

9

PROJECT RESOURCE MANAGEMENT

Project Resource Management includes the processes to identify, acquire, and manage the resources needed for the successful completion of the project. These processes help ensure that the right resources will be available to the project manager and project team at the right time and place.

The Project Resource Management processes are:

9.1 Plan Resource Management—The process of defining how to estimate, acquire, manage, and utilize physical and team resources.

9.2 Estimate Activity Resources—The process of estimating team resources and the type and quantities of material, equipment, and supplies necessary to perform project work.

9.3 Acquire Resources—The process of obtaining team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work.

9.4 Develop Team—The process of improving competencies, team member interaction, and the overall team environment to enhance project performance.

9.5 Manage Team—The process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance.

9.6 Control Resources—The process of ensuring that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual use of resources, and performing corrective action as necessary.

Figure 9-1 provides an overview of the Project Resource Management processes. The Project Resource Management processes are presented as discrete processes with defined interfaces while, in practice, they overlap and interact in ways that cannot be completely detailed in the *PMBOK® Guide*.



Figure 9-1. Project Resource Management Overview

There is a distinction between the skills and competencies needed for the project manager to manage team resources versus physical resources. Physical resources include equipment, materials, facilities, and infrastructure. Team resources or personnel refer to the human resources. Personnel may have varied skill sets, may be assigned full- or part-time, and may be added or removed from the project team as the project progresses. There is some overlap between Project Resource Management and Project Stakeholder Management (Section 13). This section (Section 9) focuses on the subset of stakeholders who make up the project team.

KEY CONCEPTS FOR PROJECT RESOURCE MANAGEMENT

The project team consists of individuals with assigned roles and responsibilities who work collectively to achieve a shared project goal. The project manager should invest suitable effort in acquiring, managing, motivating, and empowering the project team. Although specific roles and responsibilities for the project team members are assigned, the involvement of all team members in project planning and decision making is beneficial. Participation of team members during planning adds their expertise to the process and strengthens their commitment to the project.

The project manager should be both leader and manager of the project team. In addition to project management activities such as initiating, planning, executing, monitoring and controlling, and closing the various project phases, the project manager is responsible for the team formation as an effective group. The project manager should be aware of different aspects that influence the team, such as:

- ◆ Team environment,
- ◆ Geographical locations of team members,
- ◆ Communications among stakeholders,
- ◆ Organizational change management,
- ◆ Internal and external politics,
- ◆ Cultural issues and organizational uniqueness, and
- ◆ Other factors that may alter project performance.

As a leader, the project manager is also responsible for proactively developing team skills and competencies while retaining and improving team satisfaction and motivation. The project manager should be aware of, and subscribe to, professional and ethical behavior, and ensure that all team members adhere to these behaviors.

Physical resource management is concentrated in allocating and using the physical resources (material, equipment, and supplies, for example) needed for successful completion of the project in an efficient and effective way. In order to do that, organizations should have data on resource demands (now and in the reasonable future), resource configurations that will be required to meet those demands, and the supply of resources. Failing to manage and control resources efficiently is a source of risk for successful project completion. For example:

- ◆ Failing to secure critical equipment or infrastructure on time may result in delays in the manufacturing of the final product,
- ◆ Ordering low-quality material may damage the quality of the product causing a high rate of recalls or rework, and
- ◆ Keeping too much inventory may result in high operations costs and reduce the organization's profit. Unacceptably low inventory level, on the other hand, may result in not satisfying customer demand and, again, reduce the organization's profit.

TRENDS AND EMERGING PRACTICES IN PROJECT RESOURCE MANAGEMENT

Project management styles are shifting away from a command and control structure for managing projects and toward a more collaborative and supportive management approach that empowers teams by delegating decision making to the team members. In addition, modern project resource management approaches seek to optimize resource utilization. Trends and emerging practices for Project Resource Management include but are not limited to:

- ◆ **Resource management methods.** Due to the scarce nature of critical resources, in some industries, several trends have become popular in the past several years. There is extensive literature about lean management, just-in-time (JIT) manufacturing, Kaizen, total productive maintenance (TPM), theory of constraints (TOC), and other methods. A project manager should determine if the performing organization has adopted one or more resource management tools and adapt the project accordingly.
- ◆ **Emotional intelligence (EI).** The project manager should invest in personal EI by improving inbound (e.g., self-management and self-awareness) and outbound (e.g., relationship management) competencies. Research suggests that project teams that succeed in developing team EI or become an emotionally competent group are more effective. Additionally, there is a reduction in staff turnover.
- ◆ **Self-organizing teams.** The increase in using agile approaches mainly for the execution of IT projects has given rise to the self-organizing team, where the team functions with an absence of centralized control. In projects that have self-organizing teams, the project manager (who may not be called a project manager) role provides the team with the environment and support needed and trusts the team to get the job done. Successful self-organizing teams usually consist of generalized specialists, instead of subject matter experts, who continuously adapt to the changing environment and embrace constructive feedback.

- ◆ **Virtual teams/distributed teams.** The globalization of projects has promoted the need for virtual teams that work on the same project, but are not colocated at the same site. The availability of communication technology such as email, audio conferencing, social media, web-based meetings, and video conferencing has made virtual teams feasible. Managing virtual teams has unique advantages, such as being able to use special expertise on a project team even when the expert is not in the same geographic area, incorporating employees who work from home offices, and including people with mobility limitations or disabilities. The challenges of managing virtual teams are mainly in the communication domain, including a possible feeling of isolation, gaps in sharing knowledge and experience between team members, and difficulties in tracking progress and productivity, possible time zone difference and cultural differences.

TAILORING CONSIDERATIONS

Because each project is unique, the project manager will need to tailor the way Project Resource Management processes are applied. Considerations for tailoring include but are not limited to:

- ◆ **Diversity.** What is the diversity background of the team?
- ◆ **Physical location.** What is the physical location of team members and physical resources?
- ◆ **Industry-specific resources.** What special resources are needed in the industry?
- ◆ **Acquisition of team members.** How will team members be acquired for the project? Are team resources full-time or part-time on the project?
- ◆ **Management of team.** How is team development managed for the project? Are there organizational tools to manage team development or will new ones need to be established? Are there team members who have special needs? Will the team need special training to manage diversity?
- ◆ **Life cycle approaches.** What life cycle approach will be used on the project?

CONSIDERATIONS FOR AGILE/ADAPTIVE ENVIRONMENTS

Projects with high variability benefit from team structures that maximize focus and collaboration, such as self-organizing teams with generalizing specialists.

Collaboration is intended to boost productivity and facilitate innovative problem solving. Collaborative teams may facilitate accelerated integration of distinct work activities, improve communication, increase knowledge sharing, and provide flexibility of work assignments in addition to other advantages.

Although the benefits of collaboration also apply to other project environments, collaborative teams are often critical to the success of projects with a high degree of variability and rapid changes, because there is less time for centralized tasking and decision making.

Planning for physical and human resources is much less predictable in projects with high variability. In these environments, agreements for fast supply and lean methods are critical to controlling costs and achieving the schedule.

9.1 PLAN RESOURCE MANAGEMENT

Plan Resource Management is the process of defining how to estimate, acquire, manage, and use team and physical resources. The key benefit of this process is that it establishes the approach and level of management effort needed for managing project resources based on the type and complexity of the project. This process is performed once or at predefined points in the project. The inputs, tools and techniques, and outputs of the process are depicted in Figure 9-2. Figure 9-3 depicts the data flow diagram for the process.

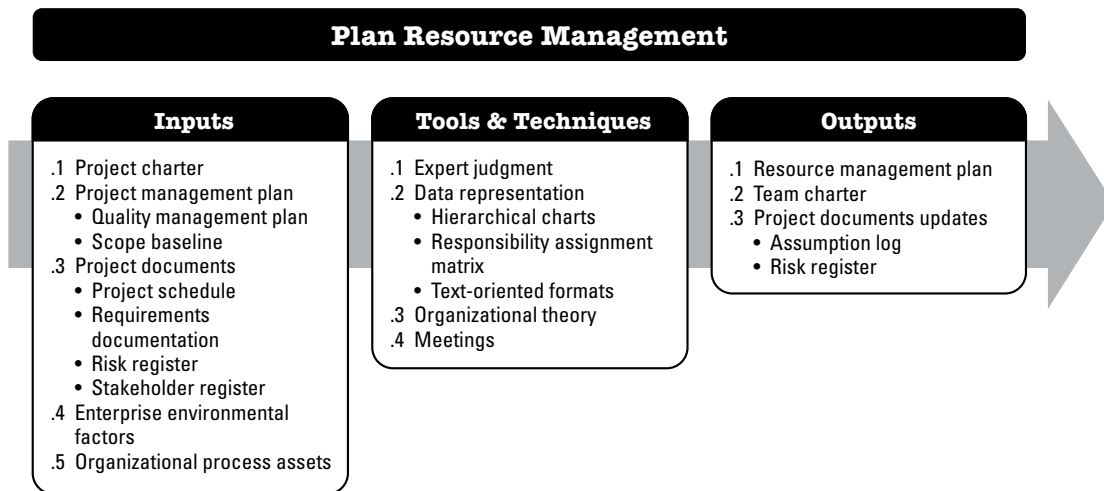


Figure 9-2. Plan Resource Management: Inputs, Tools & Techniques, and Outputs

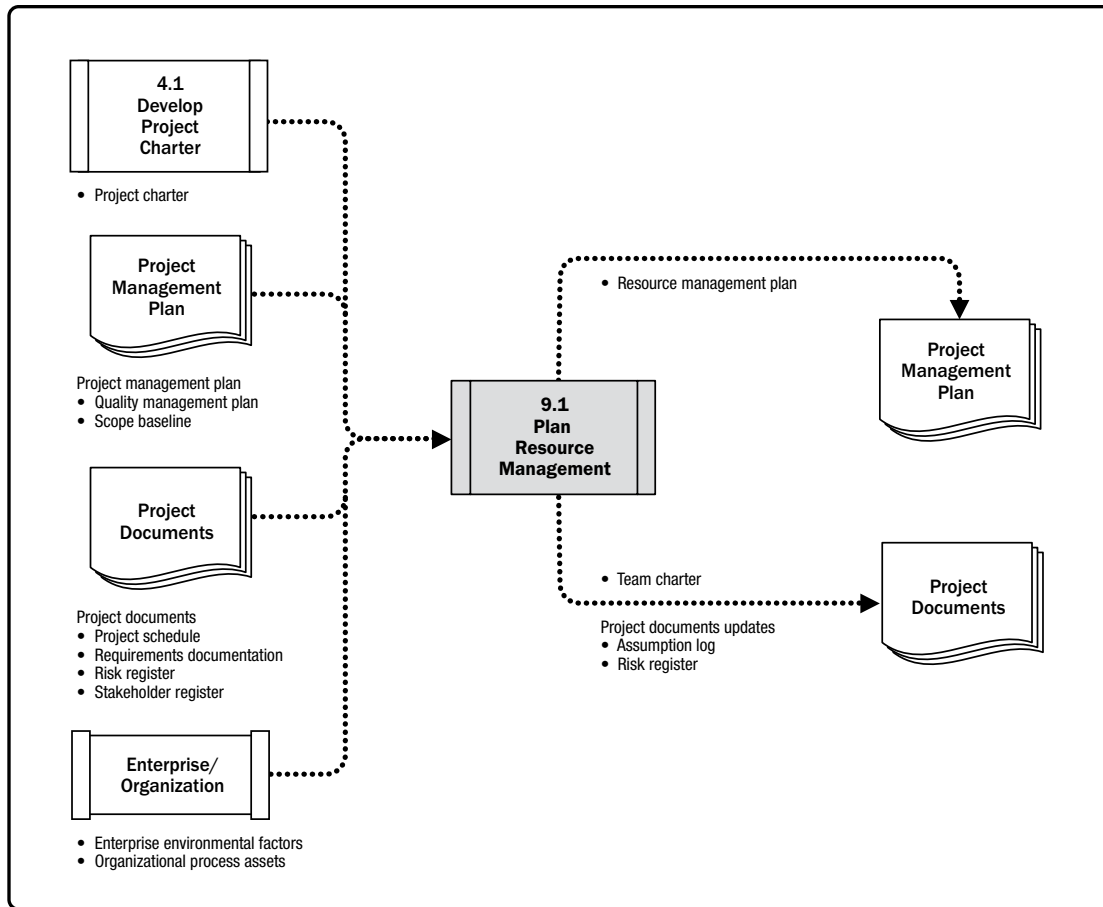


Figure 9-3. Plan Resource Management: Data Flow Diagram

Resource planning is used to determine and identify an approach to ensure that sufficient resources are available for the successful completion of the project. Project resources may include team members, supplies, materials, equipment, services and facilities. Effective resource planning should consider and plan for the availability of, or competition for, scarce resources.

