PROJECT COST MANAGEMENT

7

Project Cost Management includes the processes required to ensure that the project is completed within the approved budget. Figure 7–1 provides an overview of the following major processes:

7.1 Resource Planning—determining what resources (people, equipment, materials) and what quantities of each should be used to perform project activities.

7.2 Cost Estimating—developing an approximation (estimate) of the costs of the resources needed to complete project activities.

7.3 Cost Budgeting—allocating the overall cost estimate to individual work items.

7.4 Cost Control—controlling changes to the project budget.

These processes interact with each other and with the processes in the other knowledge areas as well. Each process may involve effort from one or more individuals or groups of individuals based on the needs of the project. Each process generally occurs at least once in every project phase.

Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here. Process interactions are discussed in detail in Chapter 3.

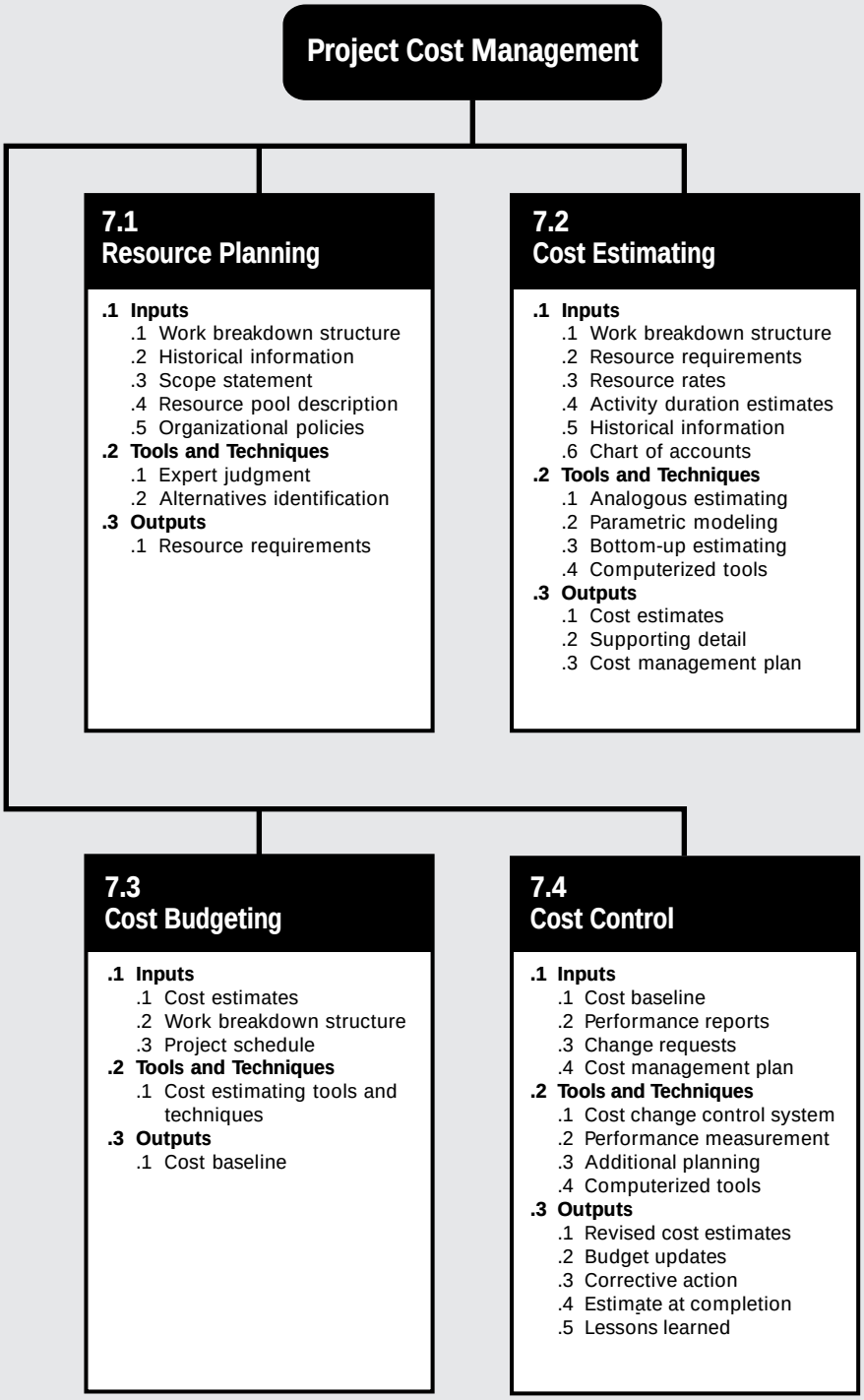
Project cost management is primarily concerned with the cost of the resources needed to complete project activities. However, project cost management should also consider the effect of project decisions on the cost of using the project product. For example, limiting the number of design reviews may reduce the cost of the project at the expense of an increase in the customer's operating costs. This broader view of project cost management is often called *life-cycle costing*.

