carolina University, which resulted in the development of accreditation guidelines. It also resulted in a program of Project Management Professional (PMP®) certification, under the guidance of Dean Martin.

The results of the ESA Project were published in a Special Report in the Project Management Journal in August 1983. The report included:

- A Code of Ethics, plus a procedure for code enforcement
- A standards baseline consisting of six major Knowledge Areas: Scope Management, Cost Management, Time Management, Quality Management, Human Resources Management, and Communications Management
- Guidelines for both accreditation (recognition of the quality of programs provided by educational institutions) and certification (recognition of the professional qualifications of individuals).

This report subsequently served as the basis for PMI’s initial Accreditation and Certification programs. Western Carolina University’s Master’s Degree in Project Management was accredited in 1983, and the first PMP certifications were awarded in 1984.

B.2 1986–87 Update

Publication of the ESA Baseline Report gave rise to much discussion within PMI about the adequacy of the standards. In 1984, the PMI Board of Directors approved a second standards-related project “to capture the knowledge applied to project management … within the existing ESA framework.” Six committees were then recruited to address each of the six identified Knowledge Areas. In addition, a workshop was scheduled as part of the PMI 1985 Annual Seminars/Symposium.

As a result of these efforts, a revised document was approved in principle by the PMI Board of Directors and published for comment in the Project Management Journal in August 1986. The primary contributors to this version of the document were:

R. Max Wideman, Chair (during development)
John R. Adams, Chair (when issued)
Joseph R. Beck
Richard Cockfield
Peter C. Georgas
Colin Morris
Pat Patrick
George Vallance

Peter Bibbes
Peggy Day
Shirl Holingsworth
Joe Muhlberger
David Pym
Larry C. Woolslager

Jim Blethen
William Dixon
William Kane
Philip Nunn
Linn C. Stuckenbruck
Shakir Zuberi

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In addition to expanding and restructuring the original material, the revised document included three new sections:

- Project Management Framework was added to cover the relationships between the project and its external environment, and between project management and general management
- Risk Management was added as a separate Knowledge Area in order to provide better coverage of this subject
- Contract/Procurement Management was added as a separate Knowledge Area in order to provide better coverage of this subject.

Subsequently, a variety of editorial changes and corrections were incorporated into the material, and the PMI Board of Directors approved it in March 1987. The final manuscript was published in August 1987 as a stand-alone document titled “The Project Management Body of Knowledge.”

B.3 1996 Update

Discussion about the proper form, content, and structure of PMI’s key standards document continued after publication of the 1987 version. In August 1991, PMI’s Director of Standards Alan Stretton initiated a project to update the document based on comments received from the membership. The revised document was developed over several years through a series of widely circulated working drafts and through workshops at the PMI Seminars/Symposia in Dallas, Pittsburgh, and San Diego.

In August 1994, the PMI Standards Committee issued an exposure draft of the document that was distributed for comment to all 10,000 PMI members and to more than twenty other professional and technical associations.

The publication of A Guide to the Project Management Body of Knowledge (PMBOK® Guide) in 1996 represented the completion of the project initiated in 1991. Contributors and reviewers are listed later in this section. A summary of the differences between the 1987 document and the 1996 document, which was included in the Preface of the 1996 edition, also is listed later in this section.

The document superseded PMI’s “The Project Management Body of Knowledge (PMBOK®)” document that was published in 1987. To assist users of the 1996 document, who may have been familiar with its predecessor, we have summarized the major differences here:

1. We changed the title to emphasize that this document is not the project management body of knowledge. The 1987 document defined the project management body of knowledge as “all those topics, subject areas and intellectual processes which are involved in the application of sound management principles to … projects.” Clearly, one document will never contain the entire project management body of knowledge.
2. We completely rewrote the Framework section. The new section consists of three chapters:
   - Introduction, which sets out the purpose of the document and defines at length the terms project and project management
   - The Project Management Context, which covers the context in which projects operate—the project life cycle, stakeholder perspectives, external influences, and key general management skills
   - Project Management Processes, which describes how the various elements of project management interrelate.

3. We developed a revised definition of project. We wanted a definition that was both inclusive (“It should not be possible to identify any undertaking generally thought of as a project that does not fit the definition.”) and exclusive (“It should not be possible to describe any undertaking that satisfies the definition and is not generally thought of as a project.”). We reviewed many of the definitions of project in the existing literature and found all of them unsatisfactory in some way. The new definition is driven by the unique characteristics of a project: a project is a temporary endeavor undertaken to create a unique product or service.

4. We developed a revised view of the project life cycle. The 1987 document defined project phases as subdivisions of the project life cycle. We have reordered this relationship and defined project life cycle as a collection of phases whose number and names are determined by the control needs of the performing organization.

5. We changed the name of the major sections from Function to Knowledge Area. The term Function had been frequently misunderstood to mean an element of a functional organization. The name change should eliminate this misunderstanding.

6. We formally recognized the existence of a ninth Knowledge Area. There has been widespread consensus for some time that project management is an integrative process. Chapter 4, Project Integration Management, recognizes the importance of this subject.

7. We added the word Project to the title of each Knowledge Area. Although this may seem redundant, it helps to clarify the scope of the document. For example, Project Human Resource Management covers only those aspects of managing human resources that are unique or nearly unique to the project context.

8. We chose to describe the Knowledge Areas in terms of their component processes. The search for a consistent method of presentation led us to completely restructure the 1987 document into thirty-seven project management processes. Each process is described in terms of its inputs, outputs, and tools and techniques. Inputs and outputs are documents (e.g., a scope statement) or documentable items (e.g., activity dependencies). Tools and techniques are the mechanisms applied to the inputs to create the outputs. In addition to its fundamental simplicity, this approach offers several other benefits:
• It emphasizes the interactions among the Knowledge Areas. Outputs from one process become inputs to another.
• The structure is flexible and robust. Changes in knowledge and practice can be accommodated by adding a new process, by resequencing processes, by subdividing processes, or by adding descriptive material within a process.
• Processes are at the core of other standards. For example, the International Organization for Standardization’s quality standards (the ISO 9000 series) are based on identification of business processes.

9. We added some illustrations. When it comes to work breakdown structures, network diagrams, and S-curves, a picture is worth a thousand words.

10. We significantly reorganized the document. The following table provides a comparison of the major headings of the 1987 document and the corresponding headings and/or content sources of the 1996 version:

<table>
<thead>
<tr>
<th>1987 Number and Name</th>
<th>1996 Number and Name</th>
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</thead>
<tbody>
<tr>
<td>0. PMBOK® Standards</td>
<td>B. Evolution of PMI’s A Guide to the Project Management Body of Knowledge</td>
</tr>
<tr>
<td>1. Framework: The Rationale</td>
<td>1. Introduction (basic definitions)</td>
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<td></td>
<td>2. The Project Context (life cycles)</td>
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<td></td>
<td>2. Various portions</td>
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<tr>
<td></td>
<td>3. Various portions</td>
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<td>5. Project Scope Management</td>
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<td>B. Quality Management</td>
<td>8. Project Quality Management</td>
</tr>
<tr>
<td>C. Time Management</td>
<td>6. Project Time Management</td>
</tr>
<tr>
<td>D. Cost Management</td>
<td>7. Project Cost Management</td>
</tr>
<tr>
<td>G. Contract/Procurement Management</td>
<td>12. Project Procurement Management</td>
</tr>
<tr>
<td>H. Communications Management</td>
<td>10. Project Communications Management</td>
</tr>
</tbody>
</table>

11. We removed “to classify” from the list of purposes. Both the 1996 document and the 1987 version provide a structure for organizing project management knowledge, but neither is particularly effective as a classification tool. First, the topics included are not comprehensive—they do not include innovative or unusual practices. Second, many elements have relevance in more than one Knowledge Area or process, such that the categories are not unique.
The following individuals, as listed in Appendix C of the 1996 document, contributed in many different ways to various drafts of the 1996 document. PMI is indebted to them for their support.

**Standards Committee**

The following individuals served as members of the PMI Standards Committee during development of the 1996 update of the PMBOK® document:

William R. Duncan  
Mark Burgess  
Drew Fetters  
Eric Jenett  
Anthony Rizzotto  
Frederick Ayer  
Helen Cooke  
Brian Fletcher  
Deborah O’Bray  
Alan Stretton  
Cynthia Berg  
Judy Doll  
Earl Glenwright  
Diane Quinn  
Douglas E. Tryloff

**Contributors**

In addition to the members of the Standards Committee, the following individuals provided original text or key concepts for one or more sections in the chapters indicated:

John Adams (Chapter 3)  
Louis J. Cabano (Chapter 5)  
Douglas Gordon (Chapter 7)  
Edward Ionata (Chapter 10)  
W. Stephen Sawle (Chapter 5)  
A. Rizzotto (Chapter 6)  
Keely Brunner (Chapter 7)  
David Curling (Chapter 12)  
David T. Hulett (Chapter 11)  
John M. Nevison (Chapter 9)  
Leonard Stolba (Chapter 8)  
Francis M. Webster Jr. (Chapter 1)

**Reviewers**

In addition to the Standards Committee and the contributors, the following individuals and organizations provided comments on various drafts of the 1996 document:

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Quentin W. Fleming  
Leo Giulianetti  
G. Alan Hellawell  
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Murray Janzen  
William F. Kerrigan  
Richard King  
Richard E. Little  
Christopher Madigan  
C. “Fred” Baker  
John A. Bing  
Dorothy J. Burton  
Karen Condos-Alfonsi  
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Rick Fletcher  
Martha D. Hammonds  
Paul Hinkley  
Lew Ireland  
Frank Jenes  
Harold Kerzner  
J. D. “Kaay” Koch  
Lyle W. Lockwood  
Michael L. McCauley  
F. J. “Bud” Baker  
Brian Bock  
Kim Colenso  
E. J. Coyle  
Maureen Dougherty  
Lawrence East  
Greg Githens  
Abdulrazak Hajibrahim  
Wayne L. Hintorn  
Elvin Isgrig  
Walter Karpowski  
Robert L. Kimmons  
Lauri Koskela  
Lawrence Mack  
Hugh McLaughlin
Appendix B – Evolution of PMI’s A Guide to the Project Management Body of Knowledge

B.4 2000 Update


The scope of the project using the 1996 publication as its starting point, was to:

• Add new material, reflecting the growth of the knowledge and practices in the field of project management by capturing those practices, tools, techniques, and other relevant items that have become generally accepted. (Generally accepted means being applicable to most projects most of the time, and having widespread consensus about their value and usefulness.)
• Add clarification to text and figures to make this document more beneficial to users.
• Correct existing errors in the predecessor document.

Major Changes to the document are as follows:

1. Throughout the document, we clarified that projects manage to requirements, which emerge from needs, wants, and expectations.
2. We strengthened linkages to organizational strategy throughout the document.
3. We provided more emphasis on progressive elaboration in Section 1.2.3.
4. We acknowledged the role of the Project Office in Section 2.3.4.
5. We added references to project management involving developing economies, as well as social, economic, and environmental impacts, in Section 2.5.4.
6. We added expanded treatment of Earned Value Management in Chapter 4 (Project Integration Management), Chapter 7 (Project Cost Management), and Chapter 10 (Project Communications Management).
7. We rewrote Chapter 11 (Project Risk Management). The chapter now contains six processes instead of the previous four processes. The six processes are Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control.
8. We moved scope verification from an Executing process to a Controlling process.
9. We changed the name of Process 4.3 from Overall Change Control to Integrated Change Control to emphasize the importance of change control throughout the entirety of the project.
10. We added a chart that maps the thirty-nine Project Management processes against the five Project Management Process Groups and the nine Project Management Knowledge Areas in Figure 3-9.
11. We standardized terminology throughout the document from “supplier” to “seller.”
12. We added several Tools and Techniques:

<table>
<thead>
<tr>
<th>Chapter 4 - Project Integration Management</th>
<th>Earned Value Management (EVM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 5 - Project Scope Management</td>
<td>Preventive Action</td>
</tr>
<tr>
<td>Chapter 6 - Project Time Management</td>
<td>Scope Statement Updates</td>
</tr>
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<td></td>
<td>Project Plan</td>
</tr>
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<td></td>
<td>Adjusted Baseline</td>
</tr>
<tr>
<td>Chapter 7 - Project Cost Management</td>
<td>Quantitatively Based Durations</td>
</tr>
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<td>Reserve Time (Contingency)</td>
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<td>Coding Structure</td>
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<td></td>
<td>Variance Analysis</td>
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<td>Milestones</td>
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<tr>
<td></td>
<td>Activity Attributes</td>
</tr>
<tr>
<td></td>
<td>Computerized Tools</td>
</tr>
<tr>
<td>Chapter 8 - Project Quality Management</td>
<td>Estimating Publications</td>
</tr>
<tr>
<td></td>
<td>Earned Value Measurement</td>
</tr>
<tr>
<td>Chapter 10 - Project Communications</td>
<td>Cost of Quality</td>
</tr>
<tr>
<td>Management</td>
<td>Project Reports</td>
</tr>
<tr>
<td></td>
<td>Project Presentations</td>
</tr>
<tr>
<td></td>
<td>Project Closure</td>
</tr>
</tbody>
</table>

**PMI Project Management Standards Program Member Advisory Group**

The following individuals served as members of the PMI Standards Program Member Advisory Group during development of this edition of A Guide to the Project Management Body of Knowledge (PMBOK® Guide) document:

- George Belev
- Cynthia A. Berg, PMP
- Sergio Coronado Arrechedera
- Judith A. Doll, PMP
- J. Brian Hobbs, PMP
- David Hotchkiss, PMP

**PMBOK® Guide Update Project Team**

The following individuals served as members of the project team for this 2000 Edition of the PMBOK® Guide, under the leadership of Cynthia A. Berg, PMP, as Project Manager:

- Cynthia A. Berg, PMP
- Judith A. Doll, PMP
- Daniel Dudek, PMP
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- Greg Githens, PMP
- Earl Glenwright
- David T. Hulett, PhD
- Gregory J. Skulmoski
Appendix B – Evolution of PMI’s A Guide to the Project Management Body of Knowledge

Contributors

In addition to the members of the PMI Standards Program Member Advisory Group and the PMBOK® Guide Project Team, the following individuals provided original text or key concepts for one or more sections in the chapters indicated. Also, the PMI Risk Management Specific Interest Group provided leadership for the rewrite of Chapter 11, Project Risk Management.