Those resources can be obtained from the organization's internal assets or from outside the organization through a procurement process. Other projects may be competing for the same resources required for the project at the same time and location. This may significantly impact project costs, schedules, risks, quality, and other project areas.

9.1.1 PLAN RESOURCE MANAGEMENT: INPUTS

9.1.1.1 PROJECT CHARTER

Described in Section 4.1.3.1. The project charter provides the high-level project description and requirements. It also has the key stakeholder list, summary milestones, and preapproved financial resources that may influence the resource management of the project.

9.1.1.2 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to:

- ◆ **Quality management plan.** Described in Section 8.1.3.1. The quality management plan helps define the level of resources that will be required to achieve and maintain the defined level of quality and achieve the metrics for the project.
- ◆ **Scope baseline.** Described in Section 5.4.3.1. The scope baseline identifies the deliverables that drive the types and quantities of resources that will need to be managed.

9.1.1.3 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Project schedule.** Described in Section 6.5.3.2. The project schedule shows the timeline for needed resources.
- ◆ **Requirements documentation.** Described in Section 5.2.3.1. Requirements will dictate the type and amount of resources needed for the project and may influence how they are managed.
- ◆ **Risk register.** Described in Section 11.2.3.1. The risk register contains information on threats and opportunities that may impact resource planning.
- ◆ **Stakeholder register.** Described in Section 13.1.3.1. The stakeholder register aids in identifying those stakeholders who have a particular interest in or an impact on resources needed for the project. It also helps to identify stakeholders who can influence the use of one kind of resource over another.

9.1.1.4 ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Plan Resource Management include but are not limited to:

- ◆ Organizational culture and structure,
- ◆ Geographic distribution of facilities and resources,
- ◆ Existing resources competencies and availability, and
- ◆ Marketplace conditions.

9.1.1.5 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Plan Resource Management include but are not limited to:

- ◆ Human resource policies and procedures,
- ◆ Physical resource management policies and procedures,
- ◆ Safety policies,
- ◆ Security policies,
- ◆ Templates for the resource management plan, and
- ◆ Historical information for similar projects.

9.1.2 PLAN RESOURCE MANAGEMENT: TOOLS AND TECHNIQUES

9.1.2.1 EXPERT JUDGMENT

Described in Section 4.1.2.1. Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- ◆ Negotiating for the best resources within the organization;
- ◆ Talent management and personnel development;
- ◆ Determining the preliminary effort level needed to meet project objectives;
- ◆ Determining reporting requirements based on the organizational culture;
- ◆ Estimating lead times required for acquisition, based on lessons learned and market conditions;
- ◆ Identifying risks associated with resource acquisition, retention, and release plans;
- ◆ Complying with applicable government and union regulations; and
- ◆ Managing sellers and the logistics effort to ensure materials and supplies are available when needed.

9.1.2.2 DATA REPRESENTATION

Data representation techniques that can be used for this process include but are not limited to charts. Various formats exist to document and communicate team member roles and responsibilities. Most fall into hierarchical, matrix, or text-oriented formats. Some project assignments are listed in subsidiary plans, such as the risk, quality, or communications management plans. Regardless of the method used to document team member roles, 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. A hierarchical format may be used to represent high-level roles, while a text-based format may be better suited to document the detailed responsibilities.

- ◆ **Hierarchical charts.** The traditional organizational chart structure can be used to show positions and relationships in a graphical, top-down format.
 - *Work breakdown structures (WBS).* The WBS is designed to show how project deliverables are broken down into work packages and provide a way of showing high-level areas of responsibility.
 - *Organizational breakdown structure (OBS).* While the WBS shows a breakdown of project deliverables, an OBS is arranged according to an organization's existing departments, units, or teams, with the project activities or work packages listed under each department. An operational department, such as information technology or purchasing, can see all of its project responsibilities by looking at its portion of the OBS.
 - *Resource breakdown structure.* The resource breakdown structure is a hierarchical list of team and physical resources related by category and resource type that is used for planning, managing and controlling project work. Each descending (lower) level represents an increasingly detailed description of the resource until the information is small enough to be used in conjunction with the work breakdown structure (WBS) to allow the work to be planned, monitored, and controlled.

- ◆ **Assignment Matrix.** A RAM shows the project resources assigned to each work package. It is used to illustrate the connections between work packages, or activities, and project team members. On larger projects, RAMs can be developed at various levels. For example, a high-level RAM can define the responsibilities of a project team, group, or unit within each component of the WBS. Lower-level RAMs are used within the group to designate roles, responsibilities, and levels of authority for specific activities. The matrix format shows all activities associated with one person and all people associated with one activity. This also ensures that there is only one person accountable for any one task to avoid confusion about who is ultimately in charge or has authority for the work. One example of a RAM is a RACI (responsible, accountable, consult, and inform) chart, shown in Figure 9-4. The sample chart shows the work to be done in the left column as activities. The assigned resources can be shown as individuals or groups. The project manager can select other options, such as “lead” and “resource” designations, as appropriate for the project. A RACI chart is a useful tool to use to ensure clear assignment of roles and responsibilities when the team consists of internal and external resources.
- ◆ **Text-oriented formats.** Team member responsibilities that require detailed descriptions can be specified in text-oriented formats. Usually in outline form, these 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 documents can be used as templates for future projects, especially when the information is updated throughout the current project by applying lessons learned.

RACI Chart	Person				
Activity	Ann	Ben	Carlos	Dina	Ed
Create charter	A	R	I	I	I
Collect requirements	I	A	R	C	C
Submit change request	I	A	R	R	C
Develop test plan	A	C	I	I	R
R = Responsible A = Accountable C = Consult I = Inform					

Figure 9-4. Sample RACI Chart

9.1.2.3 ORGANIZATIONAL THEORY

Organizational theory provides information regarding the way in which people, teams, and organizational units behave. Effective use of common techniques identified in organizational theory can shorten the amount of time, cost, and effort needed to create the Plan Resource Management process outputs and improve planning efficiency. Applicable organizational theories may recommend exercising a flexible leadership style that adapts to the changes in a team's maturity level throughout the project life cycle. It is important to recognize that the organization's structure and culture impacts the project organizational structure.

9.1.2.4 MEETINGS

The project team may hold meetings to plan resource management for the project.

9.1.3 PLAN RESOURCE MANAGEMENT: OUTPUTS

9.1.3.1 RESOURCE MANAGEMENT PLAN

The resource management plan is the component of the project management plan that provides guidance on how project resources should be categorized, allocated, managed, and released. It may be divided between the team management plan and physical resource management plan according to the specifics of the project. The resource management plan may include but is not limited to:

- ◆ **Identification of resources.** Methods for identifying and quantifying team and physical resources needed.
- ◆ **Acquiring resources.** Guidance on how to acquire team and physical resources for the project.
- ◆ **Roles and responsibilities:**
 - *Role.* The function assumed by, or assigned to, a person in the project. Examples of project roles are civil engineer, business analyst, and testing coordinator.
 - *Authority.* The rights to apply project resources, make decisions, sign approvals, accept deliverables, and influence others to carry out the work of the project. Examples of decisions that need clear authority include the selection of a method for completing an activity, quality acceptance criteria, and how to respond to project variances. Team members operate best when their individual levels of authority match their individual responsibilities.

- *Responsibility.* The assigned duties and work that a project team member is expected to perform in order to complete the project's activities.
- *Competence.* The skill and capacity required to complete assigned activities within the project constraints. 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.
- ◆ **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, 20-person project.
- ◆ **Project team resource management.** Guidance on how project team resources should be defined, staffed, managed, and eventually released.
- ◆ **Training.** Training strategies for team members.
- ◆ **Team development.** Methods for developing the project team.
- ◆ **Resource control.** Methods for ensuring adequate physical resources are available as needed and that the acquisition of physical resources is optimized for project needs. Includes information on managing inventory, equipment, and supplies during throughout the project life cycle.
- ◆ **Recognition plan.** Which recognition and rewards will be given to team members, and when they will be given.

9.1.3.2 TEAM CHARTER

The team charter is a document that establishes the team values, agreements, and operating guidelines for the team. The team charter may include but is not limited to:

- ◆ Team values,
- ◆ Communication guidelines,
- ◆ Decision-making criteria and process,
- ◆ Conflict resolution process,
- ◆ Meeting guidelines, and
- ◆ Team agreements.

The team charter establishes clear expectations regarding acceptable behavior by project team members. Early commitment to clear guidelines decreases misunderstandings and increases productivity. Discussing areas such as codes of conduct, communication, decision making, and meeting etiquette allows team members to discover values that are important to one another. The team charter works best when the team develops it, or at least has an opportunity to contribute to it. All project team members share responsibility for ensuring the rules documented in the team charter are followed. The team charter can be reviewed and updated periodically to ensure a continued understanding of the team ground rules and to orient and integrate new team members.

9.1.3.3 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Assumption log.** Described in Section 4.1.3.2. The assumption log is updated with assumptions regarding the availability, logistics requirements, and location of physical resources as well as the skill sets and availability of team resources.
- ◆ **Risk register.** Described in Section 11.2.3.1. The risk register is updated with risks associated with team and physical resource availability or other known resource-related risks.

9.2 ESTIMATE ACTIVITY RESOURCES

Estimate Activity Resources is the process of estimating team resources and the type and quantities of materials, equipment, and supplies necessary to perform project work. The key benefit of this process is that it identifies the type, quantity, and characteristics of resources required to complete the project. This process is performed periodically throughout the project as needed. The inputs, tools and techniques, and outputs of this process are depicted in Figure 9-5. Figure 9-6 depicts the data flow diagram of the process.

