

# Chapter 6

# Cost Management

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# Cost Management

## 6.1 Introduction

Cost is one of the three pillars supporting project success or failure, the other two being schedule and performance. Projects that go significantly “over budget” are often terminated without achieving the project goals because stakeholders simply run out of money or perceive additional expenditures as “throwing good money after bad.” Projects that stay within budget are the exception, not the rule. A project manager who can control costs while achieving performance and schedule goals should be viewed as somewhat of a hero, especially when we consider that cost, performance, and schedule are closely interrelated.

The level of effort and expertise needed to perform good cost management are seldom appreciated. Too often, there is the pressure to come up with estimates within too short a period of time. When this happens, there is not enough time to gather adequate historical data, select appropriate estimating methods, consider alternatives, or carefully apply proper methods. The result is estimates that lean heavily toward guesswork. The problem is exacerbated by the fact that estimates are often not viewed as estimates but more as actual measurements made by some time traveler from the future. Estimates, once stated, have a tendency to be considered facts. Project managers must remember that estimates are the best guesses by estimators under various forms of pressure and with personal biases. They must also be aware of how others perceive these estimates.

Cost management consists of the four main activities or processes shown in Figure 6-1. It requires an understanding of costs far beyond the concepts of money and numbers. Cost of itself can be only measured, not controlled. Costs are one-dimensional representations of three-dimensional objects traveling through a fourth dimension, time. The real-world things that cost represents are people, materials, equipment, facilities, transportation, etc. Cost is used to monitor performance or use of real things but it must be remembered that management of those real things determines cost, and not vice versa.

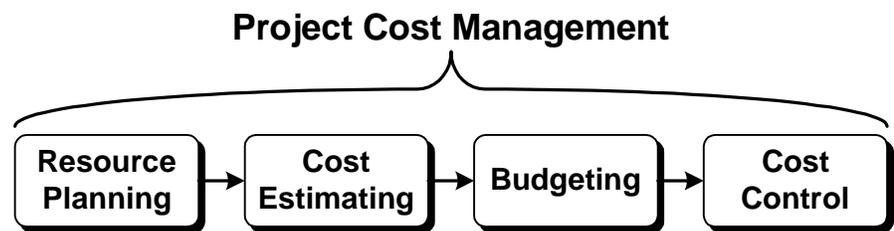


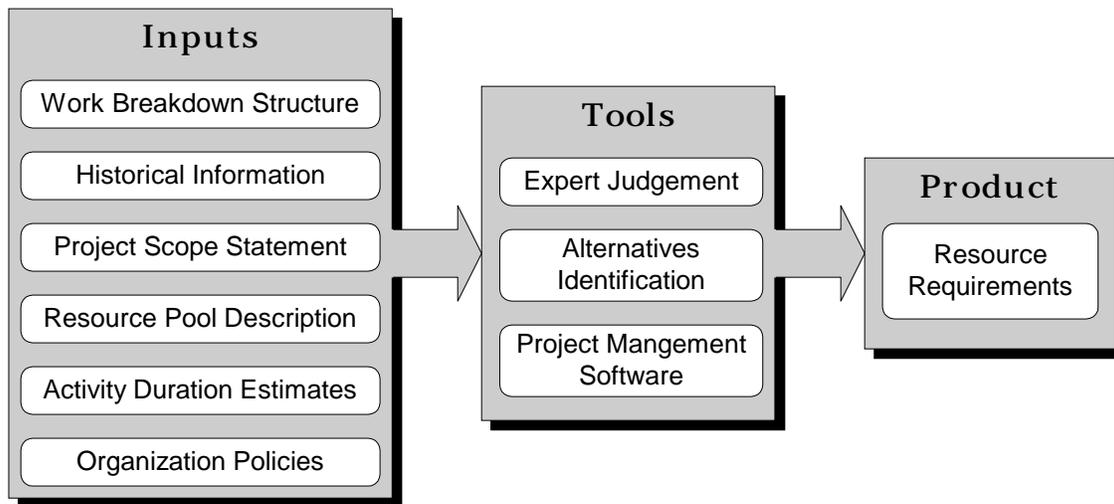
Figure 6-1 Cost Management Processes

## 6.2 Process Description

The first three cost management processes are completed, with the exception of updates, during the project planning phase. The final process, controlling costs, is ongoing throughout the remainder of the project. Each of these processes is summarized below.