Alfredo del Caño (Chapter 11)  Quentin Fleming (Chapters 4 and 12)
Roger Graves (Chapter 11)  David Hillson (Chapter 11)
David Hulett (Chapter 11)  Sam Lane (Chapter 11)
Janice Preston (Chapter 11)  Stephen Reed (Chapter 11)
David Shuster (Chapter 8)  Ed Smith (Chapter 11)
Mike Wakshull (Chapter 11)  Robert Youker (several chapters)

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Bruce C. Chadbourne, PMP  Michael T. Clark, PMP
Raymond C. Clark, PE  Elizabeth Clarke
David Coates, PMP  Kim Colenso, PMP
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Peter Bryan Goldsberry  Michael Goodman, PMP
Contributions to Predecessor Documents

Portions of the 1996 edition and other predecessor documents are included in the 2000 edition. PMI wishes to acknowledge the following volunteers as substantial contributors to the 2000 Edition:

John R. Adams  William R. Duncan  Matthew H. Parry
Alan Stretton  R. Max Wideman

Production Staff

Special mention is due to the following employees of PMI:
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Linda V. Gillman, Advertising Coordinator/PMBOK® Guide Copyright
Permissions Coordinator
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Paul Grace, Certification Manager
Sandy Jenkins, Managing Editor
Toni D. Knott, Book Editor
John McHugh, Interim Publisher
Dewey L. Messer, Design and Production Manager
Mark S. Parker, Production Coordinator
Shirley B. Parker, Business/Book Publishing Manager
Michelle Triggs Owen, Graphic Designer
Iesha D. Turner-Brown, Standards Administrator
APPENDIX C

Contributors and Reviewers of PMBOK® Guide – Third Edition

PMI volunteers first attempted to codify the Project Management Body of Knowledge in the Special Report on Ethics, Standards, and Accreditation, published in 1983. Since that time, other volunteers have come forward to update and improve that original document and contribute the now de facto standard for project management, PMI’s A Guide to the Project Management Body of Knowledge (PMBOK® Guide). This appendix lists, alphabetically within groupings, those individuals who have contributed to the development and production of the PMBOK® Guide – Third Edition. No simple list or even multiple lists can adequately portray all the contributions of those who have volunteered to develop the PMBOK® Guide – Third Edition. Appendix B describes specific contributions of many of the individuals listed below and should be consulted for further information about individual contributions to the project.

The Project Management Institute is grateful to all of these individuals for their support and acknowledges their contributions to the project management profession.

C.1 PMBOK® Guide 2004 Update Project Leadership Team

The following individuals served as members were contributors of text or concepts and served as leaders within the Project Leadership Team (PLT):

- Dennis Bolles, PMP, Project Manager
- Darrel G. Hubbard, PE, Deputy Project Manager
- J. David Blaine, PMP (Quality Control Coordinator)
- Theodore R. Boccuzzi, PMP (Document Research Team Leader)
- Elden Jones, PMP (Configuration Management Coordinator)
- Dorothy Kangas, PMP (Product Overview Team Leader)
- Carol Steuer, PMP (Framework Team Leader)
- Geree Streun, PMP (Process Groups Team Leader)
- Lee Towe, PMP (Special Appointment)
C.2 PMBOK® Guide 2004 Update Project Core Team

In addition to the Project Leadership Team, the following individuals served as contributors of text or concepts and as Co-Leaders within the Project Core Team (PCT):

Nigel Blampied, PE, PMP (Framework Team Co-Leader)
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Elden Jones, MSPM, PMP (Process Groups Team Co-Leader)
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C.3 PMBOK® Guide 2004 Update Project Sub-Teams

The following individuals served as contributors of text or concepts and as leaders of the Project Sub-Teams (PST):

W. Clifton Baldwin, PMP (Index and Input Guidance Leader)
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Kim D. Colenso, PMP, CSQE (Glossary Leader)
Earl Glenwright, PE, VEA (Knowledge Areas Chapter 7 Leader)
Darrel G. Hubbard, PE (Knowledge Areas Chapter 12 Leader)
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John A. Thoren, Jr., PMP, PhD (Knowledge Areas Chapter 10 Leader)
Lee Towe, PMP, MBA (Knowledge Areas Chapter 9 Leader)

C.4 Significant Contributors

In addition to the members of the Project Leadership Team, the Project Core Team, and the Sub-Team Leaders, the following individuals provided significant input or concepts:

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Crispin “Kik” Piney, BSc, PMP
Massimo Torre, PhD, PMP
Cornelis (Kees) Vonk, PMP
Linda Westfall, PE, CSQE
## C.5 PMBOK® Guide 2004 Update Project Team Members

In addition to those listed above, the following PMBOK® Guide 2004 Update Project Team Members provided input to and recommendations on drafts of the PMBOK® Guide – Third Edition, or submitted Enterprise Change Requests (ECRs):

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
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<td>Abdallah Abi-Aad, PMP, P.Eng.</td>
<td></td>
</tr>
<tr>
<td>Adrian Abramovici, PMP</td>
<td></td>
</tr>
<tr>
<td>Mark Allyn, PMP</td>
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<td>Lionel Andrew, MBA, ISP</td>
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<td>Prabu V. Ayyagari, PhD, PMP</td>
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<td>Pamela M. Baker, PMP</td>
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<td>James S. Bennett, PMP</td>
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<td>Howland Blackiston</td>
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<td>Charles W. Bosler, Jr.</td>
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<td>Carolyn Boyles, MBA, PMP</td>
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<td>Alex S. Brown, PMP</td>
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<td>Giuseppe A. Caruso, PMP</td>
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<td>Clare Chan</td>
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<td>Robert L. Cutler, PMP</td>
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<td>Mario Damiani, PMP</td>
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<tr>
<td>Robert de Jong, PMP</td>
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APPENDIX D

Application Area Extensions

D.1 Need for Application Area Extensions

Application area extensions are necessary when there are generally accepted knowledge and practices for a category of projects in one application area that are not generally accepted across the full range of project types in most application areas. Application area extensions reflect:

- Unique or unusual aspects of the project environment of which the project management team must be aware, in order to manage the project efficiently and effectively
- Common knowledge and practices that, if followed, will improve the efficiency and effectiveness of the project (e.g., standard work breakdown structures).

Application area-specific knowledge and practices can arise as a result of many factors, including, but not limited to, differences in cultural norms, technical terminology, societal impact, or project life cycles. For example:

- In construction, where virtually all work is accomplished under contract, there are common knowledge and practices related to procurement that do not apply to all categories of projects
- In bioscience, there are common knowledge and practices driven by the regulatory environment that do not apply to all categories of projects
- In government contracting, there are common knowledge and practices driven by government acquisition regulations that do not apply to all categories of projects
- In consulting, there are common knowledge and practices created by the project manager’s sales and marketing responsibilities that do not apply to all categories of projects.
Application area extensions are:

- Additions to the core material of *PMBOK® Guide* Chapters 1 through 12, not substitutes for it
- Organized in a fashion similar to the *PMBOK® Guide*—that is, by identifying and describing the project management processes unique to that application area
- Unique additions to the core material. Such content may:
  - Identify new or modified processes
  - Subdivide existing processes
  - Describe different sequences or interactions of processes
  - Increase elements or modifying the common process definitions
  - Define special inputs, tools and techniques, and/or outputs for the existing processes.

Application area extensions are not:

- “How-to” documents or “practice guidelines”—such documents may be issued as PMI Standards, but they are not what are intended as extensions
- A lower level of detail than is addressed in the *PMBOK® Guide*—such details may be addressed in handbooks or guidebooks that may be issued as PMI Standards, but they are not what is intended as extensions.

### D.2 Criteria for Development of Application Area Extensions

Extensions will be developed under the following criteria:

- There is a substantial body of knowledge that is both project-oriented and unique or nearly unique to that application area.
- There is an identifiable PMI component (e.g., a PMI Specific Interest Group, College, or Chapter) or an identifiable external organization willing and able to commit the necessary resources to subscribe to and support the PMI Standards Program with the development and maintenance of a specific PMI Standard. Or, the extension may be developed by PMI itself.
- The proposed extension is able to pass the same level of rigorous PMI Project Management Standard-Setting Process as any other PMI Standard.
D.3 Publishing and Format of Application Area Extensions

Application area extensions are developed and/or published by PMI, or they are developed and/or published by either a PMI component or an external organization under a formal agreement with PMI.

- Extensions match the *PMBOK® Guide* in style and content. They use the same paragraph and subparagraph numbers for the material that has been extended.
- Sections and paragraphs of the *PMBOK® Guide* that are not extended are not repeated in extensions.
- Extensions contain a rationale/justification about the need for an extension and its material.
- Extensions are delimited in terms of what they are not intended to do.

D.4 Process for Development and Maintenance of Application Area Extensions

When approved in accordance with the PMI Standards-Setting Process, application area extensions become PMI Standards. They will be developed and maintained in accordance with the process described below.

- An extension must be sponsored by PMI, a formally chartered PMI component (e.g., a Specific Interest Group, College, or Chapter), or another organization external to PMI, which has been approved by the PMI Standards Program Member Advisory Group and the PMI Standards Manager. Co-sponsorship with PMI is the preferred arrangement. All approvals will be by formal written agreement between PMI and the sponsoring entity; such agreement will include, among other things, the parties’ agreement as to intellectual property ownership rights and publications rights to the extension.
- A project to develop, publish, and/or maintain an extension must be approved by the PMI Standards Program. Permission to initiate, develop, and maintain an extension must be received from PMI and will be the subject of an agreement between or among the organizations. If there is no other sponsoring organization, the PMI Standards Program may elect to proceed alone.
- The sponsoring group will notify and solicit advice and support from the PMI Standards Program Member Advisory Group and PMI Standards Manager throughout the development and maintenance process. They will concur with the appropriateness of the sponsoring organization for the proposed extension and will review the extension during its development to identify any conflicts or overlaps with other similar projects that may be under way.
The sponsoring group will prepare a proposal to develop the extension. The proposal will include a justification for the project with a matrix of application-area-specific processes and the affected sections of this document (i.e., the *PMBOK*® Guide). It will also contain the commitment of sufficient qualified drafters and reviewers; identification of funding requirements, including reproduction, postage, telephone costs, desktop publishing, etc.; commitment to the PMI procedures for PMI Standards extension development and maintenance; and a plan and schedule for extension development and maintenance.

Following acceptance of the proposal, the project team will prepare a project charter for approval by the sponsoring group and the PMI Standards Program Team. The charter will include sources of funding and any funding proposed to be provided by PMI. It will include a requirement for periodic review of the extension with reports to the PMI Standards Program Team and a “Sunset Clause” that specifies when, and under what conditions, the extension will be removed from active status as a PMI Standard.

The proposal will be submitted to the PMI Standards Manager in accordance with the PMI Standards-Setting Process. The PMI Standards Manager will determine if the proposal can be expected to result in a document that will meet the requirements for a PMI Standard and if adequate resources and sources of support have been identified. To help with this determination, the PMI Standards Manager will seek review and comment by the PMI Standards Program Member Advisory Group and, if appropriate, a panel of knowledgeable persons not involved with the extension.

The PMI Standards Manager, with the support of the PMI Standards Program Member Advisory Group, will monitor and support the development of the approved project.

The sponsoring organization will develop the extension according to the approved project charter, including coordinating with the PMI Standards Program Team for support, review, and comment.

When the extension has been completed to the satisfaction of the sponsoring organization, it will be submitted to the PMI Standards Manager, who will manage the final approval and publication processes in accordance with the PMI Standards-Setting Process. This final submittal will include listing of, and commitment by, the sponsoring organization to the PMI extension maintenance processes and efforts.

Following approval of the extension as a PMI Standard, the sponsoring organization will implement the extension maintenance process in accordance with the approved plan.
APPENDIX E

Additional Sources of Information on Project Management

Project management is a growing, dynamic field; books and articles on the subject are published regularly. The entities listed below provide a variety of products and services that may be of use to those interested in project management.

E.1 Professional and Technical Organizations

This document was developed and published by the Project Management Institute (PMI). PMI can be contacted at:

Project Management Institute
Four Campus Boulevard
Newtown Square, PA 19073-3299 USA
Phone: +1-610-356-4600
Fax: +1-610-356-4647
E-mail: pmihq@pmi.org
Internet: http://www.pmi.org

PMI currently has cooperative agreements with the following organizations:

Association for the Advancement of Cost Engineering (AACE International)
Phone: +1-304-296-8444 Fax: +1-304-291-5728
http://www.aacei.org/

Asociacion Espanola de Ingenieria de Proyectos (AEIPRO)
Phone: +3476-976-761-910 Fax: +347-6976-761861
www.aeipro.org

Australian Institute of Project Management (AIPM)
Phone: +61-2-9252-7277 Fax: +61-2-9252-7077
www.aipm.com.au

Construction & Economy Research Institute of Korea (CERIK)
Phone: +822-3441-0801 Fax: +822-544-6234
www.cerik.re.kr

Defense Systems Management College Alumni Association (DSMCAA)
Phone: +1-703-960-6802 Fax: +1-703-960-6807

Engineering Advancement Association of Japan (ENAA)
Phone: +81-4-5682-8071 Fax: +81-4-5682-8710
www.enaa.or.jp
Appendix E – Additional Sources of Information on Project Management

Institute of Project Management (IPM-Ireland)
Phone: +353-1-661-4677 Fax: +353-1-661-3588

International Project Management Association (IPMA)
Phone: +44-1594-531-007 Fax: +44-1594-531-008

Korean Institute of Project Management & Technology (PROMAT)
Phone: +822-523-16446 Fax: +822-523-1680
www.promat.or.kr

National Contract Management Association (NCMA)
Phone: +703-448-9231 Fax: +703-448-0939

The NORDNET National Associations
(Denmark, Finland, Iceland, Norway, and Sweden)
Fax: +468-719-9316

Project Management Associates (PMA-India)
Phone: +91-11-852-6673 Fax: +91-11-646-4481
www.pma.india.org

Project Management Association of Slovakia (SPPR)
Phone: +421-805-599-1806 Fax: +421-805-599-1-818

Project Management South Africa
Phone: +2711-706-6813 Fax: +2711-706-6813
www.pmis.na.co.za

Projekt Management Austria
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www.p-m-a.at

Russian Project Management Association (SOVNET)
www.sovnet.ru

Slovenian Project Management Association (ZPM)
Phone: +61-1767-134 Fax: +61-217-341
www.ipma.ch

Ukrainian Project Management Association (UPMA)
Phone: +38-044-459-3464 or +38-044-241-5400
www.upma.kiev.ua

In addition, there are numerous other organizations in related fields, which may be able to provide additional information about project management. For example:

- Academy of Management
- American Management Association International
- American Society for Quality Control
- Construction Industry Institute
- Construction Management Association of America (CMAA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Industrial Engineers (IIE)
- International Council on Systems Engineering (INCOSE)
- National Association for Purchasing Management
- National Contract Management Association
E.2 **Commercial Publishers**

PMI is the premier publisher of books on project management. Many commercial publishers produce books on project management and related fields. Commercial publishers that regularly produce such materials include:

- Addison-Wesley
- AMACOM
- Gower Press
- John Wiley & Sons
- Marcel Dekker
- McGraw-Hill
- Prentice-Hall
- Probus
- Van Nostrand Reinhold

Most project management books from these publishers are available from PMI. Many of the books available from these sources include extensive bibliographies or lists of suggested readings.