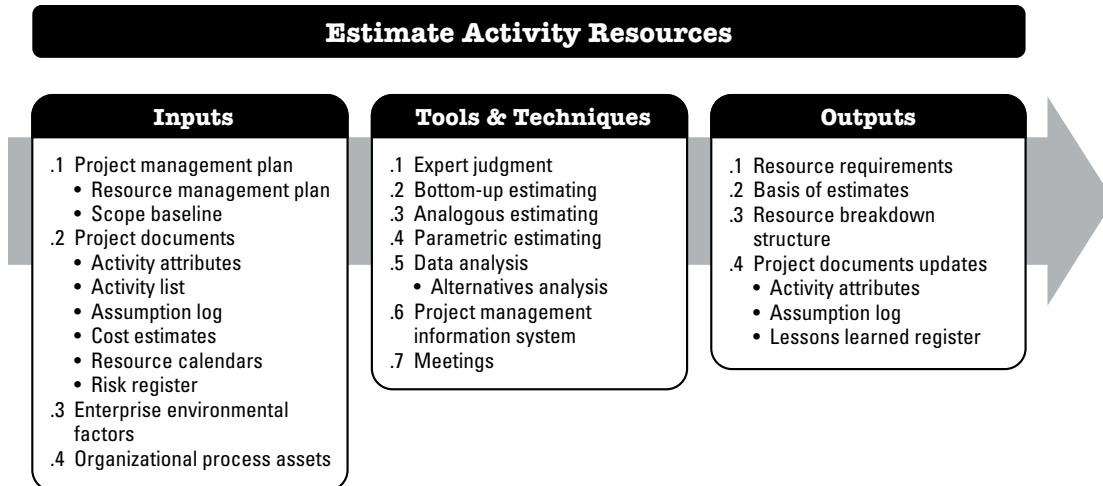


Figure 9-5. Estimate Activity Resources: Inputs, Tools & Techniques, and Outputs

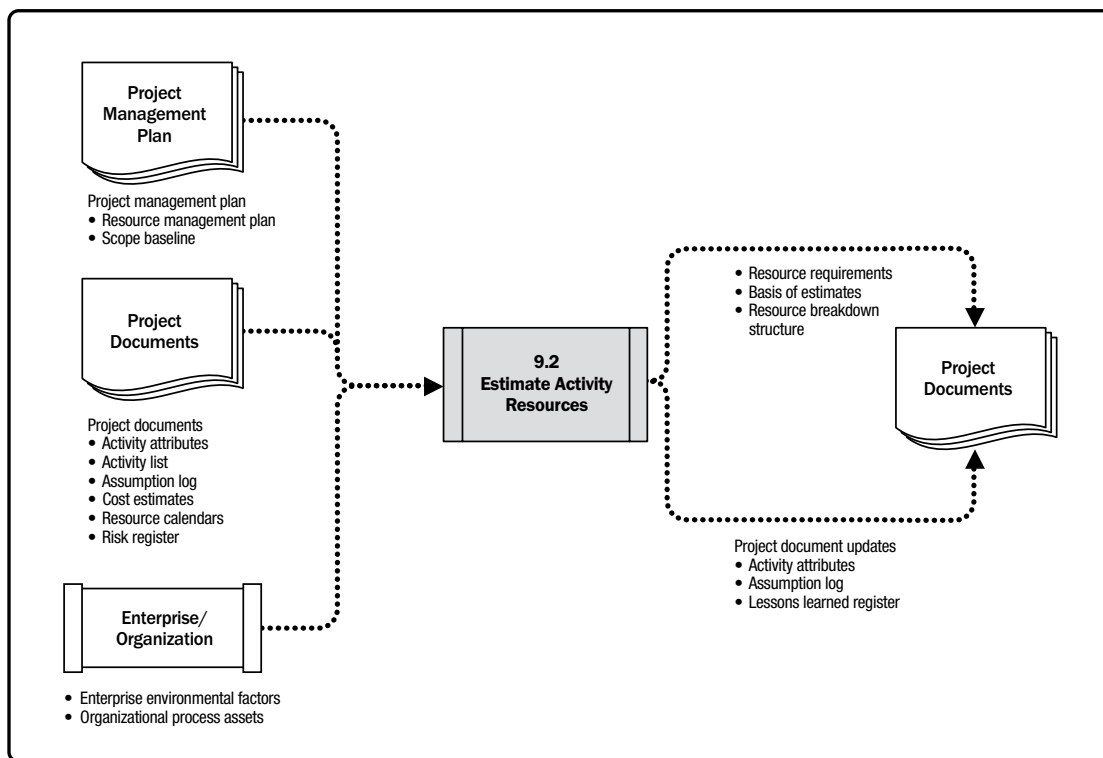


Figure 9-6. Estimate Activity Resources: Data Flow Diagram

The Estimate Activity Resources process is closely coordinated with other processes, such as the Estimate Costs process. For example:

- ◆ A construction project team will need to be familiar with local building codes. Such knowledge is often readily available from local sellers. If the internal labor pool lacks experience with unusual or specialized construction techniques, the additional cost for a consultant may be the most effective way to secure knowledge of the local building codes.
- ◆ An automotive design team will need to be familiar with the latest automated assembly techniques. The requisite knowledge could be obtained by hiring a consultant, by sending a designer to a seminar on robotics, or by including someone from manufacturing as a member of the project team.

9.2.1 ESTIMATE ACTIVITY RESOURCES: INPUTS

9.2.1.1 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to:

- ◆ **Resource management plan.** Described in Section 9.1.3.1. The resource management plan defines the approach to identify the different resources needed for the project. It also defines the methods to quantify the resources needed for each activity and aggregates this information.
- ◆ **Scope baseline.** Described in Section 5.4.3.1. The scope baseline identifies the project and product scope necessary to meet the project objectives. The scope drives the needs for both team and physical resources.

9.2.1.2 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Activity attributes.** Described in Section 6.2.3.2. Activity attributes provide the primary data source for use in estimating team and physical resources required for each activity on the activity list. Examples of attributes include the resource requirements, imposed dates, activity location, assumptions, and constraints.
- ◆ **Activity list.** Described in Section 6.2.3.1. The activity list identifies the activities that will need resources.

- ◆ **Assumption log.** Described in Section 4.1.3.2. The assumption log may have information on productivity factors, availability, cost estimates, and approaches to work that will influence the nature and number of team and physical resources.
- ◆ **Cost estimates.** Described in Section 7.2.3.1. The cost of resources may impact resource selection from the quantity and skill level perspectives.
- ◆ **Resource calendars.** A resource calendar identifies the working days, shifts, start and end of normal business hours, weekends, and public holidays when each specific resource is available. Information on which resources (such as team resource, equipment, and material) are potentially available during a planned activity period is used for estimating resource utilization. Resource calendars also specify when, and for how long, identified team and physical resources will be available during the project. This information may be at the activity or project level. This includes consideration of attributes such as resource experience and/or skill level, as well as various geographical locations.
- ◆ **Risk register.** Described in Section 11.2.3.1. The risk register describes the individual risks that can impact resource selection and availability.

9.2.1.3 ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Estimate Activity Resources process include but are not limited to:

- ◆ Resource location,
- ◆ Resource availability,
- ◆ Team resource skills,
- ◆ Organizational culture,
- ◆ Published estimating data, and
- ◆ Marketplace conditions.

9.2.1.4 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Estimate Activity Resources process include but are not limited to:

- ◆ Policies and procedures regarding staffing,
- ◆ Policies and procedures relating to supplies and equipment, and
- ◆ Historical information regarding types of resources used for similar work on previous projects.

9.2.2 ESTIMATE ACTIVITY RESOURCES: TOOLS AND TECHNIQUES

9.2.2.1 EXPERT JUDGMENT

Described in Section 4.1.2.1. Expertise should be considered from individuals or groups with specialized knowledge or training in team and physical resource planning and estimating.

9.2.2.2 BOTTOM-UP ESTIMATING

Described in Section 6.4.2.5. Team and physical resources are estimated at the activity level and then aggregated to develop the estimates for work packages, control accounts, and summary project levels.

9.2.2.3 ANALOGOUS ESTIMATING

Described in Section 6.4.2.2. Analogous estimating uses information regarding resources from a previous similar project as the basis for estimating a future project. It is used as quick estimating method and can be used when the project manager can only identify a few top levels of the WBS.

9.2.2.4 PARAMETRIC ESTIMATING

Described in Section 6.4.2.3. Parametric estimating uses an algorithm or a statistical relationship between historical data and other variables to calculate resource quantities needed for an activity, based on historical data and project parameters. For example, if an activity needs 4,000 hours of coding and it needs to finish it in 1 year, it will require two people to code (each doing 2,000 hours a year). This technique can produce higher levels of accuracy depending on the sophistication and underlying data built into the model.

9.2.2.5 DATA ANALYSIS

A data analysis technique used in this process includes but is not limited to alternatives analysis. Alternatives analysis is used to evaluate identified options in order to select the options or approaches to use to execute and perform the work of the project. Many activities have multiple options for accomplishment. They include using various levels of resource capability or skills, different sizes or types of machines, different tools (manual versus automated), and make-rent-or-buy decisions regarding the resources. Alternatives analysis assists in providing the best solution to perform the project activities, within the defined constraints.

9.2.2.6 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Described in Section 4.3.2.2. Project management information systems can include resource management software that can help plan, organize, and manage resource pools and develop resource estimates. Depending on the sophistication of the software, resource breakdown structures, resource availability, resource rates, and various resource calendars can be defined to assist in optimizing resource utilization.

9.2.2.7 MEETINGS

The project manager may hold planning meetings with functional managers to estimate the resources needed per activity, level of effort (LoE), skill level of the team resources, and the quantity of the materials needed. Participants at these meetings may include the project manager, the project sponsor, selected project team members, selected stakeholders, and others as needed.

9.2.3 ESTIMATE ACTIVITY RESOURCES: OUTPUTS

9.2.3.1 RESOURCE REQUIREMENTS

Resource requirements identify the types and quantities of resources required for each work package or activity in a work package and can be aggregated to determine the estimated resources for each work package, each WBS branch, and the project as a whole. The amount of detail and the level of specificity of the resource requirement descriptions can vary by application area. The resource requirements' documentation can include assumptions that were made in determining which types of resources are applied, their availability, and what quantities are needed.

9.2.3.2 BASIS OF ESTIMATES

Described in Section 6.4.3.2. The amount and type of additional details supporting the resource estimate vary by application area. Regardless of the level of detail, the supporting documentation should provide a clear and complete understanding of how the resource estimate was derived.

Supporting detail for resource estimates may include:

- ◆ Method used to develop the estimate,
- ◆ Resources used to develop the estimate (such as information from previous similar projects),
- ◆ Assumptions associated with the estimate,
- ◆ Known constraints,
- ◆ Range of estimates,
- ◆ Confidence level of the estimate, and
- ◆ Documentation of identified risks influencing the estimate.

9.2.3.3 RESOURCE BREAKDOWN STRUCTURE

The resource breakdown structure is a hierarchical representation of resources by category and type (see Figure 9-7 for example). Examples of resource categories include but are not limited to labor, material, equipment, and supplies. Resource types may include the skill level, grade level, required certifications, or other information as appropriate to the project. In Plan Resource Management, the resource breakdown structure was used to guide the categorization for the project. In this process it is a completed document that will be used to acquire and monitor resources.

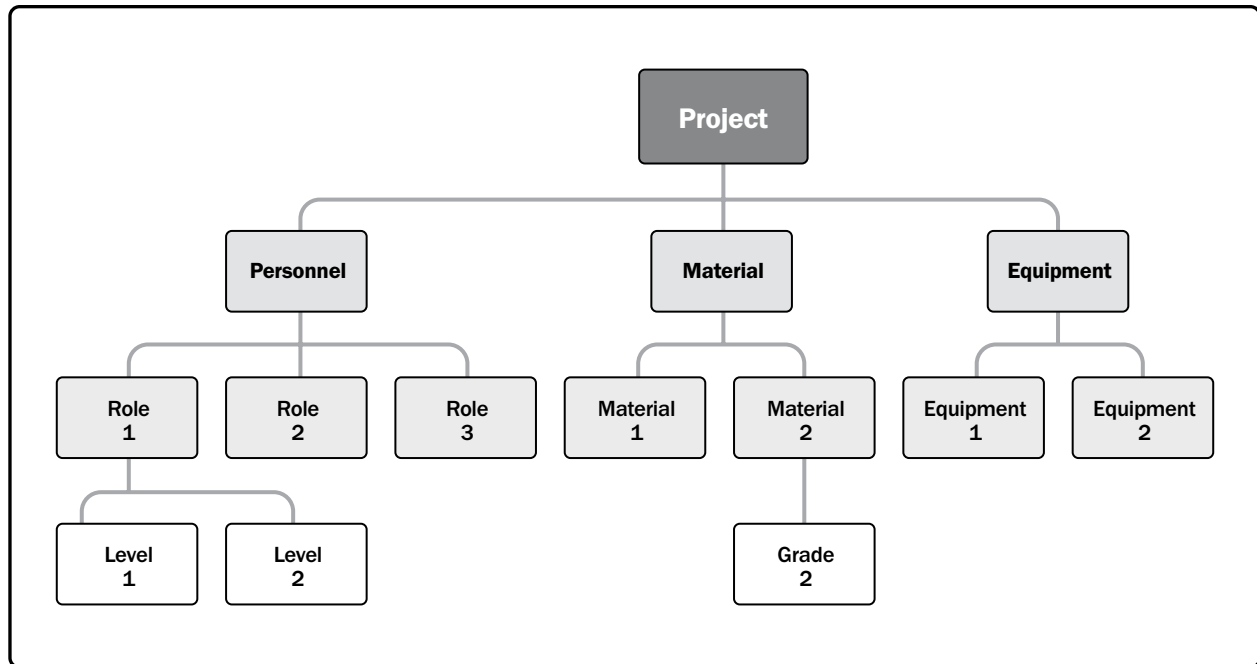


Figure 9-7. Sample Resource Breakdown Structure

9.2.3.4 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Activity attributes.** Described in Section 6.2.3.2. The activity attributes are updated with the resource requirements.
- ◆ **Assumption log.** Described in Section 4.1.3.2. The assumption log is updated with assumptions regarding the types and quantities of resources required. Additionally, any resource constraints are entered including collective bargaining agreements, continuous hours of operation, planned leave, etc.
- ◆ **Lessons learned register.** Described in Section 11.2.3.1. The lessons learned register can be updated with techniques that were efficient and effective in developing resource estimates, and information on those techniques that were not efficient or effective.