### 6.2.1 Resource Planning

Cost management is begun by planning the resources that will be used to execute the project. Figure 6-2 shows the inputs, tools, and product of this process. All the tasks needed to achieve the project goals are identified by analyzing the deliverables described in the Work Breakdown Structure (WBS). The planners use this along with historical information from previous similar projects, available resources, and activity duration estimates to develop resource requirements. It is important to get experienced people involved with this activity, as noted by the “expert judgment” listed under Tools. They will know what works and what doesn’t work.



**Figure 6-2 Resource Planning Elements [1]**

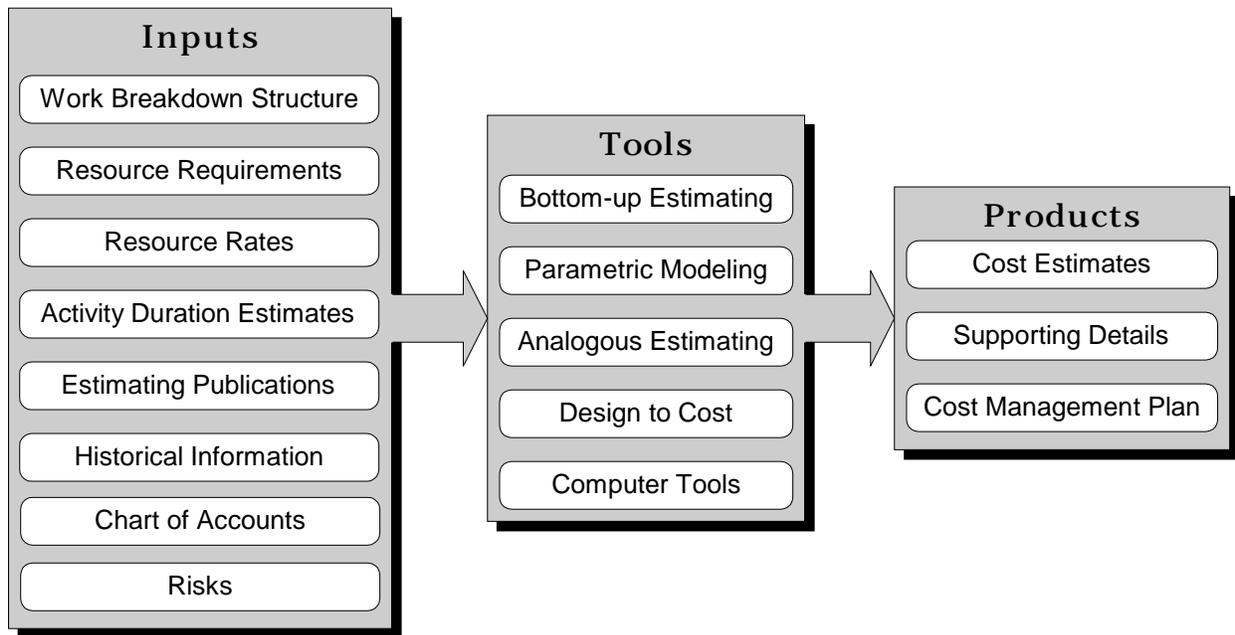
In trying to match up resources with tasks and keep costs in line, the planners will need to look at alternatives in timing and choosing resources. They will need to refer back to project scope and organizational policies to ensure plans meet with these two guidelines.

Except for very small projects, trying to plan without good project management software is tedious and subject to errors, both in forgetting to cover all tasks and in resource and cost calculations.

The output of this process is a description of the resources needed, when they are needed, and for how long. This will include all types of resources, people, facilities, equipment, and materials. Once there is a resource plan, the process of estimating begins.

### 6.2.2 Estimating Costs

Estimating is the process of determining the expected costs of the project. It is a broad science with many branches and several popular, and sometimes disparate, methods. There are overall strategies to determining the cost of the overall project, as well as individual methods of estimating costs of specific types of activity. Several of these can be found in the resources listed at the end of the chapter. In most software development projects the majority of the cost pertains to staffing. In this case, knowledge of the pay rates (including overhead) of the people working on the project, and being able to accurately estimate the number of people needed and the time necessary to complete their work will produce a fairly accurate project cost estimate. Unfortunately, this is not as simple as it sounds. Most project estimates are derived by summing the estimates for individual project elements. Several general approaches to estimating costs for project elements are presented here. [3] Your choice of approach will depend on the time, resources, and historical project data available to you. The cost estimating process elements are shown in Figure 6-3.



