Project Cost Management

Project Skills

Team FME

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Preface

This eBook describes the process of cost management in projects. The first task is to set the budget based on cost estimates and the second is to manage the costs so that they remain within the budget that has been set. Project cost management can be both specialized and complex and the aim of this eBook is to give you a general understanding of what is involved so that you know what should be done, even if you don't have the skills needed to actually do it.

You will learn:

- How to approximate the monetary cost of a project
- How a project budget is arrived at based on these figures
- How the spend is monitored and changes to the cost baseline are managed
- How Earned Value Management (EVM) is used in projects
- The importance of managing cash flow throughout the project

The Free Management eBooks 'Project Skills' series are structured around the ten key knowledge areas of project management detailed in the 'Project Management Institute, A Guide to the Project Management Body of Knowledge, (PMBOK® Guide)—Fifth Edition, Project Management Institute Inc., 2013'. ISBN-13: 978-1935589679.

The eBooks in this series follow the structure of the PMBOK® Guide because it represents a tried and tested framework. We have tried to ensure full alignment of our eBooks with the Guide by using the numbering convention as well as the naming convention.

If you need more detailed explanation of a particular subject then you can simply refer to the related chapter and paragraph number in the PMBOK® Guide. Remember, many of the generic project management methodologies available refer to the PMBOK® Guide as a basic framework.

A knowledge of the PMBOK® processes will go a long way towards giving you an understanding of almost any project management methodology that your organization may use.

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About this Knowledge Area

Project Cost Management involves defining the cost of the project and then making sure that it is delivered within that approved budget. The PMBOK® defines the elements of this process as follows:

Process	Project Phase	Key Deliverables
7.1 Plan Cost Management	**Planning**	Cost Management Plan
7.2 Estimate Costs		Activity Cost Estimates Basis of estimates
7.3 Determine Budget		Cost Performance Baseline
7.4 Control Costs	**Monitoring & Controlling**	Work Performance Measurements

The first three of these processes, creating the cost management plan, estimating the costs and determining the budget are done in the planning phase. While controlling costs is an ongoing process and therefore part of the monitoring and controlling process group.

Successful cost management is based on other planning processes like scope management and resource allocation being done effectively.

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Introduction

The first step in the cost management process group is to answer the questions:

'How much will the project cost?'

'How accurate is this estimate?'

Project managers make many of their day-to-day decisions based on estimates and the accuracy of these can have a big influence on the outcome of the project.

Experience suggests that projects launched without an accurate initial estimate are far more likely to experience serious problems than those where sound estimates were made. One of the keys to successful project completion is an accurate cost estimate and a realistic risk assessment.

In addition, in some project environments, the project manager may have a legal responsibility for ensuring that cost estimates are prepared properly. Even where this is not the case the project manager should document all of the supporting information that went into the cost estimates in order to justify their decisions if these are challenged later on.

In common with many of the processes in project management, cost estimation is an iterative process and the more work that is done and the more experience that is gained the more accurate the estimates of future work will become.

Even projects with acceptable initial estimates are doomed to overrun cost and schedule budgets if they are not guided by rules of thumb and rigorous estimates-to-complete.