E.3 **Product and Service Vendors**

Companies that provide software, training, consulting, and other products and services to the project management profession often provide monographs or reprints.

The PMI Registered Education Provider (R.E.P.) program facilitates the ongoing professional development of PMI members, Project Management Professional (PMP®) certificants, and other project management stakeholders by linking stakeholders and training coordinators with qualified educational providers and products. A listing of R.E.P.s and their associated educational offerings is found at [http://www.pmi.org/education/rep](http://www.pmi.org/education/rep).

E.4 **Educational Institutions**

Many universities, colleges, and junior colleges offer continuing education programs in project management and related disciplines. Many of these institutions also offer graduate or undergraduate degree programs.
Project Integration Management

Project Integration Management includes the processes and activities needed to identify, define, combine, unify and coordinate the various processes and project management activities within the Project Management Process Groups. In the project management context, integration includes characteristics of unification, consolidation, articulation and integrative actions that are crucial to project completion, successfully meeting customer and stakeholder requirements and managing expectations. The Project Integration Management processes include:

- Develop Project Charter – developing the project charter that formally authorizes a project
- Develop Preliminary Project Scope Statement – developing the preliminary project scope statement that provides a high-level scope narrative
- Develop Project Management Plan – documenting the actions necessary to define, prepare, integrate, and coordinate all subsidiary plans into a project management plan
- Direct and Manage Project Execution – executing the work defined in the project management plan to achieve the project’s requirements defined in the project scope statement
- Monitor and Control Project Work – monitoring and controlling the processes required to initiate, plan, execute, and close a project to meet the performance objectives defined in the project management plan
- Integrated Change Control – reviewing all change requests, approving changes, and controlling changes to the deliverables and organizational process assets
- Close Project – finalizing all activities across all of the Project Process Groups to formally close the project.
**Project Scope Management**

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. Project Scope Management is primarily concerned with defining and controlling what is and is not included in the project. The Project Scope Management processes include:

- **Scope Planning** - creating a project scope management plan that documents how the project scope will be defined, verified, and controlled, and how the work breakdown structure (WBS) will be created and defined
- **Scope Definition** - developing a detailed project scope statement as the basis for future project decisions
- **Create WBS** - subdividing the major project deliverables and project work into smaller, more manageable components
- **Scope Verification** - formalizing acceptance of the completed project deliverables
- **Scope Control** - controlling changes to the project scope.

**Project Time Management**

Project Time Management includes the processes required to accomplish timely completion of the project. The Project Time Management processes include:

- **Activity Definition** - identifying the specific schedule activities that need to be performed to produce the various project deliverables
- **Activity Sequencing** - identifying and documenting dependencies among schedule activities
- **Activity Resource Estimating** - estimating the type and quantities of resources required to perform each schedule activity
- **Activity Duration Estimating** - estimating the number of work periods that will be needed to complete individual schedule activities
- **Schedule Development** - analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule
- **Schedule Control** - controlling changes to the project schedule.

**Project Cost Management**

Project Cost Management includes the processes involved in planning, estimating, budgeting, and controlling costs so that the project can be completed within the approved budget. The Project Cost Management processes include:

- **Cost Estimating** - developing an approximation of the costs of the resources needed to complete project activities
- **Cost Budgeting** - aggregating the estimated costs of individual activities or work packages to establish a cost baseline
- **Cost Control** - influencing the factors that create cost variances and controlling changes to the project budget.
Project Quality Management

Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken. It implements the quality management system through policy and procedures, with continuous process improvement activities conducted throughout, as appropriate. The Project Quality Management processes include:

- Quality Planning - identifying which quality standards are relevant to the project and determining how to satisfy them
- Perform Quality Assurance - applying the planned, systematic quality activities to ensure that the project employs all processes needed to meet requirements
- Perform Quality Control - monitoring specific project results to determine whether they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

Project Human Resource Management

Project Human Resource Management includes the processes that organize and manage the project team. The project team is comprised of the people who have assigned roles and responsibilities for completing the project. While it is common to speak of roles and responsibilities being assigned, team members should be involved in much of the project’s planning and decision-making. Early involvement of team members adds expertise during the planning process and strengthens commitment to the project. The type and number of project team members can often change as the project progresses. Project team members can be referred to as the project’s staff. Project Human Resource Management processes include:

- Human Resource Planning - Identifying and documenting project roles, responsibilities, and reporting relationships, as well as creating the staffing management plan
- Acquire Project Team - Obtaining the human resources needed to complete the project
- Develop Project Team - Improving the competencies and interaction of team members to enhance project performance
- Manage Project Team - Tracking team member performance, providing feedback, resolving issues, and coordinating changes to enhance project performance.
Project Communications Management

Project Communications Management includes the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information. The Project Communications Management processes provide the critical links among people and information that are necessary for successful communications. Project managers can spend an inordinate amount of time communicating with the project team, stakeholders, customer, and sponsor. Everyone involved in the project should understand how communications affect the project as a whole. Project Communications Management processes include:

- Communications Planning - determining the information and communications needs of the project stakeholders
- Information Distribution - making needed information available to project stakeholders in a timely manner
- Performance Reporting - collecting and distributing performance information, including status reporting, progress measurement, and forecasting
- Manage Stakeholders - managing communications to satisfy the requirements of, and resolve issues with, project stakeholders.

Project Risk Management

Project Risk Management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project. The objectives of Project Risk Management are to increase the probability and impact of positive events and decrease the probability and impact of events adverse to project objectives. Project Risk Management processes include:

- Risk Management Planning - deciding how to approach, plan, and execute the risk management activities for a project
- Risk Identification - determining which risks might affect the project and documenting their characteristics
- Qualitative Risk Analysis - prioritizing risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact
- Quantitative Risk Analysis - numerically analyzing the effect on overall project objectives of identified risks
- Risk Response Planning - developing options and actions to enhance opportunities and to reduce threats to project objectives
- Risk Monitoring and Control - tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.
Project Procurement Management

Project Procurement Management includes the processes to purchase or acquire the products, services, or results needed from outside the project team to perform the work. This chapter presents two perspectives of procurement. The organization can be either the buyer or seller of the product, service, or results under a contract.

Project Procurement Management includes the contract management and change control processes required to administer contracts or purchase orders issued by authorized project team members. Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project from the performing organization (the seller) and administering contractual obligations placed on the project team by the contract.

Project Procurement Management processes include:

- Plan Purchases and Acquisitions - determining what to purchase or acquire, and determining when and how
- Plan Contracting - documenting products, services, and results requirements and identifying potential sellers
- Request Seller Responses - obtaining information, quotations, bids, offers, or proposals, as appropriate
- Select Sellers - reviewing offers, choosing from among potential sellers, and negotiating a written contract with a seller
- Contract Administration - managing the contract and the relationship between the buyer and the seller, reviewing and documenting how a seller is performing or has performed to establish required corrective actions and provide a basis for future relationships with the seller, managing contract related changes and, when appropriate, managing the contractual relationship with the outside buyer of the project
- Contract Closure - completing and settling each contract, including the resolution of any open items, and closing each contract.
REFERENCES

Chapter 1. Introduction


Chapter 2. Project Life Cycle and Organization
No references for this chapter.

Chapter 3. Project Management Processes for a Project
No references for this chapter.

Chapter 4. Project Integration Management


Chapter 5. Project Scope Management


Chapter 6. Project Time Management
No references for this chapter.

Chapter 7. Project Cost Management
No references for this chapter.
Chapter 8. Project Quality Management

Chapter 9. Project Human Resource Management
No references for this chapter.

Chapter 10. Project Communications Management
No references for this chapter.

Chapter 11. Project Risk Management
No references for this chapter.

Chapter 12. Project Procurement Management
No references for this chapter.
1. Inclusions and Exclusions

This glossary includes terms that are:

- Unique or nearly unique to project management (e.g., project scope statement, work package, work breakdown structure, critical path method)
- Not unique to project management, but used differently or with a narrower meaning in project management than in general everyday usage (e.g., early start date, schedule activity).

This glossary generally does not include:

- Application area-specific terms (e.g., project prospectus as a legal document—unique to real estate development)
- Terms whose uses in project management do not differ in any material way from everyday use (e.g., calendar day, delay)
- Compound terms whose meaning is clear from the combined meanings of the component parts
- Variants when the meaning of the variant is clear from the base term (e.g., exception report is included, exception reporting is not).

As a result of the above inclusions and exclusions, this glossary includes:

- A preponderance of terms related to Project Scope Management, Project Time Management, and Project Risk Management, since many of the terms used in these knowledge areas are unique or nearly unique to project management
- Many terms from Project Quality Management, since these terms are used more narrowly than in their everyday usage
- Relatively few terms related to Project Human Resource Management and Project Communications Management, since most of the terms used in these knowledge areas do not differ significantly from everyday usage
- Relatively few terms related to Project Cost Management, Project Integration Management, and Project Procurement Management, since many of the terms used in these knowledge areas have narrow meanings that are unique to a particular application area.
2. Common Acronyms

AC  Actual Cost
ACWP  Actual Cost of Work Performed
AD  Activity Description
ADM  Arrow Diagramming Method
AE  Apportioned Effort
AF  Actual Finish date
AOA  Activity-on-Arrow
AON  Activity-on-Node
AS  Actual Start date
BAC  Budget at Completion
BCWP  Budgeted Cost of Work Performed
BCWS  Budgeted Cost of Work Scheduled
BOM  Bill Of Materials
CA  Control Account
CAP  Control Account Plan
CCB  Change Control Board
COQ  Cost of Quality
CPF  Cost-Plus-Fee
CPFF  Cost-Plus-Fixed-Fee
CPI  Cost Performance Index
CPIF  Cost-Plus-Incentive-Fee
CPM  Critical Path Method
CPPC  Cost-Plus-Percentage of Cost
CV  Cost Variance
CWBS  Contract Work Breakdown Structure
DD  Data Date
DU  Duration
DUR  Duration
EAC  Estimate at Completion
EF  Early Finish date
EMV  Expected Monetary Value
ES  Early Start date
ETC  Estimate to Complete
EV  Earned Value
EVM  Earned Value Management
EVT  Earned Value Technique
FF  Finish-to-Finish
FF  Free Float
FFP  Firm-Fixed-Price
FMEA  Failure Mode and Effect Analysis
FPFF  Fixed-Price-Fixed-Fee
FS  Finish-to-Start
IFB  Invitation for Bid
LF  Late Finish date
LOE  Level of Effort
LS  Late Start date
OBS  Organizational Breakdown Structure
OD  Original Duration
PC  Percent Complete
PCT  Percent Complete
PDM  Precedence Diagramming Method
PF  Planned Finish date
PM  Project Management
PM  Project Manager
PMBOK®  Project Management Body of Knowledge
PMIS  Project Management Information System
PMO  Program Management Office
PMO  Project Management Office
PMP®  Project Management Professional
PS  Planned Start date
PSWBS  Project Summary Work Breakdown Structure
PV  Planned Value
QA  Quality Assurance
QC  Quality Control
RAM  Responsibility Assignment Matrix
RBS  Resource Breakdown Structure
RD  Remaining Duration
RFP  Request for Proposal
RFQ  Request for Quotation
SF  Scheduled Finish date
SF  Start-to-Finish
SOW  Statement of Work
SPI  Schedule Performance Index
SS  Scheduled Start date
SS  Start-to-Start
SV  Schedule Variance
SWOT  Strengths, Weaknesses, Opportunities, and Threats
TC  Target Completion date
TF  Target Finish date
TF  Total Float
T&M  Time and Material
TQM  Total Quality Management
TS  Target Start date
VE  Value Engineering
WBS  Work Breakdown Structure
3. Definitions

Many of the words defined here have broader, and in some cases different, dictionary definitions.

The definitions use the following conventions:

- Terms used as part of the definitions and that are defined in the glossary are shown in *italics*.
  - When the same glossary term appears more than once in a given definition, only the first occurrence is italicized.
  - In some cases, a single glossary term consists of multiple words (e.g., risk response planning).
  - In many cases, there are multiple, consecutive glossary terms within a given definition. For example, duration estimate denotes two separate glossary entries, one for “duration” and another for “estimate.”
  - There are even some definitions with a string of consecutive italicized words (not separated by commas) that represent multiple, consecutive glossary terms, at least one of which consists of multiple words. For example, critical path method late finish date denotes two separate glossary entries, one for “critical path method” and another for “late finish date.” In situations such as this, an asterisk (*) will follow the last italicized word in the string to denote that there are multiple adjacent glossary terms.

- When synonyms are included, no definition is given and the reader is directed to the preferred term (i.e., see preferred term).

- Related terms that are not synonyms are cross-referenced at the end of the definition (i.e., see also related term).

Accept. The act of formally receiving or acknowledging something and regarding it as being true, sound, suitable, or complete.