**Figure 6-3 Cost Estimating Elements [1]**

Cost estimating uses the resource requirements, resource cost rates, and the activity duration estimates to calculate cost estimates for each activity. Estimating publications, historical information, and risk information are used to help determine which strategies and methods would yield the most accurate estimates. A chart of accounts may be needed to assign costs to different accounting categories. A final, but very important, input to the estimating process is the WBS. Carefully comparing activity estimates to the activities listed in the WBS will serve as a reality check and discover tasks that may have been overlooked or forgotten.

The tools used to perform the actual estimating can be one or more of several types. The major estimating approaches shown in Figure 6-3 are discussed here. While other approaches are used, they can usually be classed as variations of these. One caution that applies to all estimating approaches: If the assumptions used in developing the estimates are not correct, any conclusions based on the assumptions will not be correct either.

#### **6.2.2.1 Bottom-Up Estimating**

Bottom-up estimating consists of examining each individual work package or activity and estimating its costs for labor, materials, facilities, equipment, etc. This method is usually time consuming and laborious but usually results in accurate estimates if well prepared, detailed input documents are used. [3]

#### **6.2.2.2 Analogous Estimating**

Analogous estimating, also known as top-down estimating, uses historical cost data from a similar project or activities to estimate the overall project cost. It is often used where information about the project is limited, especially in the early phases. Analogous estimating is less costly than other methods but it requires expert judgment and true similarity between the current and previous projects to obtain acceptable accuracy. [1]

#### **6.2.2.3 Parametric Estimating**

Parametric estimating uses mathematical models, rules of thumb, or Cost Estimating Relationships (CERs) to estimate project element costs. CERs are relationships between cost and measurements of work, such as the cost per line of code. [3] Parametric estimating is usually faster and easier to perform than bottom-up methods but it is only accurate if the correct model or CER is used in the appropriate manner.

#### **6.2.2.4 Design-to-Cost Estimating**

Design-to-cost methods are based on cost unit goals as an input to the estimating process. Tradeoffs are made in performance and other systems design parameters to achieve lower overall system costs. A variation of this method

is **cost-as-the-independent-variable**, where the estimators start with a fixed system-level budget and work backwards, prioritizing and selecting requirements to bring the project scope within budget constraints. [3]

#### 6.2.2.5 Computer Tools

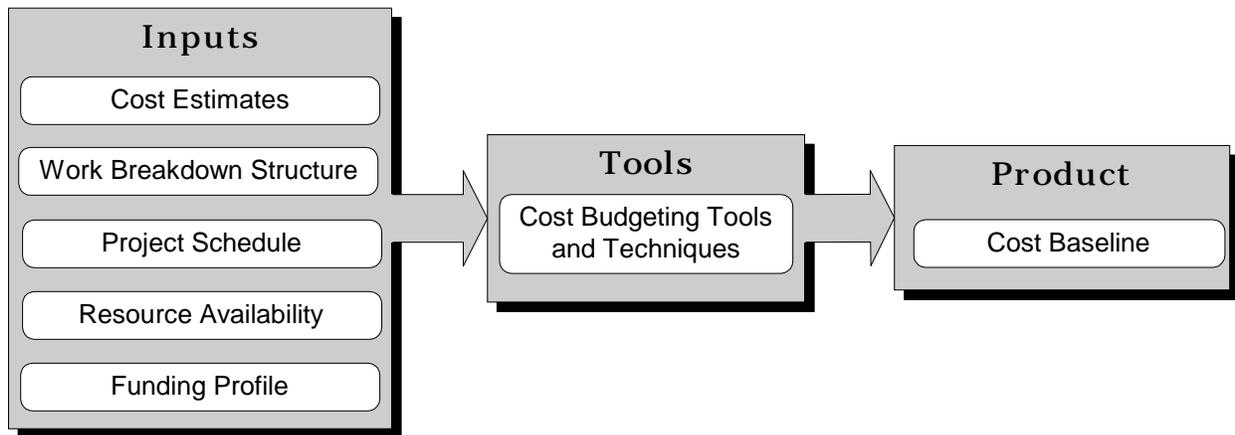
Computer tools are used extensively to assist in cost estimation. These range from spreadsheets and project management software to specialized simulation and estimating tools. Computer tools reduce the incidence of calculation errors, speed up the estimation process, and allow consideration of multiple costing alternatives. [1] One of the more widely used computer tools for estimating software development costs is the Constructive Cost Model (COCOMO). The software and users manual are available for download without cost (see COCOMO in the Resources.) However, please note that most computer tools for developing estimates for software development use either lines of code or function points as input data. If the number of lines of code or function points cannot be accurately estimated, the output of the tools will not be accurate. The best use of tools is to derive ranges of estimates and gain understanding of the sensitivities of those ranges to changes in various input parameters.