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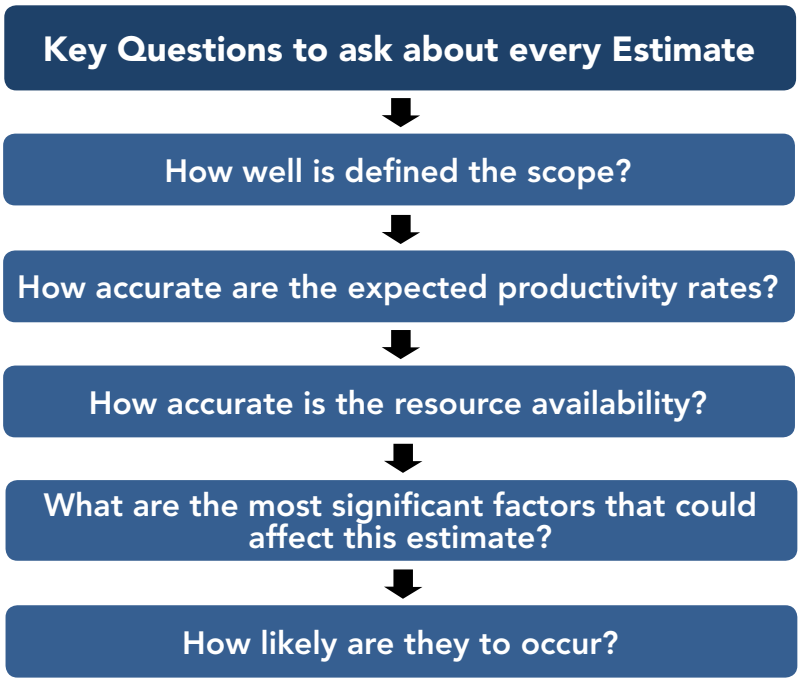
There are five questions project managers should ask about every estimate as they define and manage their projects:

1. How well defined is the scope?
2. How accurate are the expected productivity rates?
3. How accurate is the resource availability assumption?
4. What are the most significant factors that could affect this estimate?
5. How likely are they to occur?

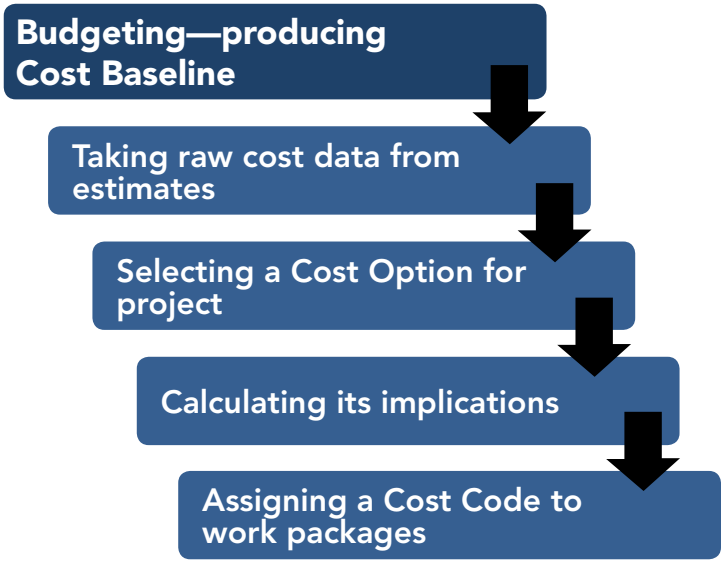


There is no point in working out costs to the nearest dollar if you are not clear about these things. In fact, providing very specific cost estimates to the sponsor can hide the fact that you are basing them on scope, resource and productivity figures that are themselves likely to be revised in the light of experience.

On the subject of accuracy, you will need to decide just how accurate the estimates need to be. For example, an initial estimate may suggest a figure of between $50,000 and $75,000 for a particular part of the project. The benefit gained from narrowing this down needs to be factored against the additional time (and cost) it would take to do so. If the project sponsor is happy to accept this initial estimate, then why bother? The key word

here is 'initial', you should be able to narrow this down without too much effort when you have more experience and more data to work with.