Acceptance. See accept.

Acceptance Criteria. Those criteria, including performance requirements and essential conditions, which must be met before project deliverables are accepted.

Acquire Project Team [Process]. The process of obtaining the human resources needed to complete the project.

Activity. A component of work performed during the course of a project. See also schedule activity.

Activity Attributes [Output/Input]. Multiple attributes associated with each schedule activity that can be included within the activity list. Activity attributes include activity codes, predecessor activities, successor activities, logical relationships, leads and lags, resource requirements, imposed dates, constraints, and assumptions.

Activity Code. One or more numerical or text values that identify characteristics of the work or in some way categorize the schedule activity that allows filtering and ordering of activities within reports.

Activity Definition [Process]. The process of identifying the specific schedule activities that need to be performed to produce the various project deliverables.

Activity Description (AD). A short phrase or label for each schedule activity used in conjunction with an activity identifier to differentiate that project schedule activity from...
other schedule activities. The activity description normally describes the scope of work of the schedule activity.

**Activity Duration.** The time in calendar units between the start and finish of a schedule activity. See also actual duration, original duration, and remaining duration.

**Activity Duration Estimating** [Process]. The process of estimating the number of work periods that will be needed to complete individual schedule activities.

**Activity Identifier.** A short unique numeric or text identification assigned to each schedule activity to differentiate that project activity from other activities. Typically unique within any one project schedule network diagram.

**Activity List** [Output/Input]. A documented tabulation of schedule activities that shows the activity description, activity identifier, and a sufficiently detailed scope of work description so project team members understand what work is to be performed.

**Activity-on-Arrow (AOA).** See arrow diagramming method.

**Activity-on-Node (AON).** See precedence diagramming method.

**Activity Resource Estimating** [Process]. The process of estimating the types and quantities of resources required to perform each schedule activity.

**Activity Sequencing** [Process]. The process of identifying and documenting dependencies among schedule activities.

**Actual Cost (AC).** Total costs actually incurred and recorded in accomplishing work performed during a given time period for a schedule activity or work breakdown structure component. Actual cost can sometimes be direct labor hours alone, direct costs alone, or all costs including indirect costs. Also referred to as the actual cost of work performed (ACWP). See also earned value management and earned value technique.

**Actual Cost of Work Performed (ACWP).** See actual cost (AC).

**Actual Duration.** The time in calendar units between the actual start date of the schedule activity and either the data date of the project schedule if the schedule activity is in progress or the actual finish date if the schedule activity is complete.

**Actual Finish Date (AF).** The point in time that work actually ended on a schedule activity. (Note: In some application areas, the schedule activity is considered “finished” when work is “substantially complete.”)

**Actual Start Date (AS).** The point in time that work actually started on a schedule activity.

**Analogous Estimating** [Technique]. An estimating technique that uses the values of parameters, such as scope, cost, budget, and duration or measures of scale such as size, weight, and complexity from a previous, similar activity as the basis for estimating the same parameter or measure for a future activity. It is frequently used to estimate a parameter when there is a limited amount of detailed information about the project (e.g., in the early phases). Analogous estimating is a form of expert judgment. Analogous estimating is most reliable when the previous activities are similar in fact and not just in appearance, and the project team members preparing the estimates have the needed expertise.

**Application Area.** A category of projects that have common components significant in such projects, but are not needed or present in all projects. Application areas are usually defined in terms of either the product (i.e., by similar technologies or production methods) or the type of customer (i.e., internal versus external, government versus commercial) or industry sector (i.e., utilities, automotive, aerospace, information technologies). Application areas can overlap.
Apportioned Effort (AE). Effort applied to project work that is not readily divisible into discrete efforts for that work, but which is related in direct proportion to measurable discrete work efforts. Contrast with discrete effort.

Approval. See approve.

Approve. The act of formally confirming, sanctioning, ratifying, or agreeing to something.

Approved Change Request [Output/Input]. A change request that has been processed through the integrated change control process and approved. Contrast with requested change.

Arrow. The graphic presentation of a schedule activity in the arrow diagramming method or a logical relationship between schedule activities in the precedence diagramming method.

Arrow Diagramming Method (ADM) [Technique]. A schedule network diagramming technique in which schedule activities are represented by arrows. The tail of the arrow represents the start, and the head represents the finish of the schedule activity. (The length of the arrow does not represent the expected duration of the schedule activity.) Schedule activities are connected at points called nodes (usually drawn as small circles) to illustrate the sequence in which the schedule activities are expected to be performed. See also precedence diagramming method.

As-of Date. See data date.

Assumptions [Output/Input]. Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration. Assumptions affect all aspects of project planning, and are part of the progressive elaboration of the project. Project teams frequently identify, document, and validate assumptions as part of their planning process. Assumptions generally involve a degree of risk.

Assumptions Analysis [Technique]. A technique that explores the accuracy of assumptions and identifies risks to the project from inaccuracy, inconsistency, or incompleteness of assumptions.

Authority. The right to apply project resources*, expend funds, make decisions, or give approvals.

Backward Pass. The calculation of late finish dates and late start dates for the uncompleted portions of all schedule activities. Determined by working backwards through the schedule network logic from the project’s end date. The end date may be calculated in a forward pass or set by the customer or sponsor. See also schedule network analysis.

Bar Chart [Tool]. A graphic display of schedule-related information. In the typical bar chart, schedule activities or work breakdown structure components are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars. Also called a Gantt chart.

Baseline. The approved time phased plan (for a project, a work breakdown structure component, a work package, or a schedule activity), plus or minus approved project scope, cost, schedule, and technical changes. Generally refers to the current baseline, but may refer to the original or some other baseline. Usually used with a modifier (e.g., cost baseline, schedule baseline, performance measurement baseline, technical baseline). See also performance measurement baseline.

Baseline Finish Date. The finish date of a schedule activity in the approved schedule baseline. See also scheduled finish date.

Baseline Start Date. The start date of a schedule activity in the approved schedule baseline. See also scheduled start date.
Bill of Materials (BOM). A documented formal hierarchical tabulation of the physical assemblies, subassemblies, and components needed to fabricate a product.

Bottom-up Estimating [Technique]. A method of estimating a component of work. The work is decomposed into more detail. An estimate is prepared of what is needed to meet the requirements of each of the lower, more detailed pieces of work, and these estimates are then aggregated into a total quantity for the component of work. The accuracy of bottom-up estimating is driven by the size and complexity of the work identified at the lower levels. Generally smaller work scopes increase the accuracy of the estimates.

Brainstorming [Technique]. A general data gathering and creativity technique that can be used to identify risks, ideas, or solutions to issues by using a group of team members or subject-matter experts. Typically, a brainstorming session is structured so that each participant’s ideas are recorded for later analysis.

Budget. The approved estimate for the project or any work breakdown structure component or any schedule activity. See also estimate.

Budget at Completion (BAC). The sum of all the budget values established for the work to be performed on a project or a work breakdown structure component or a schedule activity. The total planned value for the project.

Budgeted Cost of Work Performed (BCWP). See earned value (EV).

Budgeted Cost of Work Scheduled (BCWS). See planned value (PV).

Buffer. See reserve.

Buyer. The acquirer of products, services, or results for an organization.

Calendar Unit. The smallest unit of time used in scheduling the project. Calendar units are generally in hours, days, or weeks, but can also be in quarter years, months, shifts, or even in minutes.

Change Control. Identifying, documenting, approving or rejecting, and controlling changes to the project baselines*.

Change Control Board (CCB). A formally constituted group of stakeholders responsible for reviewing, evaluating, approving, delaying, or rejecting changes to the project, with all decisions and recommendations being recorded.

Change Control System [Tool]. A collection of formal documented procedures that define how project deliverables and documentation will be controlled, changed, and approved. In most application areas the change control system is a subset of the configuration management system.

Change Request. Requests to expand or reduce the project scope, modify policies, processes, plans, or procedures, modify costs or budgets, or revise schedules. Requests for a change can be direct or indirect, externally or internally initiated, and legally or contractually mandated or optional. Only formally documented requested changes are processed and only approved change requests are implemented.

Chart of Accounts [Tool]. Any numbering system used to monitor project costs* by category (e.g., labor, supplies, materials, and equipment). The project chart of accounts is usually based upon the corporate chart of accounts of the primary performing organization. Contrast with code of accounts.

Charter. See project charter.

Checklist [Output/Input]. Items listed together for convenience of comparison, or to ensure the actions associated with them are managed appropriately and not forgotten.
An example is a list of items to be inspected that is created during quality planning and applied during quality control.

Claim. A request, demand, or assertion of rights by a seller against a buyer, or vice versa, for consideration, compensation, or payment under the terms of a legally binding contract, such as for a disputed change.

Close Project [Process]. The process of finalizing all activities across all of the project process groups to formally close the project or phase.

Closing Processes [Process Group]. Those processes performed to formally terminate all activities of a project or phase, and transfer the completed product to others or close a cancelled project.

Code of Accounts [Tool]. Any numbering system used to uniquely identify each component of the work breakdown structure. Contrast with chart of accounts.

Co-location [Technique]. An organizational placement strategy where the project team members are physically located close to one another in order to improve communication, working relationships, and productivity.

Common Cause. A source of variation that is inherent in the system and predictable. On a control chart, it appears as part of the random process variation (i.e., variation from a process that would be considered normal or not unusual), and is indicated by a random pattern of points within the control limits. Also referred to as random cause. Contrast with special cause.

Communication. A process through which information is exchanged among persons using a common system of symbols, signs, or behaviors.

Communication Management Plan [Output/Input]. The document that describes: the communications needs and expectations for the project; how and in what format information will be communicated; when and where each communication will be made; and who is responsible for providing each type of communication. A communication management plan can be formal or informal, highly detailed or broadly framed, based on the requirements of the project stakeholders. The communication management plan is contained in, or is a subsidiary plan of, the project management plan.

Communications Planning [Process]. The process of determining the information and communications needs of the project stakeholders: who they are, what is their level of interest and influence on the project, who needs what information, when will they need it, and how it will be given to them.

Compensation. Something given or received, a payment or recompense, usually something monetary or in kind for products, services, or results provided or received.

Component. A constituent part, element, or piece of a complex whole.

Configuration Management System [Tool]. A subsystem of the overall project management system. It is a collection of formal documented procedures used to apply technical and administrative direction and surveillance to: identify and document the functional and physical characteristics of a product, result, service, or component; control any changes to such characteristics; record and report each change and its implementation status; and support the audit of the products, results, or components to verify conformance to requirements. It includes the documentation, tracking systems, and defined approval levels necessary for authorizing and controlling changes. In most application areas, the configuration management system includes the change control system.
Constraint [Input]. The state, quality, or sense of being restricted to a given course of action or inaction. An applicable restriction or limitation, either internal or external to the project, that will affect the performance of the project or a process. For example, a schedule constraint is any limitation or restraint placed on the project schedule that affects when a schedule activity can be scheduled and is usually in the form of fixed imposed dates. A cost constraint is any limitation or restraint placed on the project budget such as funds available over time. A project resource constraint is any limitation or restraint placed on resource usage, such as what resource skills or disciplines are available and the amount of a given resource available during a specified time frame.

Contingency. See reserve.

Contingency Allowance. See reserve.

Contingency Reserve [Output/Input]. The amount of funds, budget, or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization.

Contract [Output/Input]. A contract is a mutually binding agreement that obligates the seller to provide the specified product or service or result and obligates the buyer to pay for it.

Contract Administration [Process]. The process of managing the contract and the relationship between the buyer and seller, reviewing and documenting how a seller is performing or has performed to establish required corrective actions and provide a basis for future relationships with the seller, managing contract related changes and, when appropriate, managing the contractual relationship with the outside buyer of the project.

Contract Closure [Process]. The process of completing and settling the contract, including resolution of any open items and closing each contract.

Contract Management Plan [Output/Input]. The document that describes how a specific contract will be administered and can include items such as required documentation delivery and performance requirements. A contract management plan can be formal or informal, highly detailed or broadly framed, based on the requirements in the contract. Each contract management plan is a subsidiary plan of the project management plan.

Contract Statement of Work (SOW) [Output/Input]. A narrative description of products, services, or results to be supplied under contract.

Contract Work Breakdown Structure (CWBS) [Output/Input]. A portion of the work breakdown structure for the project developed and maintained by a seller contracting to provide a subproject or project component.

Control [Technique]. Comparing actual performance with planned performance, analyzing variances, assessing trends to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.

Control Account (CA) [Tool]. A management control point where the integration of scope, budget, actual cost, and schedule takes place, and where the measurement of performance will occur. Control accounts are placed at selected management points (specific components at selected levels) of the work breakdown structure. Each control account may include one or more work packages, but each work package may be associated with only one control account. Each control account is associated with a specific single organizational component in the organizational breakdown structure (OBS). Previously called a Cost Account. See also work package.
Control Account Plan (CAP) [Tool]. A plan for all the work and effort to be performed in a control account. Each CAP has a definitive statement of work, schedule, and time-phased budget. Previously called a Cost Account Plan.

Control Chart [Tool]. A graphic display of process data over time and against established control limits, and that has a centerline that assists in detecting a trend of plotted values toward either control limit.

Control Limits. The area composed of three standard deviations on either side of the centerline, or mean, of a normal distribution of data plotted on a control chart that reflects the expected variation in the data. See also specification limits.

Controlling. See control.

Corrective Action. Documented direction for executing the project work to bring expected future performance of the project work in line with the project management plan.

Cost. The monetary value or price of a project activity* or component that includes the monetary worth of the resources required to perform and complete the activity or component, or to produce the component. A specific cost can be composed of a combination of cost components including direct labor hours, other direct costs, indirect labor hours, other indirect costs, and purchased price. (However, in the earned value management methodology, in some instances, the term cost can represent only labor hours without conversion to monetary worth.) See also actual cost and estimate.

Cost Baseline. See baseline.

Cost Budgeting [Process]. The process of aggregating the estimated costs of individual activities or work packages to establish a cost baseline.

Cost Control [Process]. The process of influencing the factors that create variances, and controlling changes to the project budget.

Cost Estimating [Process]. The process of developing an approximation of the cost of the resources needed to complete project activities*.