9.3 ACQUIRE RESOURCES

Acquire Resources is the process of obtaining team members, facilities, equipment, materials, supplies, and other resources necessary to complete project work. The key benefit of this process is that it outlines and guides the selection of resources and assigns them to their respective activities. This process is performed periodically throughout the project as needed. The inputs, tools and techniques, and outputs of the process are depicted in Figure 9-8. Figure 9-9 depicts the data flow diagram for the process.

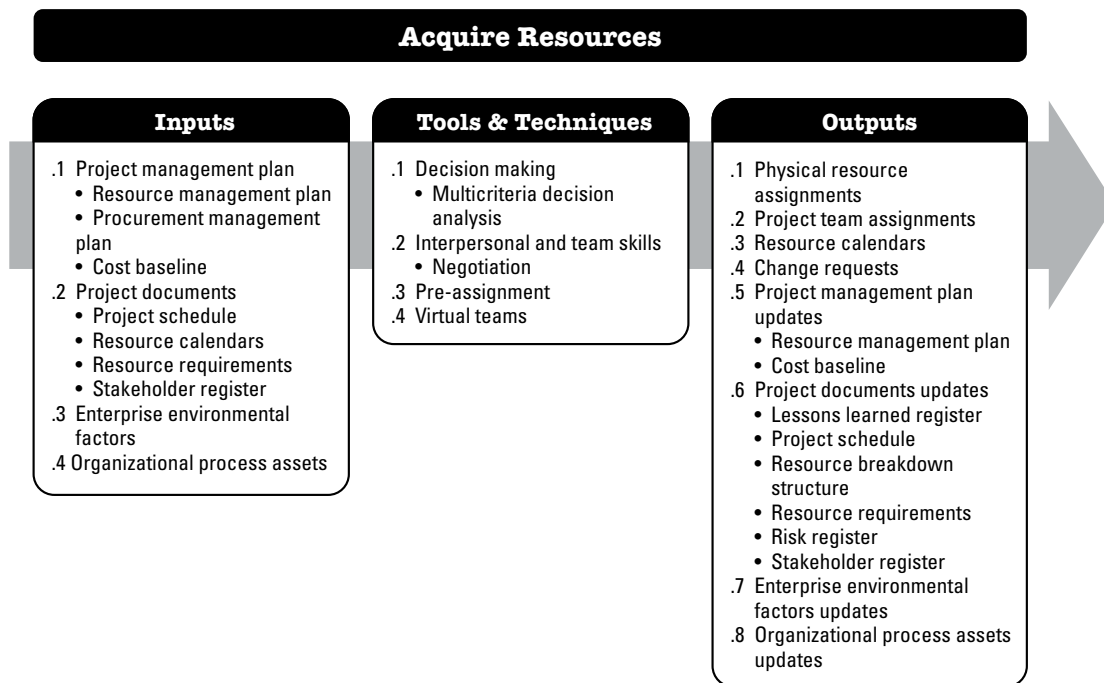


Figure 9-8. Acquire Resources: Inputs, Tools & Techniques, and Outputs

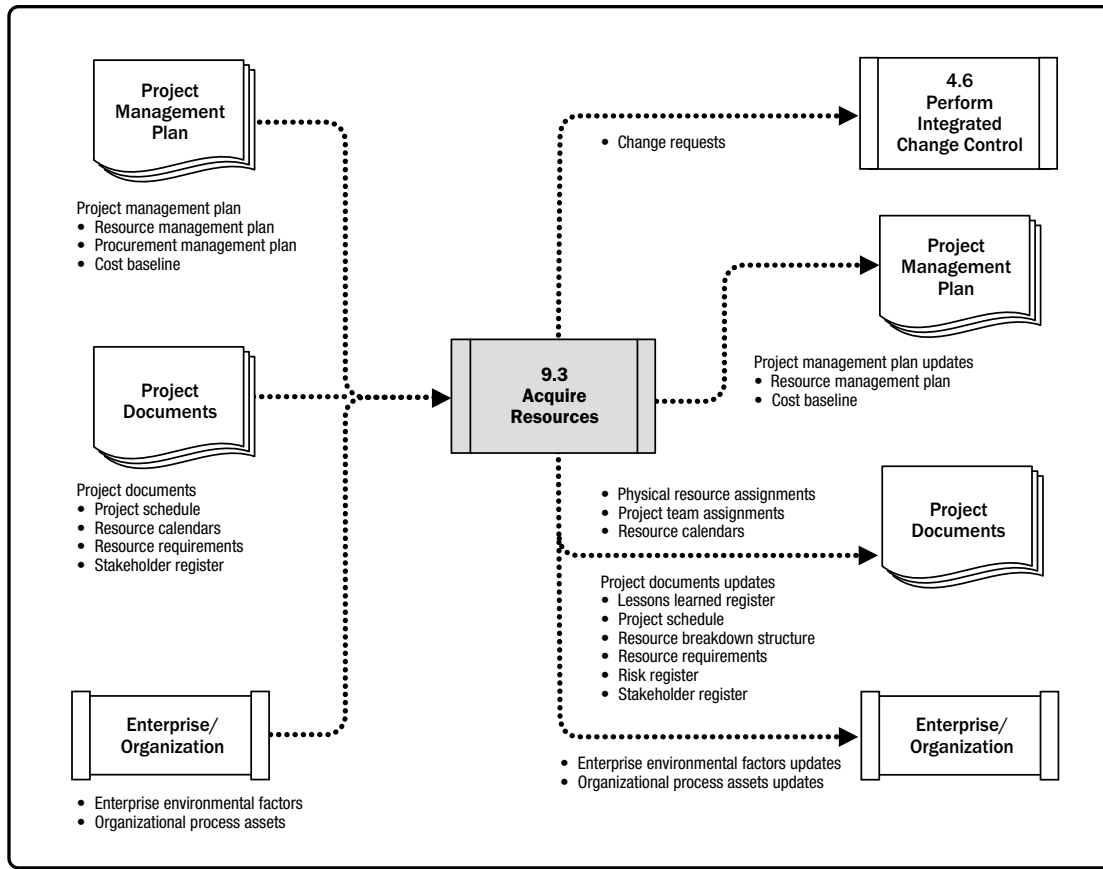


Figure 9-9. Acquire Resources: Data Flow Diagram

The resources needed for the project can be internal or external to the project-performing organization. Internal resources are acquired (assigned) from functional or resource managers. External resources are acquired through the procurement processes.

The project management team may or may not have direct control over resource selection because of collective bargaining agreements, use of subcontractor personnel, a matrix project environment, internal or external reporting relationships, or other reasons. It is important that the following factors are considered during the process of acquiring the project resources:

- ◆ The project manager or project team should effectively negotiate and influence others who are in a position to provide the required team and physical resources for the project.
- ◆ Failure to acquire the necessary resources for the project may affect project schedules, budgets, customer satisfaction, quality, and risks. Insufficient resources or capabilities decrease the probability of success and, in a worst-case scenario, could result in project cancellation.
- ◆ If the team resources are not available due to constraints such as economic factors or assignment to other projects, the project manager or project team may be required to assign alternative resources, perhaps with different competencies or costs. Alternative resources are allowed provided there is no violation of legal, regulatory, mandatory, or other specific criteria.

These factors should be considered and accounted for in the planning stages of the project. The project manager or project management team will be required to document the impact of the unavailability of required resources in the project schedule, project budget, project risks, project quality, training plans, and other project management plans.

9.3.1 ACQUIRE RESOURCES: INPUTS

9.3.1.1 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to:

- ◆ **Resource management plan.** Described in Section 9.1.3.1. The resource management plan provides guidance on how to acquire resources for the project.
- ◆ **Procurement management plan.** Described in Section 12.1.3.1. The procurement management plan has information regarding resources that will be acquired from outside the project. This includes information on how procurements will be integrated with other project work and stakeholders involved in procuring resources.
- ◆ **Cost baseline.** Described in Section 7.3.3.1. The cost baseline provides the overall budget for the project activities.

9.3.1.2 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Project schedule.** Described in Section 6.5.3.2. The project schedule shows the activities and their planned start and end dates to help determine when the resources need to be available and acquired.
- ◆ **Resource calendars.** Described in Section 9.3.3.3. Resource calendars document the time periods that each resource needed for the project is available for the project. Creating a reliable schedule depends on having a good understanding of each resource's availability and schedule constraints, including time zones, work hours, vacation time, local holidays, maintenance schedule and commitments to other projects. Resource calendars are progressively elaborated and updated throughout the project. Once created as an output of this process, they are used as needed whenever this process is repeated.
- ◆ **Resource requirements.** Described in Section 9.2.3.1. Resource requirements identify which resources need to be acquired.
- ◆ **Stakeholder register.** Described in Section 13.1.3.1. The stakeholder register may reveal stakeholders' needs or expectations for specific resources to be used on the project that need to be considered in the Acquire Resources process.

9.3.1.3 ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Acquire Resources process include but are not limited to:

- ◆ Existing information on organizational resources including availability, competence levels, and prior experience for team resources and resource costs;
- ◆ Marketplace conditions;
- ◆ Organizational structure; and
- ◆ Geographic locations.

9.3.1.4 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Acquire Resources process include but are not limited to:

- ◆ Policies and procedures for acquiring, allocating, and assigning resources to the project; and
- ◆ Historical information and lessons learned repository.

9.3.2 ACQUIRE RESOURCES: TOOLS AND TECHNIQUES

9.3.2.1 DECISION MAKING

Described in Section 5.2.2.4. Decision-making techniques that can be used in the Acquire Resources process include but are not limited to multicriteria decision analysis, as described in Section 8.1.2.4. Selection criteria are often used to select physical project resources, or the project team. Using a multicriteria decision analysis tool, criteria are developed and used to rate or score potential resources (for example, choosing between internal and external team resources). The criteria are weighted according to their relative importance and values can be changed for different types of resources. Some examples of selection criteria that can be used are:

- ◆ **Availability.** Verify that the resource is available to work on the project within the time period needed.
- ◆ **Cost.** Verify if the cost of adding the resource is within the prescribed budget.
- ◆ **Ability.** Verify that the team member provides the capability needed by the project.

Some selection criteria that are unique for team resources are:

- ◆ **Experience.** Verify that the team member has the relevant experience that will contribute to the project success.
- ◆ **Knowledge.** Consider if the team member has relevant knowledge of the customer, similar implemented projects, and nuances of the project environment.
- ◆ **Skills.** Determine if the team member has the relevant skills to use a project tool.
- ◆ **Attitude.** Determine if the team member has the ability to work with others as a cohesive team.
- ◆ **International factors.** Consider team member location, time zone, and communication capabilities.

9.3.2.2 INTERPERSONAL AND TEAM SKILLS

An interpersonal and team skill that can be used for this process includes but is not limited to negotiation. Described in Section 12.2.2.5. Many projects need to negotiate for required resources. The project management team may need to negotiate with:

- ◆ **Functional managers.** Ensure that the project receives the best resources possible in the required timeframe and until their responsibilities are complete.
- ◆ **Other project management teams within the performing organization.** Appropriately assign or share scarce or specialized resources.
- ◆ **External organizations and suppliers.** Provide appropriate, scarce, specialized, qualified, certified, or other specific team or physical resources. Special consideration should be given to external negotiating policies, practices, processes, guidelines, legal, and other such criteria.

The project management team's ability to influence others plays an important role in negotiating resource allocation, as does the politics of the organizations involved. For example, convincing a functional manager about the high visibility of the project may influence him or her to assign the best resources to this project over competing ones.

9.3.2.3 PRE-ASSIGNMENT

When physical or team resources for a project are determined in advance, they are considered pre-assigned. This situation can occur if the project is the result of specific resources being identified as part of a competitive proposal or if the project is dependent upon the expertise of particular persons. Pre-assignment might also include the team members who have already been assigned in Develop Project Charter Process or other processes before the initial Resource Management Plan has been completed.

9.3.2.4 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 communication technology such as email, audio conferencing, social media, web-based meetings, and video conferencing has made virtual teams feasible. The virtual team model makes it possible to:

- ◆ Form teams of people from the same organization 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, hours, or days;
- ◆ Include people with mobility limitations or disabilities;
- ◆ Move forward with projects that would have been held or canceled due to travel expenses; and
- ◆ Save the expense of offices and all physical equipment needed for employees.