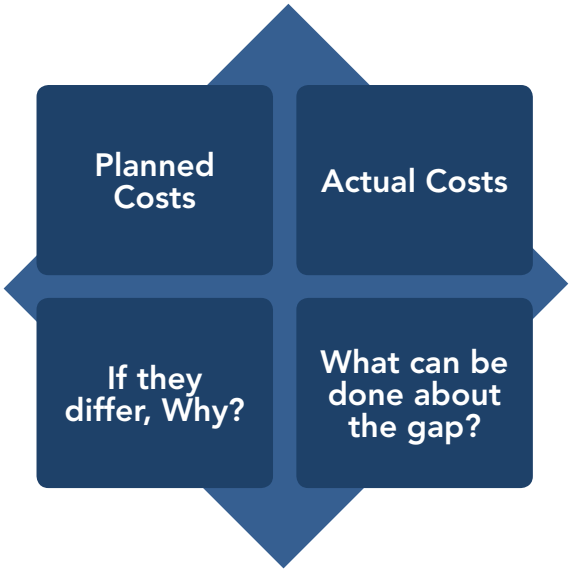
Whilst cost estimating operates at the level of activities, cost budgeting aggregates these figures at the project level to produce a cost baseline and the project funding requirements. The process of aggregation involves more than simply adding the figures from the estimating process to produce totals.



Budgeting involves taking the raw cost data from the estimating step, deciding which cost options to use, calculating their implication, and finally assigning cost codes to work packages. The project cost plan will also need to be structured in a way that is compatible with how the funds are being disbursed and it will need to be compatible with the organization's own accounting system.

The final process in this group is cost control, which is concerned with answering the questions:

- Is the project on track in terms of cost to date?
- Does it look as if this will continue?
- If not, what action can be taken to remedy the situation?



To answer these, you need to know four things:

- The planned costs
- The actual costs
- Why they differ (assuming they do)
- What you can do about it

The process of determining the difference between the planned costs and the actual costs is fairly straightforward and there are several tools that can be used to quantify any 'variance'. A project manager is expected to be able to report exactly where a project is in terms of costs against the planned budget. You will normally be expected to produce a variance report to the project sponsor detailing these figures.

The real skill of project management is to be able to identify problems and to address them as soon as possible, before they become too big to fix.

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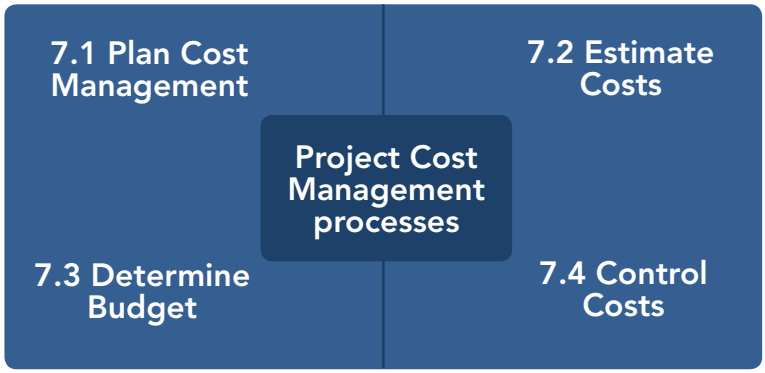
The PMBOK® Project Cost Management Processes

As previously stated, money is usually one of the key constraints of any project and this process is therefore all about defining the budget and managing the actual project costs within it.



There are four Project Cost Management processes:

7.1 Plan Cost Management
7.2 Estimate Costs
7.3 Determine Budget
7.4 Control Costs

These are dealt with in detail in the following chapters of this eBook.

7.1 Plan Cost Management

This process establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs. The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.

The inputs, tools and techniques, and outputs of this process are described below.

Inputs	Tools & Techniques	Outputs
Project Management Pan	Expert Judgment	Cost Management Plan
Project Charter	Analytical Techniques	
Enterprise Environmental Factors	Meetings	
Organizational Process Assets		

7.1.1 Plan Cost Management: Inputs

This process requires the following inputs:

7.1.1.1 Project Management Plan

The following elements of the Project Management Plan are used:

- Scope Baseline (the project scope statement, WBS, and WBS dictionary)
- Schedule Baseline
- Cost, Risk, and Communications management plans

7.1.1.2 Project Charter

This provides the summary budget from which detailed project costs are developed, as well as project approval requirements (particularly those dealing with project cost constraints).