In many application areas predicting and analyzing the prospective financial performance of the project product is done outside the project. In others (e.g., capital facilities projects), project cost management also includes this work. When such predictions and analysis are included, project cost management will include additional processes and numerous general management techniques such as return on investment, discounted cash flow, payback analysis, and others.

Project cost management should consider the information needs of the project stakeholders—different stakeholders may measure project costs in different ways and at different times. For example, the cost of a procurement item may be measured when committed, ordered, delivered, incurred, or recorded for accounting purposes.

When project costs are used as a component of a reward and recognition system (reward and recognition systems are discussed in Section 9.3.2.3), controllable and uncontrollable costs should be estimated and budgeted separately to ensure that rewards reflect actual performance.

Figure 7–1. Project Cost Management Overview

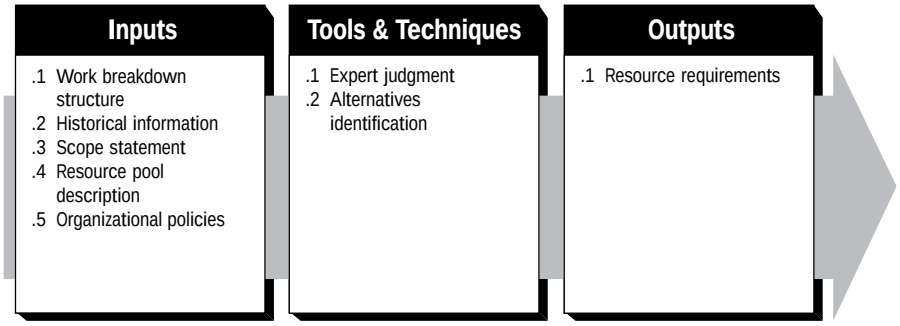


On some projects, especially smaller ones, resource planning, cost estimating, and cost budgeting are so tightly linked that they are viewed as a single process (e.g., they may be performed by a single individual over a relatively short period of time). They are presented here as distinct processes because the tools and techniques for each are different.

7.1 RESOURCE PLANNING

Resource planning involves determining what physical resources (people, equipment, materials) and what quantities of each should be used to perform project activities. It must be closely coordinated with cost estimating (described in Section 7.2). For example:

- A construction project team will need to be familiar with local building codes. Such knowledge is often readily available at virtually no cost by using local labor. However, if the local labor pool lacks experience with unusual or specialized construction techniques, the additional cost for a consultant might be the most effective way to secure knowledge of the local building codes.
- An automotive design team should be familiar with the latest in automated assembly techniques. The requisite knowledge might 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 team.



7.1.1 Inputs to Resource Planning

.1 Work breakdown structure. The work breakdown structure (WBS, described in Section 5.3.3.1) identifies the project elements that will need resources and thus is the primary input to resource planning. Any relevant outputs from other planning processes should be provided through the WBS to ensure proper control.

.2 Historical information. Historical information regarding what types of resources were required for similar work on previous projects should be used if available.