Communication planning becomes increasingly important in a virtual team environment. Additional time may be needed to set clear expectations, facilitate communications, develop protocols for resolving conflict, include people in decision making, understand cultural differences, and share credit in successes.

9.3.3 ACQUIRE RESOURCES: OUTPUTS

9.3.3.1 PHYSICAL RESOURCE ASSIGNMENTS

Documentation of the physical resource assignments records the material, equipment, supplies, locations, and other physical resources that will be used during the project.

9.3.3.2 PROJECT TEAM ASSIGNMENTS

Documentation of team assignments records the team members and their roles and responsibilities for the project. Documentation can include a project team directory and names inserted into the project management plan, such as the project organization charts and schedules.

9.3.3.3 RESOURCE CALENDARS

A resource calendar identifies the working days, shifts, start and end of normal business hours, weekends, and public holidays when each specific resource is available. Information on which resources (such as team resource, equipment, and material) are potentially available during a planned activity period is used for estimating resource utilization. Resource calendars also specify when and for how long identified team and physical resources will be available during the project. This information may be at the activity or project level. This includes consideration of attributes such as resource experience and/or skill level, as well as various geographical locations.

9.3.3.4 CHANGE REQUESTS

Described in Section 4.3.3.4. When changes occur as a result of carrying out the Acquire Resources process (for example, impacts to the schedule) or when recommended corrective or preventive actions impact any of the components of the project management plan or project documents, the project manager needs to submit a change request. Change requests are processed for review and disposition through the Perform Integrated Change Control process (Section 4.6).

9.3.3.5 PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components of the project management plan that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Resource management plan.** Described in Section 9.1.3.1. The resource management plan may be updated to reflect actual experience in acquiring resources for the project, including lessons learned in acquiring resources early in the project that will impact how resources are acquired later in the project.
- ◆ **Cost baseline.** Described in Section 7.3.3.1. The cost baseline may change as a result of the acquisition of resources for the project.

9.3.3.6 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Lessons learned register.** Described in Section 4.4.3.1. The lessons learned register is updated with information on challenges encountered and how they could have been avoided as well as approaches that worked well for acquiring resources.
- ◆ **Project schedule.** Described in Section 6.5.3.2. Changes to the project schedule may result from the availability of required resources.
- ◆ **Resource breakdown structure.** Described in Section 9.2.3.3. Resources acquired during this process are recorded in the resource breakdown structure.
- ◆ **Resource requirements.** Described in Section 9.2.3.1. Resource requirements documentation is updated to reflect resources acquired for the project.
- ◆ **Risk register.** Described in Section 11.2.3.1. New risks identified during this process are recorded in the risk register and managed using the risk management processes.
- ◆ **Stakeholder register.** Described in Section 13.1.3.1. The stakeholder register is updated with any new stakeholders and any new information about existing stakeholders that has been gained as a result of this process.

9.3.3.7 ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

Enterprise environmental factors that are updated include but are not limited to:

- ◆ Resource availability within the organization, and
- ◆ Amount of the organization's consumable resources that have been used.

9.3.3.8 ORGANIZATIONAL PROCESS ASSETS UPDATES

Organizational process assets that are updated as a result of the Acquire Resources process include but are not limited to documentation related to acquiring, assigning and allocating resources.

9.4 DEVELOP TEAM

Develop Team is the process of improving competencies, team member interaction, and the overall team environment to enhance project performance. The key benefit of this process is that it results in improved teamwork, enhanced interpersonal skills and competencies, motivated employees, reduced attrition, and improved overall project performance. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 9-10. Figure 9-11 depicts the data flow diagram for the process.

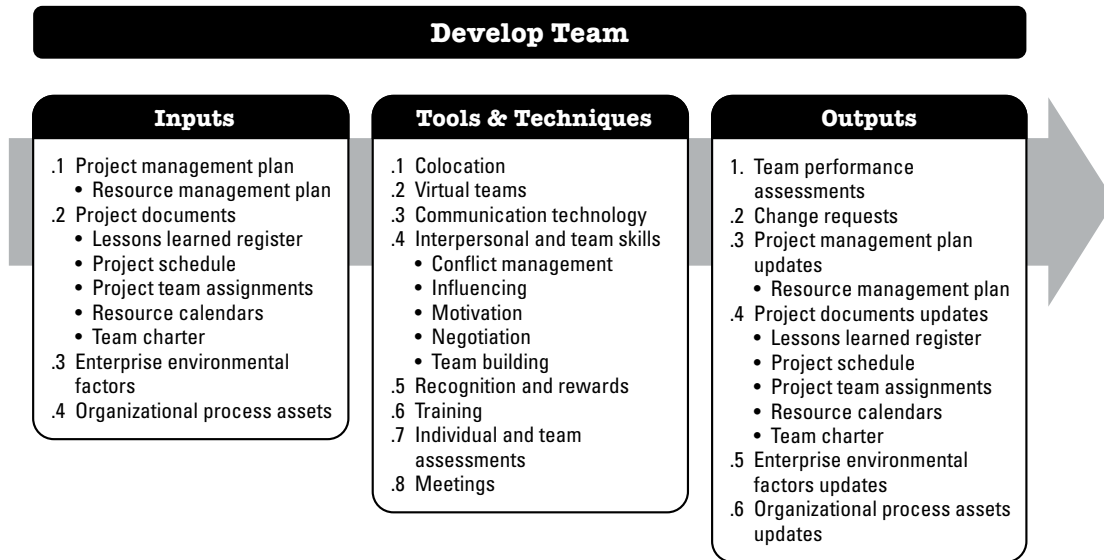


Figure 9-10. Develop Team: Inputs, Tools & Techniques, and Outputs

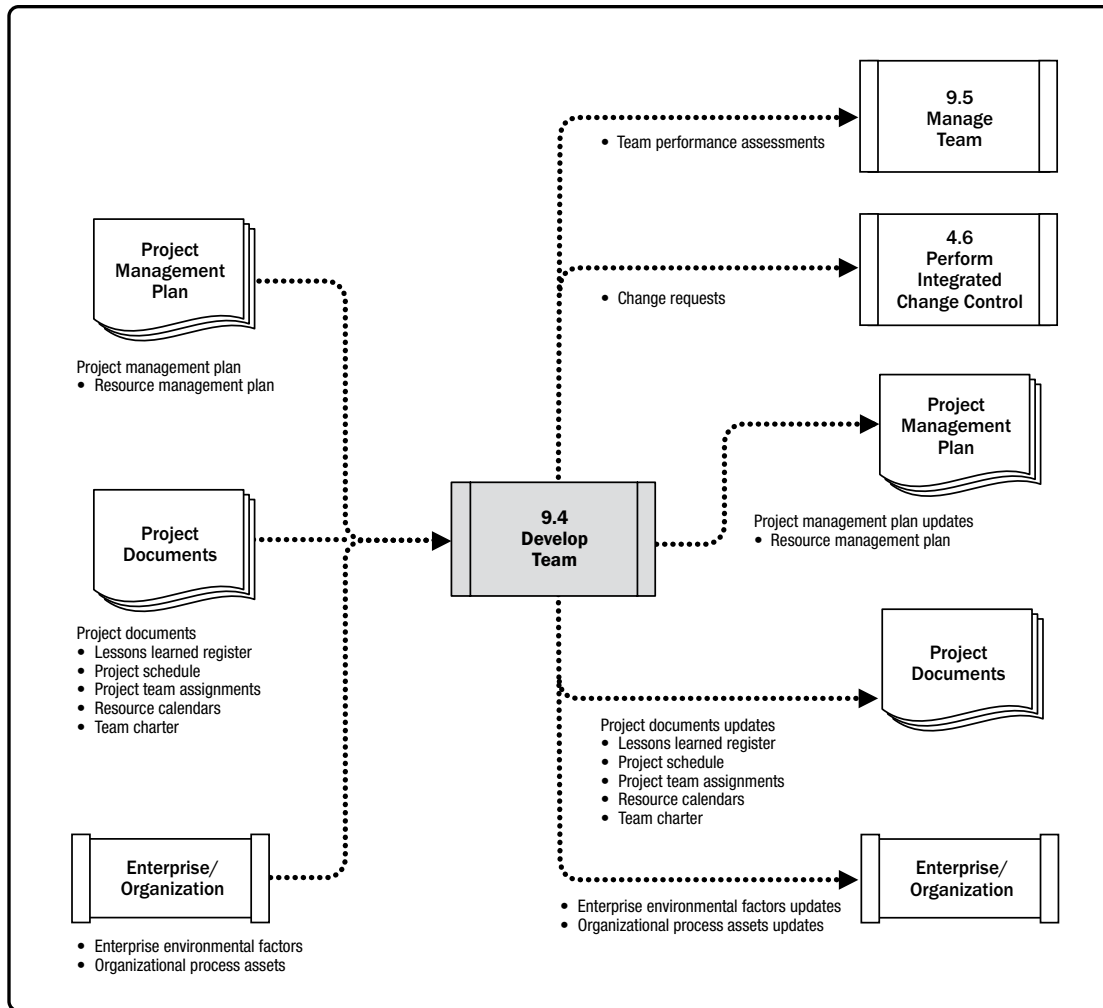


Figure 9-11. Develop Team: Data Flow Diagram

Project managers require the skills to identify, build, maintain, motivate, lead, and inspire project teams to achieve high team performance and to meet the project's objectives. Teamwork is a critical factor for project success, and developing effective project teams is one of the primary responsibilities of the project manager. Project managers should create an environment that facilitates teamwork and continually motivates the team by providing challenges and opportunities, providing timely feedback and support as needed, and recognizing and rewarding good performance. High team performance can be achieved by employing these behaviors:

- ◆ Using open and effective communication,
- ◆ Creating team-building opportunities,
- ◆ Developing trust among team members,
- ◆ Managing conflicts in a constructive manner,
- ◆ Encouraging collaborative problem solving, and
- ◆ Encouraging collaborative decision making.

Project managers operate in a global environment and work on projects characterized by cultural diversity. Team members often have diverse industry experience, communicate in multiple languages, and sometimes work with a “team language” or cultural norm that may be different from their native one. The project management team should capitalize on cultural differences, focus on developing and sustaining the project team throughout the project life cycle, and promote working together interdependently in a climate of mutual trust. Developing the project team improves the people skills, technical competencies, and overall team environment and project performance. It requires clear, timely, effective, and efficient communication between team members throughout the life of the project. Objectives of developing a project team include but are not limited to:

- ◆ Improving the knowledge and skills of team members to increase their ability to complete project deliverables, while lowering costs, reducing schedules, and improving quality;
- ◆ Improving feelings of trust and agreement among team members to raise morale, lower conflict, and increase teamwork;
- ◆ Creating a dynamic, cohesive, and collaborative team culture to: (1) improve individual and team productivity, team spirit, and cooperation; and (2) allow cross-training and mentoring between team members to share knowledge and expertise; and
- ◆ Empowering the team to participate in decision making and take ownership of the provided solutions to improve team productivity for more effective and efficient results.

One of the models used to describe team development is the Tuckman ladder [19, 20], which includes five stages of development that teams may go through. Although it is common for these stages to occur in order, it is not uncommon for a team to get stuck in a particular stage or regress to an earlier stage. Projects with team members who worked together in the past might skip a stage.

- ◆ **Forming.** This phase is where the team members meet and learn about the project and their formal roles and responsibilities. Team members tend to be independent and not as open in this phase.
- ◆ **Storming.** During this phase, the team begins to address the project work, technical decisions, and the project management approach. If team members are not collaborative or open to differing ideas and perspectives, the environment can become counterproductive.
- ◆ **Norming.** In this phase, team members begin to work together and adjust their work habits and behaviors to support the team. The team members learn to trust each other.
- ◆ **Performing.** Teams that reach the performing stage function as a well-organized unit. They are interdependent and work through issues smoothly and effectively.
- ◆ **Adjourning.** In this phase, the team completes the work and moves on from the project. This typically occurs when staff is released from the project as deliverables are completed or as part of the Close Project or Phase process.