7.1.1.3 Enterprise Environmental Factors

These include the organizational culture and structure, market conditions, currency exchange rates, commercial information such as cost rate information and published seller list prices.

7.1.1.4 Organizational Process Assets

These include financial control procedures, historical information and lessons learned from previous projects, as well as, cost estimating and budgeting-related policies, procedures, and guidelines.

7.1.2 Plan Cost Management: Tools and Techniques

There are three tools and techniques that can be used.

7.1.2.1 Expert Judgment

This can involve any member of the project management team with expertise in budgeting, particularly in the domain area of the project.

7.1.2.2 Analytical Techniques

Developing the cost management plan may involve choosing strategic options to fund the project such as:

- Self-funding,
- Funding with equity, or
- Funding with debt.

The cost management plan may also detail ways to finance project resources such as making, purchasing, renting, or leasing. These decisions, like other financial decisions affecting the project, may affect project schedule and/or risks.

Organizational policies and procedures may influence which financial techniques are employed in these decisions. Techniques may include (but are not limited to): payback period, return on investment, internal rate of return, discounted cash flow, and net present value.

7.1.2.3 Meetings

These involve people who are responsible for cost management including the project manager, the project sponsor, selected project team members, selected stakeholders, anyone with responsibility for any of the cost management processes, and others as needed.

Collective decision-making is very important area of project management that the PMBOK® does not go into any detail about but which can make or break this part of the project. Almost all of the processes that for part of project time management will involve meetings between the project manager, the team and other stakeholders in order to make decisions about the activity definitions and associated estimates. How well these meetings are conducted will have a major impact on how smoothly the project runs.

If you feel as though your project meetings could be improved then you can download the 'Meeting Skills' eBooks from http://www.free-management-ebooks.com/skills-meeting.htm. These free eBooks cover all aspects of meetings including how to set an agenda that will ensure that the meeting achieves it's aims and how to chair a meeting so that it is as productive as possible.

7.1.3 Plan Cost Management: Outputs

This process will create the following output:

7.1.3.1 Cost Management Plan

The Cost Management Plan clearly defines how the costs on a project will be managed throughout the project's lifecycle. It sets the format and standards by which the project costs are measured, reported and controlled.

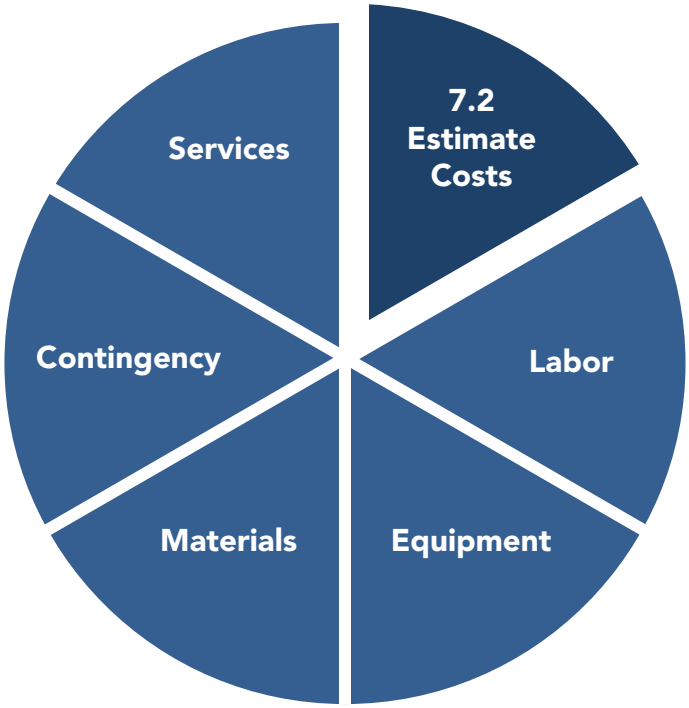
Element of Plan	Description of Element	Related Process
Units of measure	Each measurement used with resources to obtain cost estimates.	7.2 Estimate Costs
Level of precision	Degree to which cost estimates are to be rounded up or down.	7.2 Estimate Costs
Level of accuracy	Acceptable range (e.g.,+/-10%) used in determining cost estimates	7.2 Estimate Costs
Organizational procedures links	WBS provides framework for cost management plan. WBS component used for project cost accounting is the control account.	7.2 Estimate Costs, 7.3 Determine Budget
Control thresholds	Variance thresholds for monitoring cost performance before action must be taken.	7.4 Control Costs
Rules of performance measurement	Rules of measuring performance through EVM (earned value measurement) are set.	7.4 Control Costs
Reporting formats	Format and frequency of cost control reports is specified.	7.4 Control Costs
Process descriptions	Descriptions of each of the cost management processes.	ALL