The outputs of the estimating process include the project cost estimates, along with the details used to derive those estimates. The details usually define the tasks by references to the WBS. They also include a description of how the cost was derived, any assumptions made, and a range for estimate (e.g. \$20,000 +/- \$2000.) Another output of the estimating process is the Cost Management Plan. This plan describes how cost variances will be managed, and may be formal or informal. [1] The following information may be considered for inclusion in the plan:

- Cost and cost-related data to be collected and analyzed.
- Frequency of data collection and analysis.
- Sources of cost-related data.
- Methods of analysis.
- Individuals and organizations involved in the process, along with their responsibilities and duties.
- Limits of acceptable variance between actual costs and the baseline.
- The authority and interaction of the cost control process with the change control process.
- Procedures and responsibilities for dealing with unacceptable cost variances.

#### 6.2.3 Cost Budgeting

Once the costs have been estimated for each WBS task, and all these put together for an overall project cost, a project budget or cost baseline must be constructed. The budget is a spending plan, detailing how and at what rate the project funding will be spent. The budgeting process elements are shown in Figure 6-4. All project activities are not performed at once, resources are finite, and funding will probably be spread out over time. Cost estimates, WBS tasks, resource availability, and expected funding must all be integrated with the project schedule in a plan to apply funds to resources and tasks. Budgeting is a balancing act to ensure the rate of spending closely parallels the resource availability and funding, while not exceeding either. At the same time, task performance schedules must be followed so that all tasks are funded and completed before or by the end of the project schedule.



**Figure 6-4 Cost Budgeting Elements [1]**

The spending plan forms the cost baseline, which will be one of the primary measures of project health and performance. Deviations from this cost baseline are major warning signs requiring management intervention to bring the project back on track.

Various tools and techniques are available to assist in the budgeting process. Most of these are implemented in some form of computer software. Budgeting is usually a major part of project management software.

#### **6.2.4 Cost Control**

Cost control is the final step of the cost management process but it continues through the end of the project. It is a major element of project success and consists of efforts to track spending and ensure it stays within the limits of the cost baseline. The following activities make up the cost control process: [1]

- Monitor project spending to ensure it stays within the baseline plan for spending rates and totals.
- When spending varies from the plan determine the cause of variance, remembering that the variance may be a result of incorrect assumptions made when the original cost estimate was developed.
- Change the execution of the project to bring the spending back in line within acceptable limits, or recognize that the original estimate was incorrect, and either obtain additional funding or reduce the scope of the project.
- Prevent unapproved changes to the project and cost baseline.

When it is not possible to maintain the current cost baseline, the cost control process expands to include these activities: [2]

- Manage the process to change the baseline to allow for the new realities of the project (or incorrectly estimated original realities.)
- Accurately record authorized changes in the cost baseline.
- Inform stakeholders of changes.

The input, tool, and product elements of the cost control process are shown in Figure 6-5.