.3 Scope statement. The scope statement (described in Section 5.2.3.1) contains the project justification and the project objectives, both of which should be considered explicitly during resource planning.

.4 Resource pool description. Knowledge of what resources (people, equipment, material) are potentially available is necessary for resource planning. The amount of detail and the level of specificity of the resource pool description will vary. For example, during the early phases of an engineering design project, the pool may include "junior and senior engineers" in large numbers. During later phases of the same project, however, the pool may be limited to those individuals who are knowledgeable about the project as a result of having worked on the earlier phases.

.5 Organizational policies. The policies of the performing organization regarding staffing and the rental or purchase of supplies and equipment must be considered during resource planning.

7.1.2 Tools and Techniques for Resource Planning

.1 *Expert judgment.* Expert judgment will often be required to assess the inputs to this process. Such expertise may be provided by any group or individual with specialized knowledge or training and is available from many sources including:

- Other units within the performing organization.
- Consultants.
- Professional and technical associations.
- Industry groups.

.2 *Alternatives identification.* Alternatives identification is discussed in Section 5.2.2.3.

7.1.3 Outputs from Resource Planning

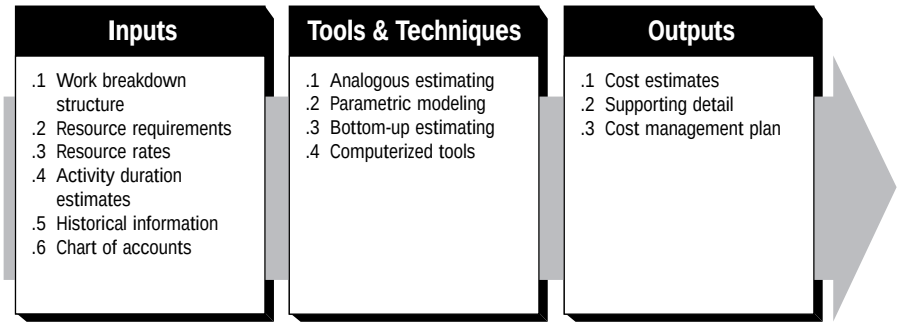
.1 *Resource requirements.* The output of the resource planning process is a description of what types of resources are required and in what quantities for each element of the work breakdown structure. These resources will be obtained either through staff acquisition (described in Section 9.2) or procurement (described in Chapter 12).

7.2 COST ESTIMATING

Cost estimating involves developing an approximation (estimate) of the costs of the resources needed to complete project activities.

When a project is performed under contract, care should be taken to distinguish cost estimating from pricing. Cost estimating involves developing an assessment of the likely quantitative result—how much will it cost the performing organization to provide the product or service involved. Pricing is a business decision—how much will the performing organization charge for the product or service—that uses the cost estimate as but one consideration of many.

Cost estimating includes identifying and considering various costing alternatives. For example, in most application areas, additional work during a design phase is widely held to have the potential for reducing the cost of the production phase. The cost estimating process must consider whether the cost of the additional design work will offset the expected savings.



7.2.1 Inputs to Cost Estimating

.1 *Work breakdown structure.* The WBS is described in Section 5.3.3.1. It will be used to organize the cost estimates and to ensure that all identified work has been estimated.

.2 *Resource requirements.* Resource requirements are described in Section 7.1.3.1.

.3 *Resource rates.* The individual or group preparing the estimates must know the unit rates (e.g., staff cost per hour, bulk material cost per cubic yard) for each resource in order to calculate project costs. If actual rates are not known, the rates themselves may have to be estimated.

.4 *Activity duration estimates.* Activity duration estimates (described in Section 6.3) will affect cost estimates on any project where the project budget includes an allowance for the cost of financing (i.e., interest charges).

.5 *Historical information.* Information on the cost of many categories of resources is often available from one or more of the following sources:

- Project files—one or more of the organizations involved in the project may maintain records of previous project results that are detailed enough to aid in developing cost estimates. In some application areas, individual team members may maintain such records.
- Commercial cost estimating databases—historical information is often available commercially.
- Project team knowledge—the individual members of the project team may remember previous actuals or estimates. While such recollections may be useful, they are generally far less reliable than documented results.