This plan identifies who is responsible for managing costs and who has the authority to approve changes to the project or its budget. It also specifies how cost performance is quantitatively measured and details report formats, frequency and to whom they are presented.

The Work Breakdown Structure (WBS) is the basis for the cost management plan because the costs are totaled or "rolled up" from the costs for the individual work packages in the WBS.

7.2 Estimate Costs

This process involves estimating the costs of all of the resources that will be charged to the project including: labor, equipment, materials, services, and any contingency costs.



In the early days of a project, estimating costs can be difficult particularly if there is little or no historical data from previous projects of a similar nature. There are various tools and techniques that can help with this but there is no substitute for experience. As the project progresses, more information becomes available and the degree of uncertainty naturally falls.

One basic assumption that needs to be made when estimating project costs is whether the estimates will be limited to direct project costs only or whether the estimates will also include indirect costs. Indirect costs are those costs that cannot be directly traced to a specific project and therefore will be accumulated and allocated equitably over multiple projects by some approved and documented accounting procedure.

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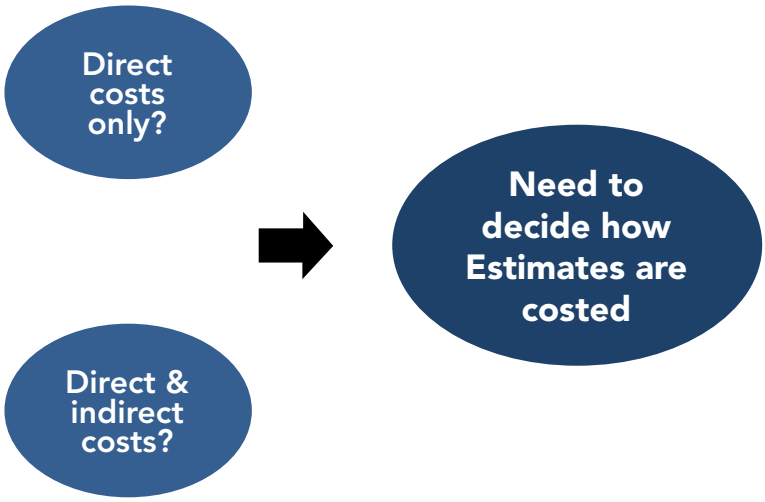


The inputs, tools and techniques, and outputs of this process are described below.

Inputs	Tools & Techniques	Outputs
Cost Management Plan	Expert Judgment	Activity Cost Estimates
Human Resource Management Plan	Analogous Estimating	Basis of Estimates
Scope Baseline	Parametric Estimating	Project Document Updates
Project Schedule	Bottom-up Estimating	
Risk Register	Three-point Estimates	
Enterprise Environmental Factors	Reserve Analysis	
Organizational Process Assets	Cost of Quality	
	Project Management Estimating Software	
	Vendor Bid Analysis	
	Group Decision Making Techniques	

7.2.1 Estimate Costs: Inputs

This process requires the following inputs:

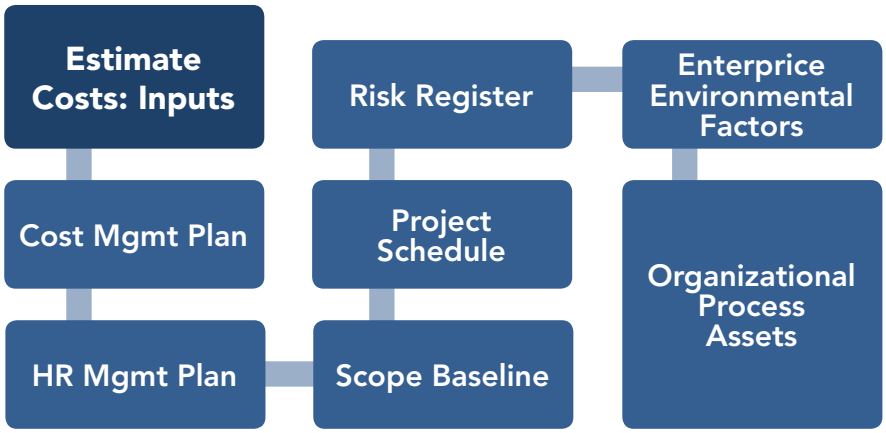
7.2.1.1 Cost Management Plan

This is an output of process 7.1 Plan Cost Management and includes information about the estimation method used and the level of accuracy required.

7.2.1.2 Human Resource Management Plan

This is an output of process 9.1 Plan Human Resource Management and defines each role that is needed on the project, including title, level of authority, responsibilities, and the competencies required by the role.

It also shows the organizational chart and includes a staffing management plan that details when people will join and leave the project as well as any training they may need. From the cost perspective it includes remuneration rates and rewards.



7.2.1.3 Scope Baseline

The scope baseline is a component of the project management plan and includes the product descriptions, acceptance criteria, key deliverables, project boundaries, assumptions, and constraints about the project.

It may also include requirements with contractual and legal implications for health, safety, security, performance, environmental, insurance, intellectual property rights, licenses, and permits. All of this information should be considered when developing the cost estimates.

7.2.1.4 Project Schedule

This is an output of process 6.6 Determine Schedule and includes a planned start date and planned finish date for each activity as well as the resources required. This information is a key input to this process.

7.2.1.5 Risk Register

This is an output of process 11.2 Identify Risks and is a central repository for all risks identified and includes information such as risk description, risk probability, impact, preferred response and the risk owner.

7.2.1.6 Enterprise Environmental Factors

In the context of this process, these include things like what products, services, and results are available in the market, from whom, and under what terms and conditions. Resource cost rate information is often available from commercial databases that track human resource costs, and provides standard costs for material and equipment.