Cost Management Plan [Output/Input]. The document that sets out the format and establishes the activities and criteria for planning, structuring, and controlling the project costs. A cost management plan can be formal or informal, highly detailed or broadly framed, based on the requirements of the project stakeholders. The cost management plan is contained in, or is a subsidiary plan, of the project management plan.

Cost of Quality (COQ) [Technique]. Determining the costs incurred to ensure quality. Prevention and appraisal costs (cost of conformance) include costs for quality planning, quality control (QC), and quality assurance to ensure compliance to requirements (i.e., training, QC systems, etc.). Failure costs (cost of non-conformance) include costs to rework products, components, or processes that are non-compliant, costs of warranty work and waste, and loss of reputation.

Cost Performance Index (CPI). A measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual costs (AC). CPI = EV divided by AC. A value equal to or greater than one indicates a favorable condition and a value less than one indicates an unfavorable condition.

Cost-Plus-Fee (CPF). A type of cost reimbursable contract where the buyer reimburses the seller for seller’s allowable costs for performing the contract work and seller also receives a fee calculated as an agreed upon percentage of the costs. The fee varies with the actual cost.

Cost-Plus-Fixed-Fee (CPFF) Contract. A type of cost-reimbursable contract where the buyer reimburses the seller for the seller’s allowable costs (allowable costs are defined by the contract) plus a fixed amount of profit (fee).
Cost-Plus-Incentive-Fee (CPIF) Contract. A type of cost-reimbursable contract where the buyer reimburses the seller for the seller’s allowable costs (allowable costs are defined by the contract), and the seller earns its profit if it meets defined performance criteria.

Cost-Plus-Percentage of Cost (CPPC). See cost-plus-fee.

Cost-Reimbursable Contract. A type of contract involving payment (reimbursement) by the buyer to the seller for the seller’s actual costs, plus a fee typically representing seller’s profit. Costs are usually classified as direct costs or indirect costs. Direct costs are costs incurred for the exclusive benefit of the project, such as salaries of full-time project staff. Indirect costs, also called overhead and general and administrative cost, are costs allocated to the project by the performing organization as a cost of doing business, such as salaries of management indirectly involved in the project, and cost of electric utilities for the office. Indirect costs are usually calculated as a percentage of direct costs. Cost-reimbursable contracts often include incentive clauses where, if the seller meets or exceeds selected project objectives, such as schedule targets or total cost, then the seller receives from the buyer an incentive or bonus payment.

Cost Variance (CV). A measure of cost performance on a project. It is the algebraic difference between earned value (EV) and actual cost (AC). CV = EV minus AC. A positive value indicates a favorable condition and a negative value indicates an unfavorable condition.

Crashing [Technique]. A specific type of project schedule compression technique performed by taking action to decrease the total project schedule duration* after analyzing a number of alternatives to determine how to get the maximum schedule duration compression for the least additional cost. Typical approaches for crashing a schedule include reducing schedule activity durations and increasing the assignment of resources on schedule activities. See schedule compression and see also fast tracking.

Create WBS (Work Breakdown Structure) [Process]. The process of subdivide the major project deliverables and project work into smaller, more manageable components.

Criteria. Standards, rules, or tests on which a judgment or decision can be based, or by which a product, service, result, or process can be evaluated.

Critical Activity. Any schedule activity on a critical path in a project schedule. Most commonly determined by using the critical path method. Although some activities are “critical,” in the dictionary sense, without being on the critical path, this meaning is seldom used in the project context.

Critical Chain Method [Technique]. A schedule network analysis technique* that modifies the project schedule to account for limited resources. The critical chain method mixes deterministic and probabilistic approaches to schedule network analysis.

Critical Path [Output/Input]. Generally, but not always, the sequence of schedule activities that determines the duration of the project. Generally, it is the longest path through the project. However, a critical path can end, as an example, on a schedule milestone that is in the middle of the project schedule and that has a finish-no-later-than imposed date schedule constraint. See also critical path method.

Critical Path Method (CPM) [Technique]. A schedule network analysis technique* used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. Early start and finish dates* are calculated by means of a forward pass, using a specified start date. Late start and finish dates* are calculated by means of a backward pass, starting from a specified completion date, which sometimes is the project early finish date determined during the forward pass calculation.
Current Finish Date. The current estimate of the point in time when a schedule activity will be completed, where the estimate reflects any reported work progress. See also scheduled finish date and baseline finish date.

Current Start Date. The current estimate of the point in time when a schedule activity will begin, where the estimate reflects any reported work progress. See also scheduled start date and baseline start date.

Customer. The person or organization that will use the project’s product or service or result. (See also user).

Data Date (DD). The date up to or through which the project’s reporting system has provided actual status and accomplishments. In some reporting systems, the status information for the data date is included in the past and in some systems the status information is in the future. Also called as-of date and time-now date.

Date. A term representing the day, month, and year of a calendar, and, in some instances, the time of day.

Decision Tree Analysis [Technique]. The decision tree is a diagram that describes a decision under consideration and the implications of choosing one or another of the available alternatives. It is used when some future scenarios or outcomes of actions are uncertain. It incorporates probabilities and the costs or rewards of each logical path of events and future decisions, and uses expected monetary value analysis to help the organization identify the relative values of alternate actions. See also expected monetary value analysis.

Decompose. See decomposition.

Decomposition [Technique]. A planning technique that subdivides the project scope and project deliverables into smaller, more manageable components, until the project work associated with accomplishing the project scope and providing the deliverables is defined in sufficient detail to support executing, monitoring, and controlling the work.

Defect. An imperfection or deficiency in a project component where that component does not meet its requirements or specifications and needs to be either repaired or replaced.

Defect Repair. Formally documented identification of a defect in a project component with a recommendation to either repair the defect or completely replace the component.

Deliverable [Output/Input]. Any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. Often used more narrowly in reference to an external deliverable, which is a deliverable that is subject to approval by the project sponsor or customer. See also product, service, and result.

Delphi Technique [Technique]. An information gathering technique used as a way to reach a consensus of experts on a subject. Experts on the subject participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project points related to the subject. The responses are summarized and are then re-circulated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome.

Dependency. See logical relationship.

Design Review [Technique]. A management technique used for evaluating a proposed design to ensure that the design of the system or product meets the customer requirements, or to assure that the design will perform successfully, can be produced, and can be maintained.
Develop Project Charter [Process]. The process of developing the project charter that formally authorizes a project.

Develop Project Management Plan [Process]. The process of documenting the actions necessary to define, prepare, integrate, and coordinate all subsidiary plans into a project management plan.

Develop Project Scope Statement (Preliminary) [Process]. The process of developing the preliminary project scope statement that provides a high level scope narrative.

Develop Project Team [Process]. The process of improving the competencies and interaction of team members to enhance project performance.

Direct and Manage Project Execution [Process]. The process of executing the work defined in the project management plan to achieve the project’s requirements defined in the project scope statement.

Discipline. A field of work requiring specific knowledge and that has a set of rules governing work conduct (e.g., mechanical engineering, computer programming, cost estimating, etc.).

Discrete Effort. Work effort that is directly identifiable to the completion of specific work breakdown structure components and deliverables, and that can be directly planned and measured. Contrast with apportioned effort.

Document. A medium and the information recorded thereon, that generally has permanence and can be read by a person or a machine. Examples include project management plans, specifications, procedures, studies, and manuals.

Documented Procedure. A formalized written description of how to carry out an activity, process, technique, or methodology.

Dummy Activity. A schedule activity of zero duration used to show a logical relationship in the arrow diagramming method. Dummy activities are used when logical relationships cannot be completely or correctly described with schedule activity arrows. Dummy activities are generally shown graphically as a dashed line headed by an arrow.

Duration (DU or DUR). The total number of work periods (not including holidays or other nonworking periods) required to complete a schedule activity or work breakdown structure component. Usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time. Contrast with effort. See also original duration, remaining duration, and actual duration.

Early Finish Date (EF). In the critical path method, the earliest possible point in time on which the uncompleted portions of a schedule activity (or the project) can finish, based on the schedule network logic, the data date, and any schedule constraints. Early finish dates can change as the project progresses and as changes are made to the project management plan.

Early Start Date (ES). In the critical path method, the earliest possible point in time on which the uncompleted portions of a schedule activity (or the project) can start, based on the schedule network logic, the data date, and any schedule constraints. Early start dates can change as the project progresses and as changes are made to the project management plan.

Earned Value (EV). The value of completed work expressed in terms of the approved budget assigned to that work for a schedule activity or work breakdown structure component. Also referred to as the budgeted cost of work performed (BCWP).

Earned Value Management (EVM). A management methodology for integrating scope, schedule, and resources, and for objectively measuring project performance and
progress. Performance is measured by determining the budgeted cost of work performed (i.e., earned value) and comparing it to the actual cost of work performed (i.e., actual cost). Progress is measured by comparing the earned value to the planned value.

**Earned Value Technique (EVT)** [Technique]. A specific technique for measuring the performance of work for a work breakdown structure component, control account, or project. Also referred to as the earning rules and crediting method.

**Effort.** The number of labor units required to complete a schedule activity or work breakdown structure component. Usually expressed as staff hours, staff days, or staff weeks. Contrast with duration.

**Enterprise.** A company, business, firm, partnership, corporation, or governmental agency.

**Enterprise Environmental Factors** [Output/Input]. Any or all external environmental factors and internal organizational environmental factors that surround or influence the project’s success. These factors are from any or all of the enterprises involved in the project, and include organizational culture and structure, infrastructure, existing resources, commercial databases, market conditions, and project management software.

**Estimate** [Output/Input]. A quantitative assessment of the likely amount or outcome. Usually applied to project costs, resources, effort, and durations and is usually preceded by a modifier (i.e., preliminary, conceptual, feasibility, order-of-magnitude, definitive). It should always include some indication of accuracy (e.g., ±x percent).

**Estimate at Completion (EAC)** [Output/Input]. The expected total cost of a schedule activity, a work breakdown structure component, or the project when the defined scope of work will be completed. EAC is equal to the actual cost (AC) plus the estimate to complete (ETC) for all of the remaining work. EAC = AC plus ETC. The EAC may be calculated based on performance to date or estimated by the project team based on other factors, in which case it is often referred to as the latest revised estimate. See also earned value technique and estimate to complete.

**Estimate to Complete (ETC)** [Output/Input]. The expected cost needed to complete all the remaining work for a schedule activity, work breakdown structure component, or the project. See also earned value technique and estimate at completion.

**Event.** Something that happens, an occurrence, an outcome.

**Exception Report.** Document that includes only major variations from the plan (rather than all variations).

**Execute.** Directing, managing, performing, and accomplishing the project work, providing the deliverables, and providing work performance information.

**Executing.** See execute.

**Executing Processes** [Process Group]. Those processes performed to complete the work defined in the project management plan to accomplish the project’s objectives defined in the project scope statement.

**Execution.** See execute.

**Expected Monetary Value (EMV) Analysis.** A statistical technique that calculates the average outcome when the future includes scenarios that may or may not happen. A common use of this technique is within decision tree analysis. Modeling and simulation are recommended for cost and schedule risk analysis because it is more powerful and less subject to misapplication than expected monetary value analysis.

**Expert Judgment** [Technique]. Judgment provided based upon expertise in an application area, knowledge area, discipline, industry, etc. as appropriate for the activity being performed. Such expertise may be provided by any group or person with specialized
education, knowledge, skill, experience, or training, and is available from many sources, including: other units within the performing organization; consultants; stakeholders, including customers; professional and technical associations; and industry groups.

**Failure Mode and Effect Analysis (FMEA)** [Technique]. An analytical procedure in which each potential failure mode in every component of a product is analyzed to determine its effect on the reliability of that component and, by itself or in combination with other possible failure modes, on the reliability of the product or system and on the required function of the component; or the examination of a product (at the system and/or lower levels) for all ways that a failure may occur. For each potential failure, an estimate is made of its effect on the total system and of its impact. In addition, a review is undertaken of the action planned to minimize the probability of failure and to minimize its effects.

**Fast Tracking** [Technique]. A specific project schedule compression technique that changes network logic to overlap phases that would normally be done in sequence, such as the design phase and construction phase, or to perform schedule activities in parallel. See schedule compression and see also crashing.

**Finish Date.** A point in time associated with a schedule activity’s completion. Usually qualified by one of the following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.

**Finish-to-Finish (FF).** The logical relationship where completion of work of the successor activity cannot finish until the completion of work of the predecessor activity. See also logical relationship.

**Finish-to-Start (FS).** The logical relationship where initiation of work of the successor activity depends upon the completion of work of the predecessor activity. See also logical relationship.

**Firm-Fixed-Price (FFP) Contract.** A type of fixed price contract where the buyer pays the seller a set amount (as defined by the contract), regardless of the seller’s costs.

**Fixed-Price-Incentive-Fee (FPIF) Contract.** A type of contract where the buyer pays the seller a set amount (as defined by the contract), and the seller can earn an additional amount if the seller meets defined performance criteria.

**Fixed-Price or Lump-Sum Contract.** A type of contract involving a fixed total price for a well-defined product. Fixed-price contracts may also include incentives for meeting or exceeding selected project objectives, such as schedule targets. The simplest form of a fixed price contract is a purchase order.

**Float.** Also called slack. See total float and see also free float.

**Flowcharting** [Technique]. The depiction in a diagram format of the inputs, process actions, and outputs of one or more processes within a system.

**Forecasts.** Estimates or predictions of conditions and events in the project’s future based on information and knowledge available at the time of the forecast. Forecasts are updated and reissued based on work performance information provided as the project is executed. The information is based on the project’s past performance and expected future performance, and includes information that could impact the project in the future, such as estimate at completion and estimate to complete.

**Forward Pass.** The calculation of the early start and early finish dates for the uncompleted portions of all network activities. See also schedule network analysis and backward pass.
Free Float (FF). The amount of time that a schedule activity can be delayed without delaying the early start of any immediately following schedule activities. See also total float.

Functional Manager. Someone with management authority over an organizational unit within a functional organization. The manager of any group that actually makes a product or performs a service. Sometimes called a line manager.

Functional Organization. A hierarchical organization where each employee has one clear superior, staff are grouped by areas of specialization, and managed by a person with expertise in that area.