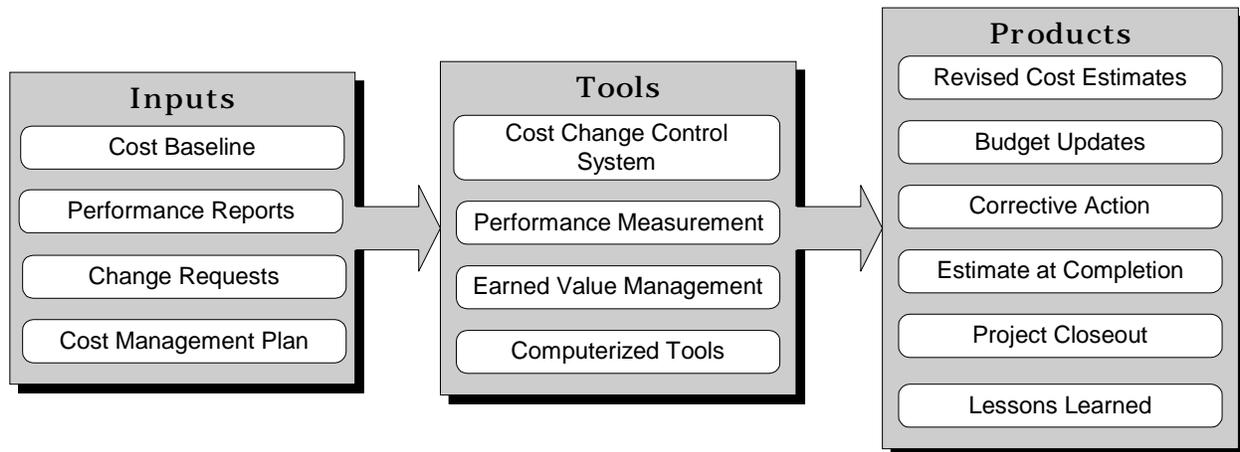


Figure 6-5 Cost Control Elements [1]

The cost control process compares cost performance reports with the cost baseline to detect variances. Guidance on what constitutes unacceptable variance and how to deal with variance can be found in the cost management plan, developed during the estimation activities. Few projects are completed without changes being suggested or requested. All change requests should run the gauntlet of cost control to weigh their advantages against their impact to project costs.

Cost control tools include performance measurement techniques, a working cost change control system, and computer based tools. A powerful technique used with considerable success in projects is **Earned Value Management**, if used appropriately. It requires a fully defined project up front and bottom-up cost estimates, but it can provide accurate and reliable indication of cost performance as early as 15% into the project. [4]

The outputs of cost control includes products which are ongoing throughout the life of the project: revised cost estimates, budget updates, corrective actions, and estimates of what the total project cost will be at completion. Corrective actions can involve anything that incurs cost, or even updating the cost baseline to realign with project realities or changes in scope. Cost data necessary to project closeout are also collected throughout the life of the project and summarized at the end. A final product, extremely important to future efforts, is a compilation of lessons learned during the execution of the project. [1]

### 6.3 Cost Management Checklist

This checklist is provided as to assist you in cost management. Consider your answers carefully to determine whether you need to examine the situation and take action.

- 1. Is cost management planning part of your project planning process?
- 2. Have you established a formal, documented cost management process?
- 3. Do you have a complete and detailed WBS, including management areas (See Mil-HDBK-881, Appendix H)?
- 4. Do you have historical information, including costs, from previous similar projects?
- 5. Have you identified all sources of costs to your project (i.e. different types of labor, materials, supplies, equipment, etc.)?
- 6. Have you identified proven and applicable estimating methods, models, and/or guides?
- 7. Have you selected computer software to assist you in estimating, budgeting, tracking, and controlling costs?
- 8. Do you have justifiable reasons for selecting your methods, models, guides, and software?
- 9. Are cost issues adequately addressed in your risk management plan?
- 10. Do you have a working change control process in place?

- 11. Does the change control process adequately address cost impact?
- 12. Do your estimates cover all tasks in the WBS?
- 13. Do you understand your project's funding profile, i.e. how much funding will be provided? At what intervals? How sure is the funding?
- 14. Have you developed a viable cost baseline that is synchronized with the project schedule and funding profile?
- 15. Do you have adequate flexibility in the cost baseline?
- 16. Do you have a plan/process for dealing with variances between cost performance and the baseline?
- 17. Have you considered incorporating earned value management into your cost management efforts?
- 18. Are you keeping records of your cost management activity for future efforts?

## 6.4 References

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## 6.5 Resources

Air Force Cost Analysis Agency (AFCAA): [www.saffm.hq.af.mil/afcaa/](http://www.saffm.hq.af.mil/afcaa/)

Air Force Cost Reference Documents: [www.saffm.hq.af.mil/afcaa/reference.html](http://www.saffm.hq.af.mil/afcaa/reference.html)

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MIL-HDBK-881, Work Breakdown Structure:

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