The duration of a particular stage depends upon team dynamics, team size, and team leadership. Project managers should have a good understanding of team dynamics in order to move their team members through all stages in an effective manner.

9.4.1 DEVELOP TEAM: INPUTS

9.4.1.1 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to the resource management plan. Described in Section 9.1.3.1, the resource management plan provides guidance on providing project team member rewards, feedback, additional training, and disciplinary actions as a result of team performance assessments and other forms of project team management. The resource management plan may include also the team performance assessment criteria.

9.4.1.2 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Lessons learned register.** Described in Section 4.4.3.1. Lessons learned earlier in the project with regard to developing the team can be applied to later phases in the project to improve team performance.
- ◆ **Project schedule.** Described in Section 6.5.3.2. The project schedule defines how and when to provide training to the project team and develop the competencies required at different phases. It identifies the need for team development strategies based on variations, if any, during the project execution.
- ◆ **Project team assignments.** Described in Section 9.3.3.1. Project team assignments identify the team and member roles and responsibilities.
- ◆ **Resource calendars.** Described in Section 9.2.1.2. Resource calendars identify times when the project team members can participate in team development activities. It also helps illustrate team availability during the entire project.
- ◆ **Team charter.** Described in Section 9.1.3.2. The team charter is where the team operating guidelines are documented. The team values and operating guidelines provide the structure that describes how the team will operate together.

9.4.1.3 ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Develop Team process include but are not limited to:

- ◆ Human resource management policies regarding hiring and termination, employee performance reviews, employee development and training records, and recognition and rewards;
- ◆ Team member skills, competencies, and specialized knowledge; and
- ◆ Geographic distribution of team members.

9.4.1.4 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Develop Team process include but are not limited to historical information and the lessons learned repository.

9.4.2 DEVELOP TEAM: TOOLS AND TECHNIQUES

9.4.2.1 COLOCATION

Colocation 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. Colocation can be temporary, such as at strategically important times during the project, or can continue for the entire project. Colocation strategies can include a team meeting room, common places to post schedules, and other conveniences that enhance communication and a sense of community.

9.4.2.2 VIRTUAL TEAMS

The use of virtual teams can bring benefits such as the use of more skilled resources, reduced costs, less travel and relocation expenses, and the proximity of team members to suppliers, customers, or other key stakeholders. Virtual teams can use technology to create an online team environment where the team can store files, use conversations threads to discuss issues, and keep a team calendar.

9.4.2.3 COMMUNICATION TECHNOLOGY

Described in Section 10.1.2.3. Communication technology is important in addressing the team development issues in colocated and virtual teams. It helps build a harmonious environment for the colocated team and a better understanding for the virtual team, especially those working in different time zones. Examples of communication technology that may be used are:

- ◆ **Shared portal.** A shared repository for information sharing (e.g., website, collaboration software or intranet) is effective for virtual project teams.
- ◆ **Video conferencing.** Video conferencing is an important technique for effective communication with virtual teams.
- ◆ **Audio conferencing.** Communication within a team using audio conferencing is another technique to build rapport and confidence within virtual teams.
- ◆ **Email/chat.** Regular communications using email and chat is also an effective technique.

9.4.2.4 INTERPERSONAL AND TEAM SKILLS

Interpersonal and team skills that can be used for this process include but are not limited to:

- ◆ **Conflict management.** Described in Section 9.5.2.1. The project manager needs to resolve conflicts in a timely manner and in a constructive way in order to achieve a high-performing team.
- ◆ **Influencing.** Described in Section 9.5.2.1. An influencing skill used in this process is gathering relevant and critical information to address important issues and reach agreements while maintaining mutual trust.
- ◆ **Motivation.** Motivation is providing a reason for someone to act. Teams are motivated by empowering them to participate in decision making and encouraging them to work independently.
- ◆ **Negotiation.** Described in Section 12.2.2.5. Negotiation among team members is used to reach consensus on project needs. Negotiation can build trust and harmony among the team members.
- ◆ **Team building.** Team building is conducting activities that enhance the team's social relations and build a collaborative and cooperative working environment. Team building activities can vary from a 5-minute agenda item in a status review meeting to an offsite, professionally facilitated event designed to improve interpersonal relationships. The objective of team-building activities is to help individual team members work together effectively. Team-building strategies are particularly valuable when team members operate from remote locations without the benefit of face-to-face contact. Informal communication and activities can help in building trust and establishing good working relationships. While team building is essential during the initial stages of a project, it should be a continuous process. Changes in a project environment are inevitable, and to manage them effectively, a continuous or renewed team-building effort may be applied. The project manager should continually monitor team functionality and performance to determine if any actions are needed to prevent or correct various team problems.

9.4.2.5 RECOGNITION AND REWARDS

Part of the team development process involves recognizing and rewarding desirable behavior. The original plan for rewarding people is developed during the Plan Resource Management process. Rewards will be effective only if they satisfy a need that is valued by that individual. Reward decisions are made, formally or informally, during the process of managing the project team. Cultural differences should be considered when determining recognition and rewards.

People are motivated when they feel they are valued in the organization and this value is demonstrated by the rewards given to them. Generally, money is viewed as a tangible aspect of any reward system, but intangible rewards could be equally or even more effective. Most project team members are motivated by an opportunity to grow, accomplish, be appreciated, and apply their professional skills to meet new challenges. A good strategy for project managers is to give the team recognition throughout the life cycle of the project rather than waiting until the project is completed.

9.4.2.6 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 the necessary management or technical skills, such skills can be developed as part of the project work. Scheduled training takes place as stated in the resource management plan. Unplanned training takes place as a result of observation, conversation, and project performance appraisals conducted during management of the project team. Training costs could be included in the project budget or supported by the performing organization if the added skills may be useful for future projects. It may be performed by in-house or by external trainers.

9.4.2.7 INDIVIDUAL AND TEAM ASSESSMENTS

Individual and team assessment tools give the project manager and the project team insight into areas of strengths and weaknesses. These tools help project managers assess team members' preferences, aspirations, how they process and organize information, how they make decisions, and how they interact with people. Various tools are available such as attitudinal surveys, specific assessments, structured interviews, ability tests, and focus groups. These tools can provide improved understanding, trust, commitment, and communications among team members and facilitate more productive teams throughout the project.

9.4.2.8 MEETINGS

Meetings are used to discuss and address pertinent topics for developing the team. Attendees include the project manager and the project team. Types of meetings include but are not limited to project orientation meetings, team-building meetings, and team development meetings.

9.4.3 DEVELOP TEAM: OUTPUTS

9.4.3.1 TEAM PERFORMANCE ASSESSMENTS

As project team development efforts such as training, team building, and colocation are implemented, the project management team makes formal or informal 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 may include indicators such as:

- ◆ Improvements in skills that allow individuals to perform assignments more effectively,
- ◆ Improvements in competencies that help team members perform better as a team,
- ◆ Reduced staff turnover rate, and
- ◆ Increased team cohesiveness where team members share information and experiences openly and help each other to improve the overall project performance.

As a result of conducting an evaluation of the team's overall performance, the project management team can identify the specific training, coaching, mentoring, assistance, or changes required to improve the team's performance. This should also include identifying the appropriate or required resources necessary to achieve and implement the improvements identified in the assessment.

9.4.3.2 CHANGE REQUESTS

Described in Section 4.3.3.4. If change requests occur as a result of carrying out the Develop Team process or if recommended corrective or preventive actions impact any of the components of the project management plan or project documents, the project manager needs to submit a change request and follow the Perform Integrated Change Control process as defined in Section 4.6.

9.4.3.3 PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to the resource management plan, as described in Section 9.1.3.1.

9.4.3.4 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Lessons learned register.** Described in Section 4.4.3.1. The lessons learned register is updated with information on challenges encountered and how they could have been avoided as well as approaches that worked well for the development of the team.
- ◆ **Project schedule.** Described in Section 6.5.3.2. Activities to develop the project team may result in changes to the project schedule.
- ◆ **Project team assignments.** Described in Section 9.3.3.1. When team development results in changes to agreed-upon assignments, these changes are recorded in the project team assignments documentation.
- ◆ **Resource calendars.** Described in Section 9.2.1.2. Resource calendars are updated to reflect the availability of resources for the project.
- ◆ **Team charter.** Described in Section 9.1.3.2. The team charter may be updated to reflect changes to agreed-upon team operating guidelines that result from team development.

9.4.3.5 ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

Enterprise environmental factors that are updated as a result of the Develop Project Team process include but are not limited to:

- ◆ Employee development plan records, and
- ◆ Skill assessments.

9.4.3.6 ORGANIZATIONAL PROCESS ASSETS UPDATES

Organizational process assets that are updated as a result of the Develop Team process include but are not limited to:

- ◆ Training requirements, and
- ◆ Personnel assessment.

9.5 MANAGE TEAM

Manage Team is the process of tracking team member performance, providing feedback, resolving issues, and managing team changes to optimize project performance. The key benefit of this process is that it influences team behavior, manages conflict, and resolves issues. This process is performed throughout the project.

The inputs, tools and techniques, and outputs of the process are depicted in Figure 9-12. Figure 9-13 depicts the data flow diagram for the process.