Funds. A supply of money or pecuniary resources immediately available.

Gantt Chart. See bar chart.

Goods. Commodities, wares, merchandise.

Grade. A category or rank used to distinguish items that have the same functional use (e.g., “hammer”), but do not share the same requirements for quality (e.g., different hammers may need to withstand different amounts of force).

Ground Rules [Tool]. A list of acceptable and unacceptable behaviors adopted by a project team to improve working relationships, effectiveness, and communication.

Hammock Activity. See summary activity.

Historical Information. Documents and data on prior projects including project files, records, correspondence, closed contracts, and closed projects.

Human Resource Planning [Process]. The process of identifying and documenting project roles, responsibilities and reporting relationships, as well as creating the staffing management plan.

Imposed Date. A fixed date imposed on a schedule activity or schedule milestone, usually in the form of a “start no earlier than” and “finish no later than” date.

Influence Diagram [Tool]. Graphical representation of situations showing causal influences, time ordering of events, and other relationships among variables and outcomes.

Influencer. Persons or groups that are not directly related to the acquisition or use of the project’s product, but, due to their position in the customer organization*, can influence, positively or negatively, the course of the project.

Information Distribution [Process]. The process of making needed information available to project stakeholders in a timely manner.

Initiating Processes [Process Group]. Those processes performed to authorize and define the scope of a new phase or project or that can result in the continuation of halted project work. A large number of the initiating processes are typically done outside the project’s scope of control by the organization, program, or portfolio processes and those processes provide input to the project’s initiating processes group.

Initiator. A person or organization that has both the ability and authority to start a project.

Input [Process Input]. Any item, whether internal or external to the project that is required by a process before that process proceeds. May be an output from a predecessor process.

Inspection [Technique]. Examining or measuring to verify whether an activity, component, product, result or service conforms to specified requirements.

Integral. Essential to completeness; requisite; constituent with; formed as a unit with another component.
Integrated. Interrelated, interconnected, interlocked, or meshed components blended and unified into a functioning or unified whole.

Integrated Change Control [Process]. The process of reviewing all change requests, approving changes and controlling changes to deliverables and organizational process assets.

Invitation for Bid (IFB). Generally, this term is equivalent to request for proposal. However, in some application areas, it may have a narrower or more specific meaning.

Issue. A point or matter in question or in dispute, or a point or matter that is not settled and is under discussion or over which there are opposing views or disagreements.

Knowledge. Knowing something with the familiarity gained through experience, education, observation, or investigation, it is understanding a process, practice, or technique, or how to use a tool.

Knowledge Area Process. An identifiable project management process within a knowledge area.

Knowledge Area, Project Management. See Project Management Knowledge Area.

Lag [Technique]. A modification of a logical relationship that directs a delay in the successor activity. For example, in a finish-to-start dependency with a ten-day lag, the successor activity cannot start until ten days after the predecessor activity has finished. See also lead.

Late Finish Date (LF). In the critical path method, the latest possible point in time that a schedule activity may be completed based upon the schedule network logic, the project completion date, and any constraints assigned to the schedule activities without violating a schedule constraint or delaying the project completion date. The late finish dates are determined during the backward pass calculation of the project schedule network.

Late Start Date (LS). In the critical path method, the latest possible point in time that a schedule activity may begin based upon the schedule network logic, the project completion date, and any constraints assigned to the schedule activities without violating a schedule constraint or delaying the project completion date. The late start dates are determined during the backward pass calculation of the project schedule network.

Latest Revised Estimate. See estimate at completion.

Lead [Technique]. A modification of a logical relationship that allows an acceleration of the successor activity. For example, in a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished. See also lag. A negative lead is equivalent to a positive lag.

Lessons Learned [Output/Input]. The learning gained from the process of performing the project. Lessons learned may be identified at any point. Also considered a project record, to be included in the lessons learned knowledge base.

Lessons Learned Knowledge Base. A store of historical information and lessons learned about both the outcomes of previous project selection decisions and previous project performance.

Level of Effort (LOE). Support-type activity (e.g., seller or customer liaison, project cost accounting, project management, etc.) that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of work performance over a period of time determined by the activities supported.

Leveling. See resource leveling.

Life Cycle. See project life cycle.
Log. A document used to record and describe or denote selected items identified during execution of a process or activity. Usually used with a modifier, such as issue, quality control, action, or defect.

Logic. See network logic.

Logic Diagram. See project schedule network diagram.

Logical Relationship. A dependency between two project schedule activities, or between a project schedule activity and a schedule milestone. See also precedence relationship. The four possible types of logical relationships are: Finish-to-Start; Finish-to-Finish; Start-to-Start; and Start-to-Finish.

Manage Project Team [Process]. The process of tracking team member performance, providing feedback, resolving issues, and coordinating changes to enhance project performance.

Manage Stakeholders [Process]. The process of managing communications to satisfy the requirements of, and resolve issues with, project stakeholders.

Master Schedule [Tool]. A summary-level project schedule that identifies the major deliverables and work breakdown structure components and key schedule milestones. See also milestone schedule.

Materiel. The aggregate of things used by an organization in any undertaking, such as equipment, apparatus, tools, machinery, gear, material, and supplies.

Matrix Organization. Any organizational structure in which the project manager shares responsibility with the functional managers for assigning priorities and for directing the work of persons assigned to the project.

Methodology. A system of practices, techniques, procedures, and rules used by those who work in a discipline.

Milestone. A significant point or event in the project. See also schedule milestone.

Milestone Schedule [Tool]. A summary-level schedule that identifies the major schedule milestones. See also master schedule.

Monitor. Collect project performance data with respect to a plan, produce performance measures, and report and disseminate performance information.

Monitor and Control Project Work [Process]. The process of monitoring and controlling the processes required to initiate, plan, execute, and close a project to meet the performance objectives defined in the project management plan and project scope statement.

Monitoring. See monitor.

Monitoring and Controlling Processes [Process Group]. Those processes performed to measure and monitor project execution so that corrective action can be taken when necessary to control the execution of the phase or project.

Monte Carlo Analysis. A technique that computes, or iterates, the project cost or project schedule many times using input values selected at random from probability distributions of possible costs or durations, to calculate a distribution of possible total project cost or completion dates.

Near-Critical Activity. A schedule activity that has low total float. The concept of near-critical is equally applicable to a schedule activity or schedule network path. The limit below which total float is considered near critical is subject to expert judgment and varies from project to project.

Network. See project schedule network diagram.
Network Analysis. See schedule network analysis.

Network Logic. The collection of schedule activity dependencies that makes up a project schedule network diagram.

Network Loop. A schedule network path that passes the same node twice. Network loops cannot be analyzed using traditional schedule network analysis techniques such as critical path method.

Network Open End. A schedule activity without any predecessor activities or successor activities creating an unintended break in a schedule network path. Network open ends are usually caused by missing logical relationships.

Network Path. Any continuous series of schedule activities connected with logical relationships in a project schedule network diagram.

Networking [Technique]. Developing relationships with persons who may be able to assist in the achievement of objectives and responsibilities.

Node. One of the defining points of a schedule network; a junction point joined to some or all of the other dependency lines. See also arrow diagramming method and precedence diagramming method.

Objective. Something toward which work is to be directed, a strategic position to be attained, or a purpose to be achieved, a result to be obtained, a product to be produced, or a service to be performed.

Operations. An organizational function performing the ongoing execution of activities that produce the same product or provide a repetitive service. Examples are: production operations, manufacturing operations, and accounting operations.

Opportunity. A condition or situation favorable to the project, a positive set of circumstances, a positive set of events, a risk that will have a positive impact on project objectives, or a possibility for positive changes. Contrast with threat.

Organization. A group of persons organized for some purpose or to perform some type of work within an enterprise.

Organization Chart [Tool]. A method for depicting interrelationships among a group of persons working together toward a common objective.

Organizational Breakdown Structure (OBS) [Tool]. A hierarchically organized depiction of the project organization arranged so as to relate the work packages to the performing organizational units. (Sometimes OBS is written as Organization Breakdown Structure with the same definition.)

Organizational Process Assets [Output/Input]. Any or all process related assets, from any or all of the organizations involved in the project that are or can be used to influence the project’s success. These process assets include formal and informal plans, policies, procedures, and guidelines. The process assets also include the organizations’ knowledge bases such as lessons learned and historical information.

Original Duration (OD). The activity duration originally assigned to a schedule activity and not updated as progress is reported on the activity. Typically used for comparison with actual duration and remaining duration when reporting schedule progress.

Output [Process Output]. A product, result, or service generated by a process. May be an input to a successor process.

Parametric Estimating [Technique]. An estimating technique that uses a statistical relationship between historical data and other variables (e.g., square footage in construction, lines of code in software development) to calculate an estimate for activity
parameters, such as scope, cost, budget, and duration. This technique can produce higher levels of accuracy depending upon the sophistication and the underlying data built into the model. An example for the cost parameter is multiplying the planned quantity of work to be performed by the historical cost per unit to obtain the estimated cost.

**Pareto Chart** [Tool]. A histogram, ordered by frequency of occurrence, that shows how many results were generated by each identified cause.

**Path Convergence.** The merging or joining of parallel schedule network paths into the same node in a project schedule network diagram. Path convergence is characterized by a schedule activity with more than one predecessor activity.

**Path Divergence.** Extending or generating parallel schedule network paths from the same node in a project schedule network diagram. Path divergence is characterized by a schedule activity with more than one successor activity.

**Percent Complete (PC or PCT).** An estimate, expressed as a percent, of the amount of work that has been completed on an activity or a work breakdown structure component.

**Perform Quality Assurance (QA) [Process].** The process of applying the planned, systematic quality activities (such as audits or peer reviews) to ensure that the project employs all processes needed to meet requirements.

**Perform Quality Control (QC) [Process].** The process of monitoring specific project results* to determine whether they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

**Performance Measurement Baseline.** An approved plan for the project work against which project execution is compared and deviations are measured for management control. The performance measurement baseline typically integrates scope, schedule, and cost parameters of a project, but may also include technical and quality parameters.

**Performance Reporting [Process].** The process of collecting and distributing performance information. This includes status reporting, progress measurement, and forecasting.

**Performance Reports [Output/Input].** Documents and presentations that provide organized and summarized work performance information, earned value management parameters and calculations, and analyses of project work progress and status. Common formats for performance reports include bar charts, S-curves, histograms, tables, and project schedule network diagram showing current schedule status.

**Performing Organization.** The enterprise whose personnel are most directly involved in doing the work of the project.

**Phase.** See project phase.

**Plan Contracting [Process].** The process of documenting the products, services, and results requirements and identifying potential sellers.

**Plan Purchases and Acquisitions [Process].** The process of determining what to purchase or acquire, and determining when and how to do so.

**Planned Finish Date (PF).** See scheduled finish date.

**Planned Start Date (PS).** See scheduled start date.

**Planned Value (PV).** The authorized budget assigned to the scheduled work to be accomplished for a schedule activity or work breakdown structure component. Also referred to as the budgeted cost of work scheduled (BCWS).

**Planning Package.** A WBS component below the control account with known work content but without detailed schedule activities. See also control account.
Planning Processes [Process Group]. Those processes performed to define and mature the project scope, develop the project management plan, and identify and schedule the project activities* that occur within the project.

Portfolio. A collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related.

Portfolio Management [Technique]. The centralized management of one or more portfolios, which includes identifying, prioritizing, authorizing, managing, and controlling projects, programs, and other related work, to achieve specific strategic business objectives.

Position Description [Tool]. An explanation of a project team member’s roles and responsibilities.

Practice. A specific type of professional or management activity that contributes to the execution of a process and that may employ one or more techniques and tools.

Precedence Diagramming Method (PDM) [Technique]. A schedule network diagramming technique in which schedule activities are represented by boxes (or nodes). Schedule activities are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed.

Precedence Relationship. The term used in the precedence diagramming method for a logical relationship. In current usage, however, precedence relationship, logical relationship, and dependency are widely used interchangeably, regardless of the diagramming method used.

Predecessor Activity. The schedule activity that determines when the logical successor activity can begin or end.

Preventive Action. Documented direction to perform an activity that can reduce the probability of negative consequences associated with project risks*.

Probability and Impact Matrix [Tool]. A common way to determine whether a risk is considered low, moderate, or high by combining the two dimensions of a risk: its probability of occurrence, and its impact on objectives if it occurs.

Procedure. A series of steps followed in a regular definitive order to accomplish something.

Process. A set of interrelated actions and activities performed to achieve a specified set of products, results, or services.


Procurement Documents [Output/Input]. Those documents utilized in bid and proposal activities, which include buyer’s Invitation for Bid, Invitation for Negotiations, Request for Information, Request for Quotation, Request for Proposal and seller’s responses.

Procurement Management Plan [Output/Input]. The document that describes how procurement processes from developing procurement documentation through contract closure will be managed.

Product. An artifact that is produced, is quantifiable, and can be either an end item in itself or a component item. Additional words for products are materiel and goods. Contrast with result and service. See also deliverable.

Product Life Cycle. A collection of generally sequential, non-overlapping product phases* whose name and number are determined by the manufacturing and control needs of the organization. The last product life cycle phase for a product is generally the product’s
deterioration and death. Generally, a project life cycle is contained within one or more product life cycles.

**Product Scope.** The features and functions that characterize a product, service or result.

**Product Scope Description.** The documented narrative description of the product scope.

**Program.** A group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. Programs may include elements of related work outside of the scope of the discrete projects in the program.

**Program Management.** The centralized coordinated management of a program to achieve the program's strategic objectives and benefits.

**Program Management Office (PMO).** The centralized management of a particular program or programs such that corporate benefit is realized by the sharing of resources, methodologies, tools, and techniques, and related high-level project management focus. See also project management office.

**Progressive Elaboration** [Technique]. Continuously improving and detailing a plan as more detailed and specific information and more accurate estimates become available as the project progresses, and thereby producing more accurate and complete plans that result from the successive iterations of the planning process.

**Project.** A temporary endeavor undertaken to create a unique product, service, or result.

**Project Calendar.** A calendar of working days or shifts that establishes those dates on which schedule activities are worked and nonworking days that determine those dates on which schedule activities are idle. Typically defines holidays, weekends and shift hours. See also resource calendar.