7.2.1.7 Organizational Process Assets

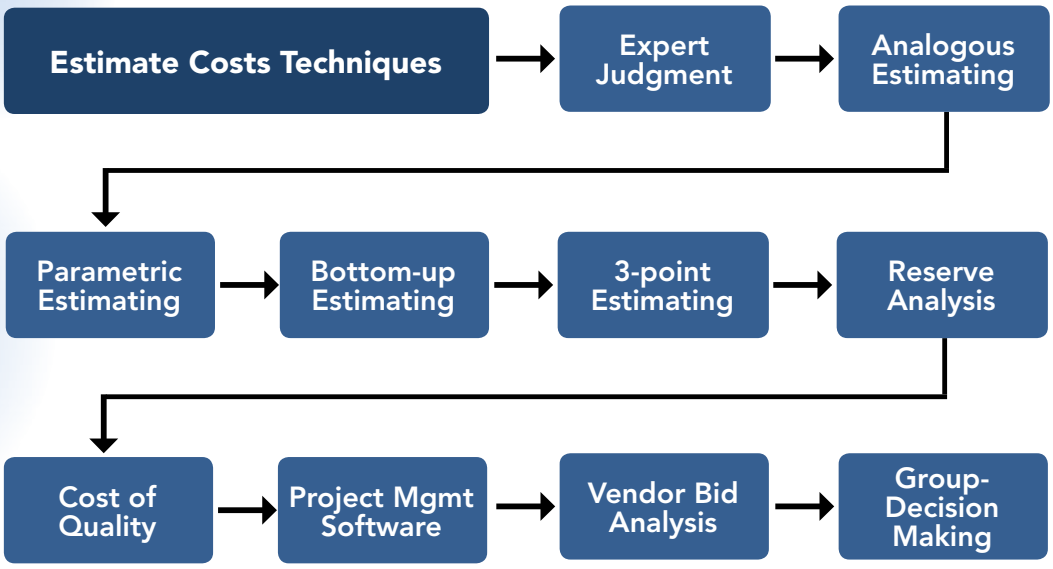
These are the processes or process-related assets that can be used to help this project succeed. They can be grouped into processes and procedures for conducting work, and a corporate knowledge base for storing and retrieving information. These assets would typically include: cost estimating policies and templates, historical information and lesson learned.

7.2.2 Estimate Costs: Tools and Techniques

There are ten tools and techniques that can be used.

7.2.2.1 Expert Judgment

Cost estimates are influenced by numerous variables such as labor rates, material costs, inflation, risk factors, and other variables. Expert judgment, guided by historical information, provides valuable insight about the environment and information from prior similar projects. Expert judgment can also be used to determine whether to combine methods of estimating and how to reconcile differences between them.



7.2.2.2 Analogous Estimating

This technique uses the values of scope, cost, budget, and duration or measures of scale such as size, weight, and complexity, from a previous, similar project as the basis for estimating the same parameter for this project. It is most often used in the early stages of a project when there is little else to base the cost estimates on. It is a relatively quick and straightforward method but is less accurate than bottom-up estimation

The accuracy of the estimate depends upon how similar the activities are and whether the team member who will perform the activity has the same level of expertise and experience as the team member from the previous project.

Analogous estimating is typically a form of expert judgment that is most reliable when the previous activities are similar to the current activity and when the team members preparing the estimates have the necessary experience.

7.2.2.3 Parametric Estimating

This is a simple technique used to calculate the cost when the productivity rate of the resource performing the activity is available. You can use the following formula:

Activity cost = Units of work in the activity / Productivity rate of the resources.

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For example, if a contractor charges $5000 to build 100 yards of security fence, the cost calculation can be performed as follows:

This technique relies on the statistical relationship that exists between a series of historical data and the variables in question. When this data is being drawn from a large body of historical data taken from similar projects, then it can yield accurate estimates.

It provides several advantages as an estimating technique for example:

- It allows estimates to be prepared in much less time than required by more detailed techniques.
- It requires quantitative inputs that are linked to algorithms providing quantitative outputs. This means that all costs are traceable.
- If two estimators input the same values for parameters, they will get the same resulting cost. Parametric models also provide a consistent estimate format and estimate documentation.
- Parametric models provide costs for a range of input values, extrapolating to derive costs for projects of a different size or nature than you may have history for.
- The models highlight the design parameters used, and can provide key statistical relationships and metrics for comparison with other projects.

The disadvantages of this method are:

- Models will not exist for activities until there is a sufficiently large experience base for the activity. Basing estimates on work that is only vaguely comparable will yield inaccurate estimates.
- Physical parameters, for example 'number of bricks laid', 'area of trees cleared' or 'number of widgets produced' are far more meaningful than non-physical parameters for example, the 'number of lines of code' in a software project.

- Improved technology or working practices may make the historical data obsolete. As well as increased computing power this could include things like new plant and equipment or a completely new way of doing the job.