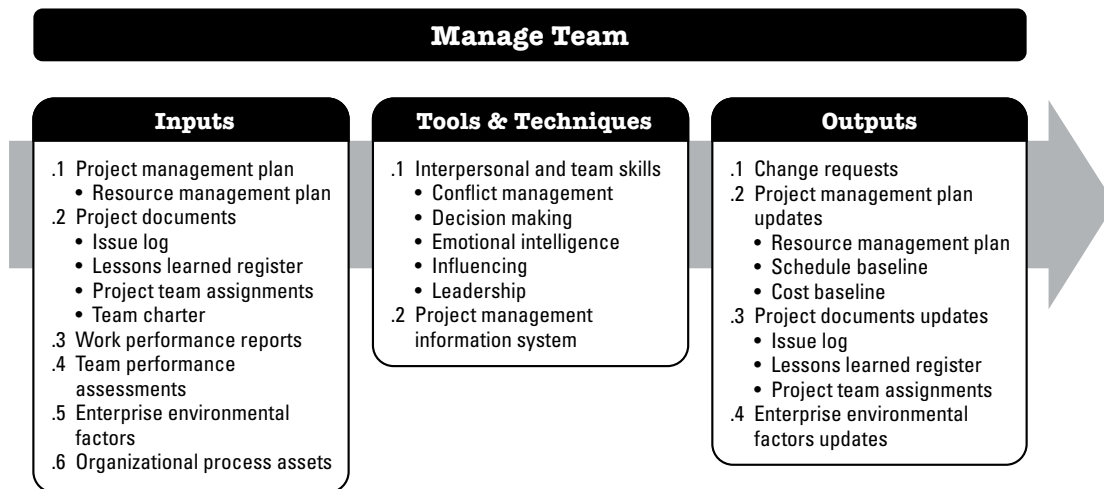


Figure 9-12. Manage Team: Inputs, Tools & Techniques, and Outputs

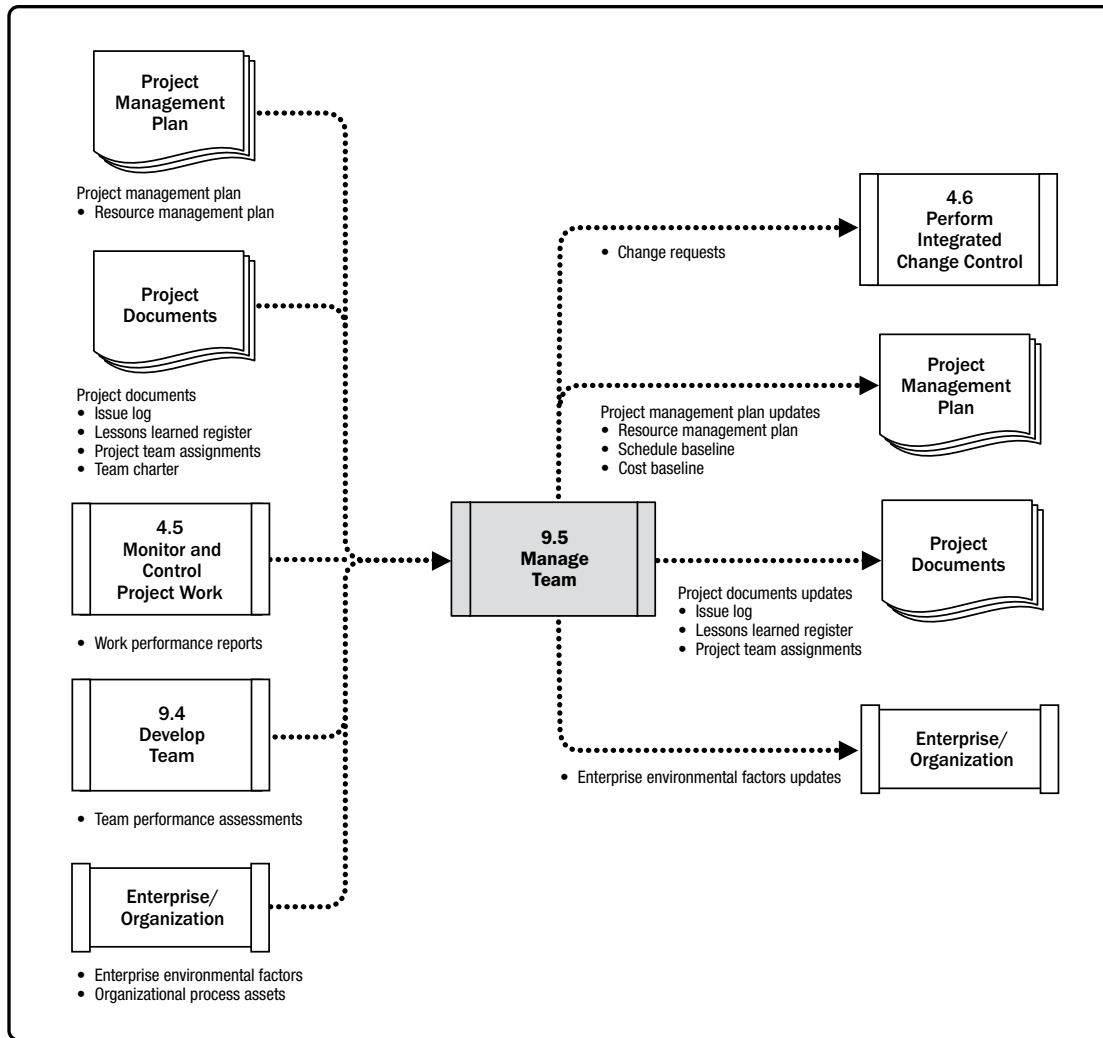


Figure 9-13. Manage Team: Data Flow Diagram

Managing the project team requires a variety of management and leadership skills for fostering teamwork and integrating the efforts of team members to create high-performance teams. Team management involves a combination of skills with special emphasis on communication, conflict management, negotiation, and leadership. Project managers should provide challenging assignments to team members and provide recognition for high performance.

The project manager needs to be sensitive to both the willingness and the ability of team members to perform their work and adjust their management and leadership styles accordingly. Team members with low-skill abilities will require more intensive oversight than those who have demonstrated ability and experience.

9.5.1 MANAGE TEAM: INPUTS

9.5.1.1 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to the resource management plan. Described in Section 9.1.3.1, the resource management plan provides guidance on how project team resources should be managed and eventually released.

9.5.1.2 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Issue log.** Described in Section 4.3.3.3. Issues arise in the course of managing the project team. An issue log can be used to document and monitor who is responsible for resolving specific issues by a target date.
- ◆ **Lessons learned register.** Described in Section 4.4.3.1. Lessons learned earlier in the project can be applied to later phases in the project to improve the efficiency and effectiveness of managing the team.
- ◆ **Project team assignments.** Described in Section 9.3.3.1. Project team assignments identify the team member roles and responsibilities.
- ◆ **Team charter.** Described in Section 9.1.3.2. The team charter provides guidance for how the team will make decisions, conduct meetings, and resolve conflict.

9.5.1.3 WORK PERFORMANCE REPORTS

Described in Section 4.5.3.1. Work performance reports are the physical or electronic representation of work performance information intended to generate decisions, actions, or awareness. Performance reports that can help with project team management include results from schedule control, cost control, quality control, and scope validation. The information from performance reports and related forecasts assists in determining future team resource requirements, recognition and rewards, and updates to the resource management plan.

9.5.1.4 TEAM PERFORMANCE ASSESSMENTS

Described in Section 9.4.3.1. The project management team makes ongoing formal or informal assessments of the project team's performance. By continually assessing the project team's performance, actions can be taken to resolve issues, modify communication, address conflict, and improve team interaction.

9.5.1.5 ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Manage Team process include but are not limited to human resource management policies.

9.5.1.6 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Manage Team process include but are not limited to:

- ◆ Certificates of appreciation,
- ◆ Corporate apparel, and
- ◆ Other organizational perquisites.

9.5.2 MANAGE TEAM: TOOLS AND TECHNIQUES

9.5.2.1 INTERPERSONAL AND TEAM SKILLS

Interpersonal and team skills that can be used for this process include but are not limited to:

- ◆ **Conflict management.** Conflict is inevitable in a project environment. 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.

Successful conflict management results in greater productivity and positive working relationships. When managed properly, differences of opinion can lead to increased creativity and better decision making. If the differences become a negative factor, project team members are initially responsible for their resolution. 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, formal procedures may be used, including disciplinary actions.

The success of project managers in managing their project teams often depends on their ability to resolve conflict. Different project managers may use different conflict resolution methods. Factors that influence conflict resolution methods include:

- Importance and intensity of the conflict,
- Time pressure for resolving the conflict,
- Relative power of the people involved in the conflict,
- Importance of maintaining a good relationship, and
- Motivation to resolve conflict on a long-term or short-term basis.

There are five general techniques for resolving conflict. Each technique has its place and use:

- *Withdraw/avoid*. Retreating from an actual or potential conflict situation; postponing the issue to be better prepared or to be resolved by others.
- *Smooth/accommodate*. Emphasizing areas of agreement rather than areas of difference; conceding one's position to the needs of others to maintain harmony and relationships.
- *Compromise/reconcile*. Searching for solutions that bring some degree of satisfaction to all parties in order to temporarily or partially resolve the conflict. This approach occasionally results in a lose-lose situation.
- *Force/direct*. Pushing one's viewpoint at the expense of others; offering only win-lose solutions, usually enforced through a power position to resolve an emergency. This approach often results to a win-lose situation.
- *Collaborate/problem solve*. Incorporating multiple viewpoints and insights from differing perspectives; requires a cooperative attitude and open dialogue that typically leads to consensus and commitment. This approach can result in a win-win situation.

◆ **Decision making.** Decision making, in this context, involves the ability to negotiate and influence the organization and the project management team, rather than the set of tools described in the decision making tool set. Some guidelines for decision making include:

- Focus on goals to be served,
- Follow a decision-making process,
- Study the environmental factors,
- Analyze available information,
- Stimulate team creativity, and
- Account for risk.

◆ **Emotional intelligence.** Emotional intelligence is the ability to identify, assess, and manage the personal emotions of oneself and other people, as well as the collective emotions of groups of people. The team can use emotional intelligence to reduce tension and increase cooperation by identifying, assessing, and controlling the sentiments of project team members, anticipating their actions, acknowledging their concerns, and following up on their issues.

- ◆ **Influencing.** Because project managers often have little or no direct authority over team members in a matrix environment, their ability to influence stakeholders on a timely basis is critical to project success. Key influencing skills include:
 - Ability to be persuasive;
 - Clearly articulating points and positions;
 - High levels of active and effective listening skills;
 - Awareness of, and consideration for, the various perspectives in any situation; and
 - Gathering relevant information to address issues and reach agreements while maintaining mutual trust.
- ◆ **Leadership.** Successful projects require leaders with strong leadership skills. Leadership is the ability to lead a team and inspire them to do their jobs well. It encompasses a wide range of skills, abilities and actions. Leadership is important through all phases of the project life cycle. There are multiple leadership theories defining leadership styles that should be used as needed for each situation or team. It is especially important to communicate the vision and inspire the project team to achieve high performance.

9.5.2.2 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Described in Section 4.3.2.2. Project management information systems can include resource management or scheduling software that can be used for managing and coordinating team members across project activities.

9.5.3 MANAGE TEAM: OUTPUTS

9.5.3.1 CHANGE REQUESTS

Described in Section 4.3.3.4. When change requests occur as a result of carrying out the Manage Team process or when recommended corrective or preventive actions impact any of the components of the project management plan or project documents, the project manager needs to submit a change request. Change requests are processed for review and disposition through the Perform Integrated Change Control process (Section 4.6).

For example, staffing changes, whether made by choice or by uncontrollable events, can disrupt the project team. This disruption can cause the schedule to slip or the budget to be exceeded. Staffing changes include moving people to different assignments, outsourcing some of the work, or replacing team members who leave.

9.5.3.2 PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components of the project management plan that may require a change request for the project management plan include but are not limited to:

- ◆ **Resource management plan.** Described in Section 9.1.3.1. The resource management plan is updated to reflect actual experience in managing the project team.
- ◆ **Schedule baseline.** Described in Section 6.5.3.1. Changes to the project schedule may be required to reflect the way the team is performing.
- ◆ **Cost baseline.** Described in Section 7.3.3.1. Changes to the project cost baseline may be required to reflect the way the team is performing.

9.5.3.3 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of carrying out this process include but are not limited to:

- ◆ **Issue log.** Described in Section 4.3.3.3. New issues raised as a result of this process are recorded in the issue log.
- ◆ **Lessons learned register.** Described in Section 4.4.3.1. The lessons learned register is updated with information on challenges encountered and how they could have been avoided as well as approaches that worked well for the managing the team.
- ◆ **Project team assignments.** Described in Section 9.3.3.1. If changes to the team are required, those changes are recorded in the project team assignments documentation.

9.5.3.4 ENTERPRISE ENVIRONMENTAL FACTORS UPDATES

Enterprise environmental factors that are updated as a result of the Manage Team process include but are not limited to:

- ◆ Input to organizational performance appraisals, and
- ◆ Personnel skill.

9.6 CONTROL RESOURCES

Control Resources is the process of ensuring that the physical resources assigned and allocated to the project are available as planned, as well as monitoring the planned versus actual utilization of resources and taking corrective action as necessary. The key benefit of this process is ensuring that the assigned resources are available to the project at the right time and in the right place and are released when no longer needed. This process is performed throughout the project. The inputs and outputs of this process are depicted in Figure 9-14. Figure 9-15 depicts the data flow diagram for the process.