**Project Charter** [Output/Input]. A document issued by the project initiator or sponsor that formally authorizes the existence of a project, and provides the project manager with the authority to apply organizational resources to project activities.

**Project Communications Management** [Knowledge Area]. See Appendix F.

**Project Cost Management** [Knowledge Area]. See Appendix F.

**Project Human Resource Management** [Knowledge Area]. See Appendix F.

**Project Initiation.** Launching a process that can result in the authorization and scope definition of a new project.

**Project Integration Management** [Knowledge Area]. See Appendix F.

**Project Life Cycle.** A collection of generally sequential project phases whose name and number are determined by the control needs of the organization or organizations involved in the project. A life cycle can be documented with a methodology.

**Project Management (PM).** The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.

**Project Management Body of Knowledge (PMBOK®).** An inclusive term that describes the sum of knowledge within the profession of project management. As with other professions such as law, medicine, and accounting, the body of knowledge rests with the practitioners and academics that apply and advance it. The complete project management body of knowledge includes proven traditional practices that are widely applied and innovative practices that are emerging in the profession. The body of knowledge includes both published and unpublished material. The PMBOK is constantly evolving.

**Project Management Information System (PMIS)** [Tool]. An information system consisting of the tools and techniques used to gather, integrate, and disseminate the
outputs of project management processes. It is used to support all aspects of the project from initiating through closing, and can include both manual and automated systems.

**Project Management Knowledge Area.** An identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools, and techniques.

**Project Management Office (PMO).** An organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. The responsibilities of a PMO can range from providing project management support functions to actually being responsible for the direct management of a project. See also program management office.

**Project Management Plan** [Output/Input]. A formal, approved document that defines how the project is executed, monitored and controlled. It may be summary or detailed and may be composed of one or more subsidiary management plans and other planning documents.

**Project Management Process.** One of the 44 processes, unique to project management and described in the PMBOK® Guide.

**Project Management Process Group.** A logical grouping of the project management processes described in the PMBOK® Guide. The project management process groups include initiating processes, planning processes, executing processes, monitoring and controlling processes, and closing processes. Collectively, these five groups are required for any project, have clear internal dependencies, and must be performed in the same sequence on each project, independent of the application area or the specifics of the applied project life cycle. Project management process groups are not project phases.

**Project Management Professional (PMP®).** A person certified as a PMP® by the Project Management Institute (PMI®).

**Project Management Software** [Tool]. A class of computer software applications specifically designed to aid the project management team with planning, monitoring, and controlling the project, including: cost estimating, scheduling, communications, collaboration, configuration management, document control, records management, and risk analysis.

**Project Management System** [Tool]. The aggregation of the processes, tools, techniques, methodologies, resources, and procedures to manage a project. The system is documented in the project management plan and its content will vary depending upon the application area, organizational influence, complexity of the project, and the availability of existing systems. A project management system, which can be formal or informal, aids a project manager in effectively guiding a project to completion. A project management system is a set of processes and the related monitoring and control functions that are consolidated and combined into a functioning, unified whole.

**Project Management Team.** The members of the project team who are directly involved in project management activities. On some smaller projects, the project management team may include virtually all of the project team members.

**Project Manager (PM).** The person assigned by the performing organization to achieve the project objectives.

**Project Organization Chart** [Output/Input]. A document that graphically depicts the project team members and their interrelationships for a specific project.

**Project Phase.** A collection of logically related project activities*, usually culminating in the completion of a major deliverable. Project phases (also called phases) are mainly
completed sequentially, but can overlap in some project situations. Phases can be subdivided into subphases and then components; this hierarchy, if the project or portions of the project are divided into phases, is contained in the work breakdown structure. A project phase is a component of a project life cycle. A project phase is not a project management process group.

**Project Process Groups.** The five process groups required for any project that have clear dependencies and that are required to be performed in the same sequence on each project, independent of the application area or the specifics of the applied project life cycle. The process groups are initiating, planning, executing, monitoring and controlling, and closing.

**Project Procurement Management** [Knowledge Area]. See Appendix F.

**Project Quality Management** [Knowledge Area]. See Appendix F.

**Project Risk Management** [Knowledge Area]. See Appendix F.

**Project Schedule** [Output/Input]. The planned dates for performing schedule activities and the planned dates for meeting schedule milestones.

**Project Schedule Network Diagram** [Output/Input]. Any schematic display of the logical relationships among the project schedule activities. Always drawn from left to right to reflect project work chronology.

**Project Scope.** The work that must be performed to deliver a product, service, or result with the specified features and functions.

**Project Scope Management** [Knowledge Area]. See Appendix F.

**Project Scope Management Plan** [Output/Input]. The document that describes how the project scope will be defined, developed, and verified and how the work breakdown structure will be created and defined, and that provides guidance on how the project scope will be managed and controlled by the project management team. It is contained in or is a subsidiary plan of the project management plan. The project scope management plan can be informal and broadly framed, or formal and highly detailed, based on the needs of the project.

**Project Scope Statement** [Output/Input]. The narrative description of the project scope, including major deliverables, project objectives, project assumptions, project constraints, and a statement of work, that provides a documented basis for making future project decisions and for confirming or developing a common understanding of project scope among the stakeholders. The definition of the project scope – what needs to be accomplished.

**Project Sponsor.** See sponsor.

**Project Stakeholder.** See stakeholder.

**Project Summary Work Breakdown Structure (PSWBS)** [Tool]. A work breakdown structure for the project that is only developed down to the subproject level of detail within some legs of the WBS, and where the detail of those subprojects are provided by use of contract work breakdown structures.

**Project Team.** All the project team members, including the project management team, the project manager and, for some projects, the project sponsor.

**Project Team Directory.** A documented list of project team members, their project roles and communication information.
**Project Team Members.** The persons who report either directly or indirectly to the *project manager*, and who are responsible for performing *project work* as a regular part of their assigned duties.

**Project Time Management** [Knowledge Area]. See Appendix F.

**Project Work.** See *work*.

**Projectized Organization.** Any organizational structure in which the *project manager* has full authority to assign priorities, apply *resources*, and direct the *work* of persons assigned to the *project*.

**Qualitative Risk Analysis** [Process]. The *process* of prioritizing *risks* for subsequent further analysis or action by assessing and combining their probability of occurrence and impact.

**Quality.** The degree to which a set of inherent characteristics fulfills *requirements*.

**Quality Management Plan** [Output/Input]. The quality management plan describes how the *project management team* will implement the performing organization’s quality policy. The quality management plan is a component or a subsidiary plan of the *project management plan*. The quality management plan may be formal or informal, highly detailed, or broadly framed, based on the *requirements* of the *project*.

**Quality Planning** [Process]. The *process* of identifying which quality standards are relevant to the *project* and determining how to satisfy them.

**Quantitative Risk Analysis** [Process]. The *process* of numerically analyzing the effect on overall project *objectives* of identified *risks*.

**Regulation.** Requirements imposed by a governmental body. These *requirements* can establish *product*, *process* or *service* characteristics—including applicable administrative provisions—that have government-mandated compliance.

**Reliability.** The probability of a *product* performing its intended function under specific conditions for a given period of time.

**Remaining Duration (RD).** The time in *calendar units*, between the *data date* of the *project schedule* and the *finish date* of a *schedule activity* that has an *actual start date*. This represents the time needed to complete a *schedule activity* where the *work* is in progress.

**Request for Information.** A type of *procurement document* whereby the *buyer* requests a potential *seller* to provide various pieces of information related to a *product* or *service* or *seller* capability.

**Request for Proposal (RFP).** A type of *procurement document* used to request proposals from prospective *sellers of products* or *services*. In some *application areas*, it may have a narrower or more specific meaning.

**Request for Quotation (RFQ).** A type of *procurement document* used to request price quotations from prospective *sellers* of common or standard *products* or *services*. Sometimes used in place of *request for proposal* and in some *application areas*, it may have a narrower or more specific meaning.

**Request Seller Responses** [Process]. The *process* of obtaining information, quotations, bids, offers, or proposals, as appropriate.

**Requested Change** [Output/Input]. A formally documented *change request* that is submitted for *approval* to the *integrated change control* process. Contrast with *approved change request*.

**Requirement.** A condition or capability that must be met or possessed by a *system*, *product*, *service*, *result*, or *component* to satisfy a *contract*, *standard*, *specification*, or other
formally imposed documents. Requirements include the quantified and documented
needs, wants, and expectations of the sponsor, customer, and other stakeholders.

**Reserve.** A provision in the project management plan to mitigate cost and/or schedule risk.
Often used with a modifier (e.g., management reserve, contingency reserve) to provide
further detail on what types of risk are meant to be mitigated. The specific meaning of
the modified term varies by application area.

**Reserve Analysis** [Technique]. An analytical technique to determine the essential features
and relationships of components in the project management plan to establish a reserve
for the schedule duration, budget, estimated cost, or funds for a project.

**Residual Risk.** A risk that remains after risk responses have been implemented.

**Resource.** Skilled human resources (specific disciplines either individually or in crews or
teams), equipment, services, supplies, commodities, materiel, budgets, or funds.

**Resource Breakdown Structure (RBS).** A hierarchical structure of resources by resource
category and resource type used in resource leveling schedules and to develop resource-
limited schedules, and which may be used to identify and analyze project human
resource assignments.

**Resource Calendar.** A calendar of working days and nonworking days that determines those
dates on which each specific resource is idle or can be active. Typically defines resource
specific holidays and resource availability periods. See also project calendar.

**Resource-Constrained Schedule.** See resource-limited schedule.

**Resource Histogram.** A bar chart showing the amount of time that a resource is scheduled
to work over a series of time periods. Resource availability may be depicted as a line for
comparison purposes. Contrasting bars may show actual amounts of resource used as the
project progresses.

**Resource Leveling** [Technique]. Any form of schedule network analysis in which
scheduling decisions (start and finish dates) are driven by resource constraints (e.g.,
limited resource availability or difficult-to-manage changes in resource availability
levels).

**Resource-Limited Schedule.** A project schedule whose schedule activity, scheduled start
dates and scheduled finish dates reflect expected resource availability. A resource-
limited schedule does not have any early or late start or finish dates. The resource-limited
schedule total float is determined by calculating the difference between the critical path
method late finish date* and the resource-limited scheduled finish date. Sometimes
called resource-constrained schedule. See also resource leveling.

**Resource Planning.** See activity resource estimating.

**Responsibility Assignment Matrix (RAM) [Tool].** A structure that relates the project
organizational breakdown structure to the work breakdown structure to help ensure that
each component of the project’s scope of work is assigned to a responsible person.

**Result.** An output from performing project management processes and activities. Results
include outcomes (e.g., integrated systems, revised process, restructured organization,
tests, trained personnel, etc.) and documents (e.g., policies, plans, studies, procedures,
 specifications, reports, etc.). Contrast with product and service. See also deliverable.

**Retainage.** A portion of a contract payment that is withheld until contract completion to
ensure full performance of the contract terms.

**Rework.** Action taken to bring a defective or nonconforming component into compliance
with requirements or specifications.
Risk. An uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives. See also risk category and risk breakdown structure.

Risk Acceptance [Technique]. A risk response planning technique* that indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy.

Risk Avoidance [Technique]. A risk response planning technique* for a threat that creates changes to the project management plan that are meant to either eliminate the risk or to protect the project objectives from its impact. Generally, risk avoidance involves relaxing the time, cost, scope, or quality objectives.

Risk Breakdown Structure (RBS) [Tool]. A hierarchically organized depiction of the identified project risks* arranged by risk category and subcategory that identifies the various areas and causes of potential risks. The risk breakdown structure is often tailored to specific project types.

Risk Category. A group of potential causes of risk. Risk causes may be grouped into categories such as technical, external, organizational, environmental, or project management. A category may include subcategories such as technical maturity, weather, or aggressive estimating. See also risk breakdown structure.

Risk Database. A repository that provides for collection, maintenance, and analysis of data gathered and used in the risk management processes.

Risk Identification [Process]. The process of determining which risks might affect the project and documenting their characteristics.

Risk Management Plan [Output/Input]. The document describing how project risk management will be structured and performed on the project. It is contained in or is a subsidiary plan of the project management plan. The risk management plan can be informal and broadly framed, or formal and highly detailed, based on the needs of the project. Information in the risk management plan varies by application area and project size. The risk management plan is different from the risk register that contains the list of project risks, the results of risk analysis, and the risk responses.

Risk Management Planning [Process]. The process of deciding how to approach, plan, and execute risk management activities for a project.

Risk Mitigation [Technique]. A risk response planning technique* associated with threats that seeks to reduce the probability of occurrence or impact of a risk to below an acceptable threshold.

Risk Monitoring and Control [Process]. The process of tracking identified risks, monitoring residual risks, identifying new risks, executing risk response plans, and evaluating their effectiveness throughout the project life cycle.

Risk Register [Output/Input]. The document containing the results of the qualitative risk analysis, quantitative risk analysis, and risk response planning. The risk register details all identified risks, including description, category, cause, probability of occurring, impact(s) on objectives, proposed responses, owners, and current status. The risk register is a component of the project management plan.

Risk Response Planning [Process]. The process of developing options and actions to enhance opportunities and to reduce threats to project objectives.

Risk Transference [Technique]. A risk response planning technique* that shifts the impact of a threat to a third party, together with ownership of the response.

Role. A defined function to be performed by a project team member, such as testing, filing, inspecting, coding.
Rolling Wave Planning [Technique]. A form of progressive elaboration planning where the work to be accomplished in the near term is planned in detail at a low level of the work breakdown structure, while the work far in the future is planned at a relatively high level of the work breakdown structure, but the detailed planning of the work to be performed within another one or two periods in the near future is done as work is being completed during the current period.

Root Cause Analysis [Technique]. An analytical technique used to determine the basic underlying reason that causes a variance or a defect or a risk. A root cause may underlie more than one variance or defect or risk.

Schedule. See project schedule and see also schedule model.

Schedule Activity. A discrete scheduled component of work performed during the course of a project. A schedule activity normally has an estimated duration, an estimated cost, and estimated resource requirements. Schedule activities are connected to other schedule activities or schedule milestones with logical relationships, and are decomposed from work packages.