.6 *Chart of accounts.* A chart of accounts describes the coding structure used by the performing organization to report financial information in its general ledger. Project cost estimates must be assigned to the correct accounting category.

7.2.2 Tools and Techniques for Cost Estimating

.1 *Analogous estimating.* Analogous estimating, also called *top-down estimating*, means using the actual cost of a previous, similar project as the basis for estimating the cost of the current project. It is frequently used to estimate total project costs when there is a limited amount of detailed information about the project (e.g., in the early phases). Analogous estimating is a form of expert judgment (described in Section 7.1.2.1).

Analogous estimating is generally less costly than other techniques, but it is also generally less accurate. It is most reliable when (a) the previous projects are similar in fact and not just in appearance, and (b) the individuals or groups preparing the estimates have the needed expertise.

.2 *Parametric modeling.* Parametric modeling involves using project characteristics (parameters) in a mathematical model to predict project costs. Models may be simple (residential home construction will cost a certain amount per square foot of living space) or complex (one model of software development costs uses 13 separate adjustment factors each of which has 5–7 points on it).

Both the cost and accuracy of parametric models varies widely. They are most likely to be reliable when (a) the historical information used to develop the model was accurate, (b) the parameters used in the model are readily quantifiable, and (c) the model is scalable (i.e., it works as well for a very large project as for a very small one).

.3 *Bottom-up estimating.* This technique involves estimating the cost of individual work items, then summarizing or rolling-up the individual estimates to get a project total.

The cost and accuracy of bottom-up estimating is driven by the size of the individual work items: smaller work items increase both cost and accuracy. The project management team must weigh the additional accuracy against the additional cost.

.4 *Computerized tools.* Computerized tools such as project management software and spreadsheets are widely used to assist with cost estimating. Such products can simplify the use of the tools described above and thereby facilitate rapid consideration of many costing alternatives.

7.2.3 Outputs from Cost Estimating

.1 *Cost estimates.* Cost estimates are quantitative assessments of the likely costs of the resources required to complete project activities. They may be presented in summary or in detail.

Costs must be estimated for all resources that will be charged to the project. This includes, but is not limited to, labor, materials, supplies, and special categories such as an inflation allowance or cost reserve.

Cost estimates are generally expressed in units of currency (dollars, francs, yen, etc.) in order to facilitate comparisons both within and across projects. Other units such as staff hours or staff days may be used, unless doing so will misstate project costs (e.g., by failing to differentiate among resources with very different costs). In some cases, estimates will have to be provided using multiple units of measure in order to facilitate appropriate management control.

Cost estimates may benefit from being refined during the course of the project to reflect the additional detail available. In some application areas, there are guidelines for when such refinements should be made and what degree of accuracy is expected. For example, AACE International has identified a progression of five types of estimates of construction costs during engineering: order of magnitude, conceptual, preliminary, definitive, and control.

.2 *Supporting detail.* Supporting detail for the cost estimates should include:

- A description of the scope of work estimated. This is often provided by a reference to the WBS.
- Documentation of the basis for the estimate, i.e., how it was developed.
- Documentation of any assumptions made.
- An indication of the range of possible results, for example, $10,000 ± $1,000 to indicate that the item is expected to cost between $9,000 and $11,000.

The amount and type of additional detail varies by application area. Retaining even rough notes may prove valuable by providing a better understanding of how the estimate was developed.

.3 *Cost management plan.* The cost management plan describes how cost variances will be managed (e.g., different responses to major problems than to minor ones). A cost management plan may be formal or informal, highly detailed or broadly framed based on the needs of the project stakeholders. It is a subsidiary element of the overall project plan (discussed in Section 4.1.3.1).

7.3 COST BUDGETING

Cost budgeting involves allocating the overall cost estimates to individual work items in order to establish a cost baseline for measuring project performance.