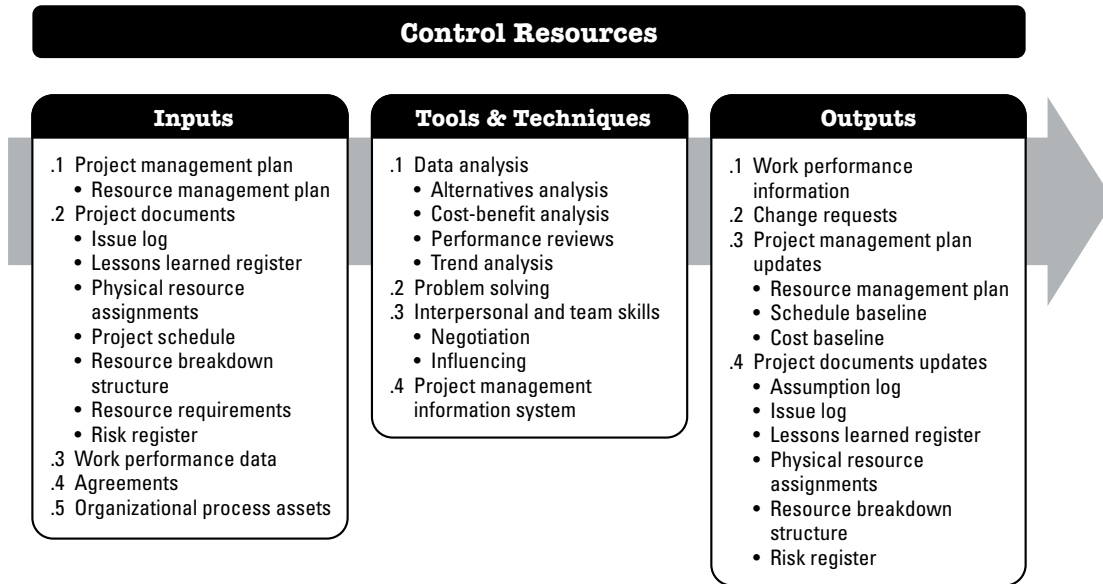


Figure 9-14. Control Resources: Inputs, Tools & Techniques, and Outputs

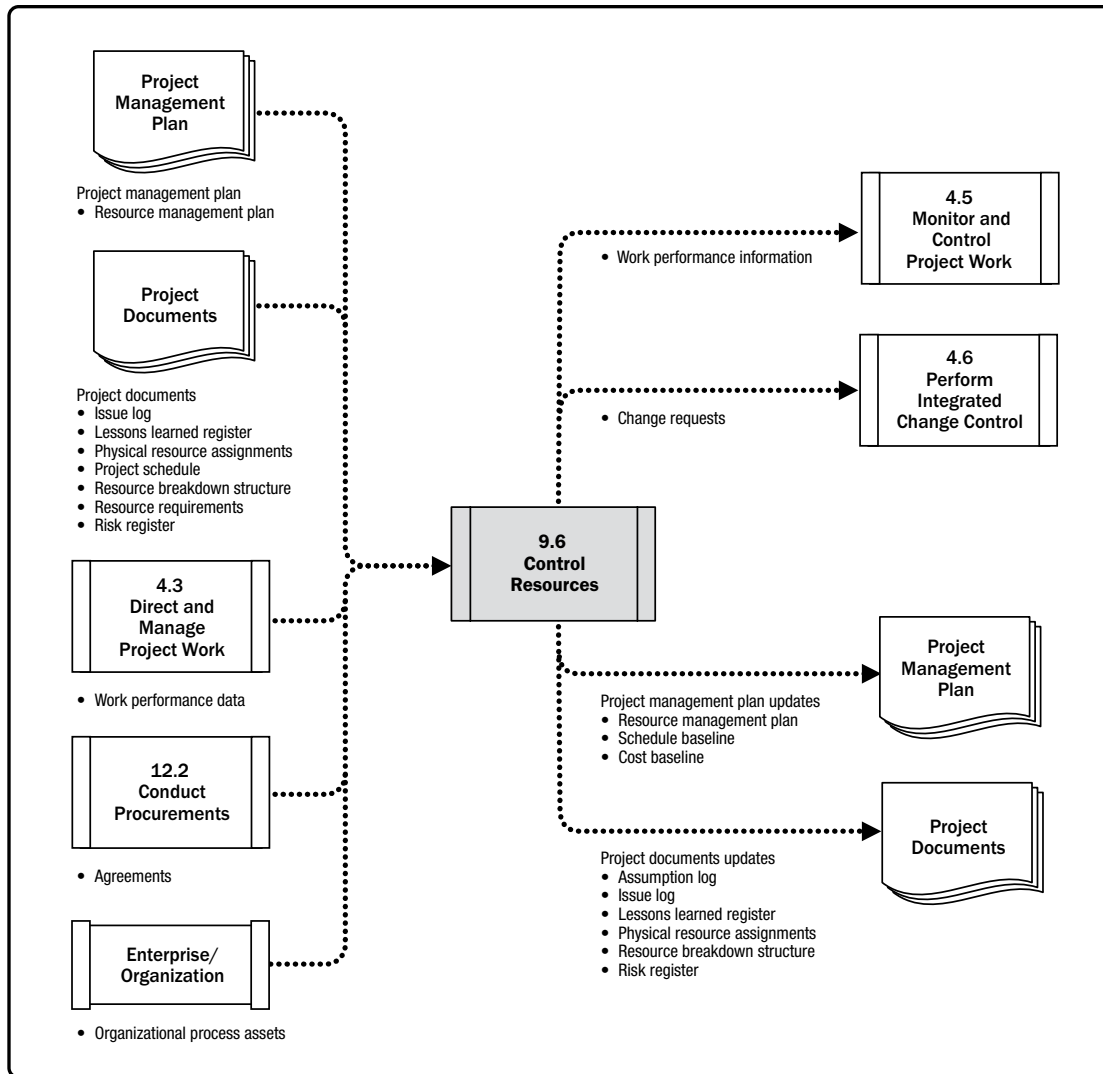


Figure 9-15. Control Resources: Data Flow Diagram

The Control Resources process should be performed continuously in all project phases and throughout the project life cycle. The resources needed for the project should be assigned and released at the right time, right place, and right amount for the project to continue without delays. The Control Resources process is concerned with physical resources such as equipment, materials, facilities, and infrastructure. Team members are addressed in the Manage Team process.

The Control Resources techniques discussed here are those used most frequently on projects. There are many others that may be useful on certain projects or in some application areas.

Updating resource allocation requires knowing what actual resources have been used to date and what is still needed. This is done mainly by reviewing the performance usage to date. Control Resources is concerned with:

- ◆ Monitoring resource expenditures,
- ◆ Identifying and dealing with resource shortage/surplus in a timely manner,
- ◆ Ensuring that resources are used and released according to the plan and project needs,
- ◆ Informing appropriate stakeholders if any issues arise with relevant resources,
- ◆ Influencing the factors that can create resources utilization change, and
- ◆ Managing the actual changes as they occur.

Any changes needed to the schedule or cost baselines can be approved only through the Perform Integrated Change Control process (Section 4.6).

9.6.1 CONTROL RESOURCES: INPUTS

9.6.1.1 PROJECT MANAGEMENT PLAN

Described in Section 4.2.3.1. Project management plan components include but are not limited to the resource management plan. Described in Section 9.1.3.1, the resource management plan provides guidance on how physical resources should be used, controlled, and eventually released.

9.6.1.2 PROJECT DOCUMENTS

Project documents that can be considered as inputs for this process include but are not limited to:

- ◆ **Issue log.** Described in Section 4.3.3.3. The issue log is used to identify issues such as lack of resources, delays in raw material supplies, or low grades of raw material.
- ◆ **Lessons learned register.** Described in Section 4.4.3.1. Lessons learned earlier in the project can be applied to later phases in the project to improve physical resource control.
- ◆ **Physical resource assignments.** Described in Section 9.3.3.1. The physical resource assignments describe the expected resource utilization along with details such as type, amount, location, and whether the resource is internal to the organization or outsourced.

- ◆ **Project schedule.** Described in Section 6.5.3.2. The project schedule shows the resources that are needed, when they are needed, and the location where they are needed.
- ◆ **Resource breakdown structure.** Described in Section 9.2.3.3. The resource breakdown structure provides a reference in case any resource needs to be replaced or reacquired during the course of the project.
- ◆ **Resource requirements.** Described in Section 9.2.3.1. Resource requirements identify the needed material, equipment, supplies, and other resources.
- ◆ **Risk register.** Described in Section 11.2.3.1. The risk register identifies individual risks that can impact equipment, materials, or supplies.

9.6.1.3 WORK PERFORMANCE DATA

Described in Section 4.3.3.2. Work performance data contains data on project status such as the number and type of resources that have been used.

9.6.1.4 AGREEMENTS

Described in Section 12.2.3.2. Agreements made within the context of the project are the basis for all resources external to the organization and should define procedures when new, unplanned resources are needed or when issues arise with the current resources.

9.6.1.5 ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Control Resources process include but are not limited to:

- ◆ Policies regarding resource control and assignment,
- ◆ Escalation procedures for handling issues within the performing organization, and
- ◆ Lessons learned repository from previous similar projects.

9.6.2 CONTROL RESOURCES: TOOLS AND TECHNIQUES

9.6.2.1 DATA ANALYSIS

Data analysis techniques that can be used in this process include but are not limited to:

- ◆ **Alternatives analysis.** Described in Section 9.2.2.5. Alternatives can be analyzed to select the best resolution for correcting variances in resource utilization. Alternatives such as paying additional for overtime or additional team resources can be weighed against a late delivery or phased deliveries.
- ◆ **Cost-benefit analysis.** Described in Section 8.1.2.3. This analysis helps to determine the best corrective action in terms of cost in case of project deviations.
- ◆ **Performance reviews.** Performance reviews measure, compare, and analyze planned resource utilization to actual resource utilization. Cost and schedule work performance information can also be analyzed to help pinpoint issues that can influence resource utilization.
- ◆ **Trend analysis.** Described in Section 4.5.2.2. As the project progresses, the project team may use trend analysis, based on current performance information, to determine the resources needed at upcoming stages of the project. Trend analysis examines project performance over time and can be used to determine whether performance is improving or deteriorating.

9.6.2.2 PROBLEM SOLVING

Described in Section 8.2.2.7. Problem solving may use a set of tools that helps the project manager to solve problems that arise during the control resource process. The problem can come from inside the organization (machines or infrastructure used by another department in the organization and not released in time, materials that have been damaged because of unsuitable storage conditions, etc.) or from outside the organization (major supplier that has gone bankrupt or bad weather that has damaged resources). The project manager should use methodical steps to deal with problem solving, which can include:

- ◆ **Identify the problem.** Specify the problem.
- ◆ **Define the problem.** Break it into smaller, manageable problems.
- ◆ **Investigate.** Collect data.
- ◆ **Analyze.** Find the root cause of the problem.
- ◆ **Solve.** Choose the suitable solution from a variety of available ones.
- ◆ **Check the solution.** Determine if the problem has been fixed.

9.6.2.3 INTERPERSONAL AND TEAM SKILLS

Interpersonal and team skills, sometimes known as “soft skills,” are personal competencies. The interpersonal and team skills used in this process include:

- ◆ **Negotiation.** Described in Section 12.2.2.5. The project manager may need to negotiate for additional physical resources, changes in physical resources, or costs associated with the resources.
- ◆ **Influencing.** Described in Section 9.5.2.1. Influencing can help the project manager solve problems and obtain the resources needed in a timely manner.

9.6.2.4 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

Described in Section 4.3.2.2. Project management information systems can include resource management or scheduling software that can be used to monitor the resource utilization which helps ensure that the right resources are working on the right activities at the right time and place.

9.6.3 CONTROL RESOURCES: OUTPUTS

9.6.3.1 WORK PERFORMANCE INFORMATION

Described in Section 4.5.1.3. Work performance information includes information on how the project work is progressing by comparing resource requirements and resource allocation to resource utilization across the project activities. This comparison can show gaps in resource availability that need to be addressed.

9.6.3.2 CHANGE REQUESTS

Described in Section 4.3.3.4. When change requests occur as a result of carrying out the Control Resources process or when recommended, corrective, or preventive actions impact any of the components of the project management plan or project documents, the project manager needs to submit a change request. Change requests are processed for review and disposition through the Perform Integrated Change Control process (Section 4.6).

9.6.3.3 PROJECT MANAGEMENT PLAN UPDATES

Any change to the project management plan goes through the organization's change control process via a change request. Components that may require a change request for the project management plan include but are not limited to:

- ◆ **Resource management plan.** Described in Section 9.1.3.1. The resource management plan is updated to reflect actual experience in managing project resources.
- ◆ **Schedule baseline.** Described in Section 6.5.3.1. Changes to the project schedule may be required to reflect the way project resources are being managed.
- ◆ **Cost baseline.** Described in Section 7.3.3.1. Changes to the project cost baseline may be required to reflect the way project resources are being managed.

9.6.3.4 PROJECT DOCUMENTS UPDATES

Project documents that may be updated as a result of performing this process include but are not limited to:

- ◆ **Assumption log.** Described in Section 4.1.3.2. The assumption log may be updated with new assumptions regarding equipment, materials, supplies, and other physical resources.
- ◆ **Issue log.** Described in Section 4.3.3.3. New issues raised as a result of this process are recorded in the issue log.
- ◆ **Lessons learned register.** Described in Section 4.4.3.1. The lessons learned register can be updated with techniques that were effective in managing resource logistics, scrap, utilization variances, and corrective actions that were used to respond to resource variances.
- ◆ **Physical resource assignments.** Described in Section 9.3.3.1. Physical resource assignments are dynamic and subject to change due to availability, the project, organization, environment, or other factors.
- ◆ **Resource breakdown structure.** Described in Section 9.2.3.3. Changes to the resource breakdown structure may be required to reflect the way project resources are being used.
- ◆ **Risk register.** Described in Section 11.2.3.1. The risk register is updated with any new risks associated with resource availability, utilization, or other physical resource risks.