Schedule Analysis. See schedule network analysis.

Schedule Compression [Technique]. Shortening the project schedule duration without reducing the project scope. See also crashing and fast tracking.

Schedule Control [Process]. The process of controlling changes to the project schedule.

Schedule Development [Process]. The process of analyzing schedule activity sequences, schedule activity durations, resource requirements, and schedule constraints to create the project schedule.

Schedule Management Plan [Output/Input]. The document that establishes criteria and the activities for developing and controlling the project schedule. It is contained in, or is a subsidiary plan of, the project management plan. The schedule management plan may be formal or informal, highly detailed or broadly framed, based on the needs of the project.

Schedule Milestone. A significant event in the project schedule, such as an event restraining future work or marking the completion of a major deliverable. A schedule milestone has zero duration. Sometimes called a milestone activity. See also milestone.

Schedule Model [Tool]. A model used in conjunction with manual methods or project management software to perform schedule network analysis to generate the project schedule for use in managing the execution of a project. See also project schedule.

Schedule Network Analysis [Technique]. The technique of identifying early and late start dates*, as well as early and late finish dates*, for the uncompleted portions of project schedule activities. See also critical path method, critical chain method, what-if analysis, and resource leveling.

Schedule Performance Index (SPI). A measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV). The SPI = EV divided by PV. An SPI equal to or greater than one indicates a favorable condition and a value of less than one indicates an unfavorable condition. See also earned value management.

Schedule Variance (SV). A measure of schedule performance on a project. It is the algebraic difference between the earned value (EV) and the planned value (PV). SV = EV minus PV. See also earned value management.

Scheduled Finish Date (SF). The point in time that work was scheduled to finish on a schedule activity. The scheduled finish date is normally within the range of dates delimited by the early finish date and the late finish date. It may reflect resource leveling of scarce resources. Sometimes called planned finish date.
Scheduled Start Date (SS). The point in time that work was scheduled to start on a schedule activity. The scheduled start date is normally within the range of dates delimited by the early start date and the late start date. It may reflect resource leveling of scarce resources. Sometimes called planned start date.

Scope. The sum of the products, services, and results to be provided as a project. See also project scope and product scope.

Scope Baseline. See baseline.

Scope Change. Any change to the project scope. A scope change almost always requires an adjustment to the project cost or schedule.

Scope Control [Process]. The process of controlling changes to the project scope.

Scope Creep. Adding features and functionality (project scope) without addressing the effects on time, costs, and resources, or without customer approval.

Scope Definition [Process]. The process of developing a detailed project scope statement as the basis for future project decisions.

Scope Planning [Process]. The process of creating a project scope management plan.

Scope Verification [Process]. The process of formalizing acceptance of the completed project deliverables.

S-Curve. Graphical display of cumulative costs, labor hours, percentage of work, or other quantities, plotted against time. The name derives from the S-like shape of the curve (flatter at the beginning and end, steeper in the middle) produced on a project that starts slowly, accelerates, and then tails off. Also a term for the cumulative likelihood distribution that is a result of a simulation, a tool of quantitative risk analysis.

Secondary Risk. A risk that arises as a direct result of implementing a risk response.

Select Sellers [Process]. The process of reviewing offers, choosing from among potential sellers, and negotiating a written contract with a seller.

Seller. A provider or supplier of products, services, or results to an organization.

Sensitivity Analysis. A quantitative risk analysis and modeling technique used to help determine which risks have the most potential impact on the project. It examines the extent to which the uncertainty of each project element affects the objective being examined when all other uncertain elements are held at their baseline values. The typical display of results is in the form of a tornado diagram.

Service. Useful work performed that does not produce a tangible product or result, such as performing any of the business functions supporting production or distribution. Contrast with product and result. See also deliverable.

Should-Cost Estimate. An estimate of the cost of a product or service used to provide an assessment of the reasonableness of a prospective seller’s proposed cost.

Simulation. A simulation uses a project model that translates the uncertainties specified at a detailed level into their potential impact on objectives that are expressed at the level of the total project. Project simulations use computer models and estimates of risk, usually expressed as a probability distribution of possible costs or durations at a detailed work level, and are typically performed using Monte Carlo analysis.

Skill. Ability to use knowledge, a developed aptitude, and/or a capability to effectively and readily execute or perform an activity.

Slack. See total float and free float.

Special Cause. A source of variation that is not inherent in the system, is not predictable, and is intermittent. It can be assigned to a defect in the system. On a control chart, points
beyond the control limits, or non-random patterns within the control limits, indicate it. Also referred to as assignable cause. Contrast with common cause.

**Specification.** A document that specifies, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a system, component, product, result, or service and, often, the procedures for determining whether these provisions have been satisfied. Examples are: requirement specification, design specification, product specification, and test specification.

**Specification Limits.** The area, on either side of the centerline, or mean, of data plotted on a control chart that meets the customer’s requirements for a product or service. This area may be greater than or less than the area defined by the control limits. See also control limits.

**Sponsor.** The person or group that provides the financial resources, in cash or in kind, for the project.

**Staffing Management Plan** [Process]. The document that describes when and how human resource requirements will be met. It is contained in, or is a subsidiary plan of, the project management plan. The staffing management plan can be informal and broadly framed, or formal and highly detailed, based on the needs of the project. Information in the staffing management plan varies by application area and project size.

**Stakeholder.** Persons and organizations such as customers, sponsors, performing organization and the public, that are actively involved in the project, or whose interests may be positively or negatively affected by execution or completion of the project. They may also exert influence over the project and its deliverables.

**Standard.** A document established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

**Start Date.** A point in time associated with a schedule activity’s start, usually qualified by one of the following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.

**Start-to-Finish (SF).** The logical relationship where completion of the successor schedule activity is dependent upon the initiation of the predecessor schedule activity. See also logical relationship.

**Start-to-Start (SS).** The logical relationship where initiation of the work of the successor schedule activity depends upon the initiation of the work of the predecessor schedule activity. See also logical relationship.

**Statement of Work (SOW).** A narrative description of products, services, or results to be supplied.

**Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis.** This information gathering technique examines the project from the perspective of each project’s strengths, weaknesses, opportunities, and threats to increase the breadth of the risks considered by risk management.

**Subnetwork.** A subdivision (fragment) of a project schedule network diagram, usually representing a subproject or a work package. Often used to illustrate or study some potential or proposed schedule condition, such as changes in preferential schedule logic or project scope.

**Subphase.** A subdivision of a phase.
Subproject. A smaller portion of the overall project created when a project is subdivided into more manageable components or pieces. Subprojects are usually represented in the work breakdown structure. A subproject can be referred to as a project, managed as a project, and acquired from a seller. May be referred to as a subnetwork in a project schedule network diagram.

Successor. See successor activity.

Successor Activity. The schedule activity that follows a predecessor activity, as determined by their logical relationship.

Summary Activity. A group of related schedule activities aggregated at some summary level, and displayed/reported as a single activity at that summary level. See also subproject and subnetwork.

System. An integrated set of regularly interacting or interdependent components created to accomplish a defined objective, with defined and maintained relationships among its components, and the whole producing or operating better than the simple sum of its components. Systems may be either physically process based or management process based, or more commonly a combination of both. Systems for project management are composed of project management processes, techniques, methodologies, and tools operated by the project management team.

Target Completion Date (TC). An imposed date that constrains or otherwise modifies the schedule network analysis.

Target Finish Date (TF). The date that work is planned (targeted) to finish on a schedule activity.

Target Schedule. A schedule adopted for comparison purposes during schedule network analysis, which can be different from the baseline schedule. See also baseline.

Target Start Date (TS). The date that work is planned (targeted) to start on a schedule activity.

Task. A term for work whose meaning and placement within a structured plan for project work varies by the application area, industry, and brand of project management software.

Team Members. See project team members.

Technical Performance Measurement [Technique]. A performance measurement technique that compares technical accomplishments during project execution to the project management plan’s schedule of planned technical achievements. It may use key technical parameters of the product produced by the project as a quality metric. The achieved metric values are part of the work performance information.

Technique. A defined systematic procedure employed by a human resource to perform an activity to produce a product or result or deliver a service, and that may employ one or more tools.

Template. A partially complete document in a predefined format that provides a defined structure for collecting, organizing and presenting information and data. Templates are often based upon documents created during prior projects. Templates can reduce the effort needed to perform work and increase the consistency of results.

Threat. A condition or situation unfavorable to the project, a negative set of circumstances, a negative set of events, a risk that will have a negative impact on a project objective if it occurs, or a possibility for negative changes. Contrast with opportunity.
**Three-Point Estimate** [Technique]. An analytical technique that uses three cost or duration estimates to represent the optimistic, most likely, and pessimistic scenarios. This technique is applied to improve the accuracy of the estimates of cost or duration when the underlying activity or cost component is uncertain.

**Threshold.** A cost, time, quality, technical, or resource value used as a parameter, and which may be included in product specifications. Crossing the threshold should trigger some action, such as generating an exception report.

**Time and Material (T&M) Contract.** A type of contract that is a hybrid contractual arrangement containing aspects of both cost-reimbursable and fixed-price contracts. Time and material contracts resemble cost-reimbursable type arrangements in that they have no definitive end, because the full value of the arrangement is not defined at the time of the award. Thus, time and material contracts can grow in contract value as if they were cost-reimbursable-type arrangements. Conversely, time and material arrangements can also resemble fixed-price arrangements. For example, the unit rates are preset by the buyer and seller, when both parties agree on the rates for the category of senior engineers.

**Time-Now Date.** See data date.

**Time-Scaled Schedule Network Diagram** [Tool]. Any project schedule network diagram drawn in such a way that the positioning and length of the schedule activity represents its duration. Essentially, it is a bar chart that includes schedule network logic.

**Tool.** Something tangible, such as a template or software program, used in performing an activity to produce a product or result.

**Total Float (TF).** The total amount of time that a schedule activity may be delayed from its early start date without delaying the project finish date, or violating a schedule constraint. Calculated using the critical path method technique and determining the difference between the early finish dates and late finish dates. See also free float.

**Total Quality Management (TQM)** [Technique]. A common approach to implementing a quality improvement program within an organization.

**Trend Analysis** [Technique]. An analytical technique that uses mathematical models to forecast future outcomes based on historical results. It is a method of determining the variance from a baseline of a budget, cost, schedule, or scope parameter by using prior progress reporting periods’ data and projecting how much that parameter’s variance from baseline might be at some future point in the project if no changes are made in executing the project.

**Triggers.** Indications that a risk has occurred or is about to occur. Triggers may be discovered in the risk identification process and watched in the risk monitoring and control process. Triggers are sometimes called risk symptoms or warning signs.

**Triple Constraint.** A framework for evaluating competing demands. The triple constraint is often depicted as a triangle where one of the sides or one of the corners represent one of the parameters being managed by the project team.

**User.** The person or organization that will use the project’s product or service. See also customer.

**Validation** [Technique]. The technique of evaluating a component or product during or at the end of a phase or project to ensure it complies with the specified requirements. Contrast with verification.
Value Engineering (VE). A creative approach used to optimize project life cycle costs, save time, increase profits, improve quality, expand market share, solve problems, and/or use resources more effectively.

Variance. A quantifiable deviation, departure, or divergence away from a known baseline or expected value.

Variance Analysis [Technique]. A method for resolving the total variance in the set of scope, cost, and schedule variables into specific component variances that are associated with defined factors affecting the scope, cost, and schedule variables.

Verification [Technique]. The technique of evaluating a component or product at the end of a phase or project to assure or confirm it satisfies the conditions imposed. Contrast with validation.

Virtual Team. A group of persons with a shared objective who fulfill their roles with little or no time spent meeting face to face. Various forms of technology are often used to facilitate communication among team members. Virtual teams can be comprised of persons separated by great distances.

Voice of the Customer. A planning technique used to provide products, services, and results that truly reflect customer requirements by translating those customer requirements into the appropriate technical requirements for each phase of project product development.

War Room. A room used for project conferences and planning, often displaying charts of cost, schedule status, and other key project data.

Work. Sustained physical or mental effort, exertion, or exercise of skill to overcome obstacles and achieve an objective.

Work Authorization [Technique]. A permission and direction, typically written, to begin work on a specific schedule activity or work package or control account. It is a method for sanctioning project work to ensure that the work is done by the identified organization, at the right time, and in the proper sequence.

Work Authorization System [Tool]. A subsystem of the overall project management system. It is a collection of formal documented procedures that defines how project work will be authorized (committed) to ensure that the work is done by the identified organization, at the right time, and in the proper sequence. It includes the steps, documents, tracking system, and defined approval levels needed to issue work authorizations.

Work Breakdown Structure (WBS) [Output/Input]. A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of the project work. The WBS is decomposed into work packages. The deliverable orientation of the hierarchy includes both internal and external deliverables. See also work package, control account, contract work breakdown structure, and project summary work breakdown structure.

Work Breakdown Structure Component. An entry in the work breakdown structure that can be at any level.

Work Breakdown Structure Dictionary [Output/Input]. A document that describes each component in the work breakdown structure (WBS). For each WBS component, the WBS dictionary includes a brief definition of the scope or statement of work, defined deliverable(s), a list of associated activities, and a list of milestones. Other information may include: responsible organization, start and end dates, resources required, an
estimate of cost, charge number, contract information, quality requirements, and technical references to facilitate performance of the work.

**Work Item.** Term no longer in common usage. See activity and schedule activity.

**Work Package.** A deliverable or project work component at the lowest level of each branch of the work breakdown structure. The work package includes the schedule activities and schedule milestones required to complete the work package deliverable or project work component. See also control account.

**Work Performance Information** [Output/Input]. Information and data, on the status of the project schedule activities being performed to accomplish the project work, collected as part of the direct and manage project execution processes*. Information includes: status of deliverables; implementation status for change requests, corrective actions, preventive actions, and defect repairs; forecasted estimates to complete; reported percent of work physically completed; achieved value of technical performance measures; start and finish dates of schedule activities.

**Workaround** [Technique]. A response to a negative risk that has occurred. Distinguished from contingency plan in that a workaround is not planned in advance of the occurrence of the risk event.
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