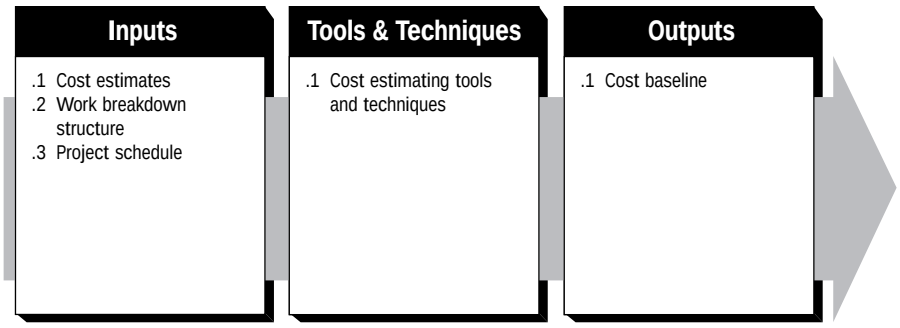
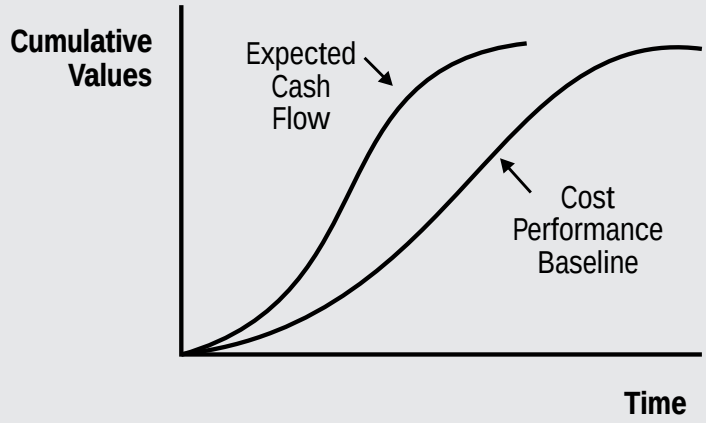


Figure 7–2. Illustrative Cost Baseline Display



7.3.1 Inputs to Cost Budgeting

.1 *Cost estimates.* Cost estimates are described in Section 7.2.3.1.

.2 *Work breakdown structure.* The work breakdown structure (described in Section 5.3.3.1) identifies the project elements that costs will be allocated to.

.3 *Project schedule.* The project schedule (described in Section 6.4.3.1) includes planned start and expected finish dates for the project elements that costs will be allocated to. This information is needed in order to assign costs to the time period when the cost will be incurred.

7.3.2 Tools and Techniques for Cost Budgeting

.1 *Cost estimating tools and techniques.* The tools and techniques described in Section 7.2.2 for developing project cost estimates are used to develop budgets for work items as well.

7.3.3 Outputs from Cost Budgeting

.1 *Cost baseline.* The cost baseline is a time-phased budget that will be used to measure and monitor cost performance on the project. It is developed by summing estimated costs by period and is usually displayed in the form of an S-curve, as illustrated in Figure 7–2.

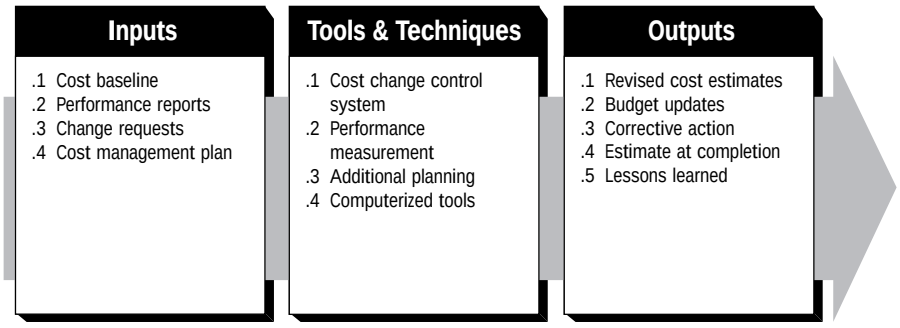
Many projects, especially larger ones, may have multiple cost baselines to measure different aspects of cost performance. For example, a spending plan or cash flow forecast is a cost baseline for measuring disbursements.

7.4 COST CONTROL

Cost control is concerned with (a) influencing the factors which create changes to the cost baseline to ensure that changes are beneficial, (b) determining that the cost baseline has changed, and (c) managing the actual changes when and as they occur. Cost control includes:

- Monitoring cost performance to detect variances from plan.
- Ensuring that all appropriate changes are recorded accurately in the cost baseline.
- Preventing incorrect, inappropriate, or unauthorized changes from being included in the cost baseline.
- Informing appropriate stakeholders of authorized changes.

Cost control includes searching out the "whys" of both positive and negative variances. It must be thoroughly integrated with the other control processes (scope change control, schedule control, quality control, and others as discussed in Section 4.3). For example, inappropriate responses to cost variances can cause quality or schedule problems or produce an unacceptable level of risk later in the project.



7.4.1 Inputs to Cost Control

.1 *Cost baseline.* The cost baseline is described in Section 7.3.3.1.

.2 *Performance reports.* Performance reports (discussed in Section 10.3.3.1) provide information on cost performance such as which budgets have been met and which have not. Performance reports may also alert the project team to issues which may cause problems in the future.

.3 *Change requests.* Change requests may occur in many forms—oral or written, direct or indirect, externally or internally initiated, and legally mandated or optional. Changes may require increasing the budget or may allow decreasing it.

.4 *Cost management plan.* The cost management plan is described in Section 7.2.3.3.

7.4.2 Tools and Techniques for Cost Control

.1 *Cost change control system.* A cost change control system defines the procedures by which the cost baseline may be changed. It includes the paperwork, tracking systems, and approval levels necessary for authorizing changes. The cost change control system should be integrated with the overall change control system discussed in Section 4.3.

.2 *Performance measurement.* Performance measurement techniques, described in Section 10.3.2, help to assess the magnitude of any variations which do occur. Earned value analysis, described in Section 10.3.2.4, is especially useful for cost control. An important part of cost control is to determine what is causing the variance and to decide if the variance requires corrective action.

.3 *Additional planning.* Few projects run exactly according to plan. Prospective changes may require new or revised cost estimates or analysis of alternative approaches.

.4 *Computerized tools.* Computerized tools such as project management software and spreadsheets are often used to track planned costs vs. actual costs, and to forecast the effects of cost changes.

7.4.3 Outputs from Cost Control

.1 *Revised cost estimates.* Revised cost estimates are modifications to the cost information used to manage the project. Appropriate stakeholders must be notified as needed. Revised cost estimates may or may not require adjustments to other aspects of the overall project plan.

.2 *Budget updates.* Budget updates are a special category of revised cost estimates. Budget updates are changes to an approved cost baseline. These numbers are generally revised only in response to scope changes. In some cases, cost variances may be so severe that "rebaselining" is needed in order to provide a realistic measure of performance.

.3 *Corrective action.* Corrective action is anything done to bring expected future project performance into line with the project plan.

.4 *Estimate at completion.* An estimate at completion (EAC) is a forecast of total project costs based on project performance. The most common forecasting techniques are some variation of:

- EAC = Actuals to date plus the remaining project budget modified by a performance factor, often the cost performance index described in Section 10.3.2.4. This approach is most often used when current variances are seen as typical of future variances.
- EAC = Actuals to date plus a new estimate for all remaining work. This approach is most often used when past performance shows that the original estimating assumptions were fundamentally flawed, or that they are no longer relevant due to a change in conditions.
- EAC = Actuals to date plus remaining budget. This approach is most often used when current variances are seen as atypical and the project management team's expectation is that similar variances will not occur in the future.

Each of the above approaches may be the correct approach for any given work item.

.5 *Lessons learned.* The causes of variances, the reasoning behind the corrective action chosen, and other types of lessons learned from cost control should be documented so that they become part of the historical database for both this project and other projects of the performing organization.

NOTES