7.2.2.4 Bottom-Up Estimating

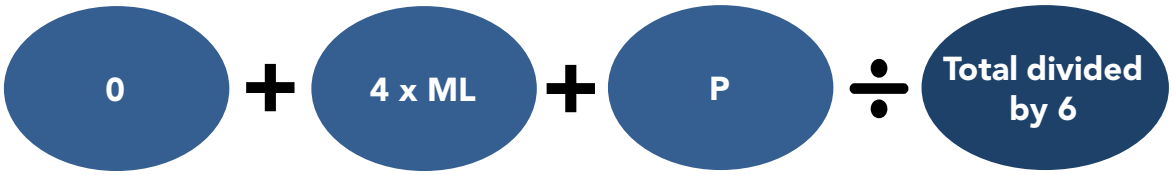
Estimates costs of individual work packages, and these estimates are then totaled or "rolled up" to higher levels.

7.2.2.5 Three-point Estimates

This method addresses the issue of uncertainty in estimating the activity duration. This uncertainty can be calculated by making a three-point estimate in which each point corresponds to one of the following estimate types:

- **Most Likely Scenario (ML)**—the activity duration is calculated in most practical terms by factoring in resources likely to be assigned, realistic expectations of the resources, dependencies, and interruptions.
- **Optimistic Scenario (O)**—this is the best-case version of the situation described in the most likely scenario.
- **Pessimistic Scenario (P)**—this is the worst-case version of the situation described in the most likely scenario.

We then find the average, but we first weight the Most Likely estimate by 4.

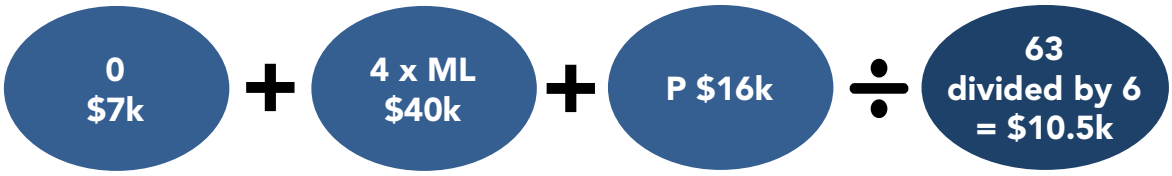


The formula is (O + (4*ML) + P) / 6. We must divide by six because we in effect have six different estimates (although three of these estimates are the same number). We are averaging (O + ML + ML + ML + ML + P) / 6.

Here's an example.

> ***A roofing contractor is replacing all of the tiles on the roof of a house. He estimates that the job cost $10,000 based on the expectation that they will need to replace some of the underlying timbers. This is his Most Likely Estimate.***
>
> ***If none of the timbers need replacing then the job will cost $7,000, this represents his Optimistic estimate.***
>
> ***If most of the timbers need replacing then the job will cost $16,000, this represents his Pessimistic estimate.***

Putting these numbers into the formula gives:



This formula is most useful in estimating the cost of activities for projects that are especially unique, such as in research and development where there are many unknowns.

7.2.2.6 Reserve Analysis

Cost estimates may include contingency reserves (sometimes called contingency allowances) to account for cost uncertainty. The contingency reserve may be a percentage of the estimated cost, a fixed number, or may be developed by using quantitative analysis methods.

One method of calculating the contingency reserve is to take a percentage of the original activity cost estimate, although it can also be estimated by using quantitative analysis methods. When more information about the project becomes available, the contingency reserve can be reduced or eliminated. Contingency should be clearly identified in cost documentation.

7.2.2.7 Cost of Quality

Assumptions about the cost of quality may affect the cost estimates.

7.2.2.8 Project Management Software

Project management cost estimating software applications, computerized spreadsheets, simulation, and statistical tools are becoming more widely accepted to assist with cost estimating. Such tools can simplify the use of some cost estimating techniques and thereby facilitate rapid consideration of cost estimate alternatives.

7.2.2.9 Vendor Bid Analysis

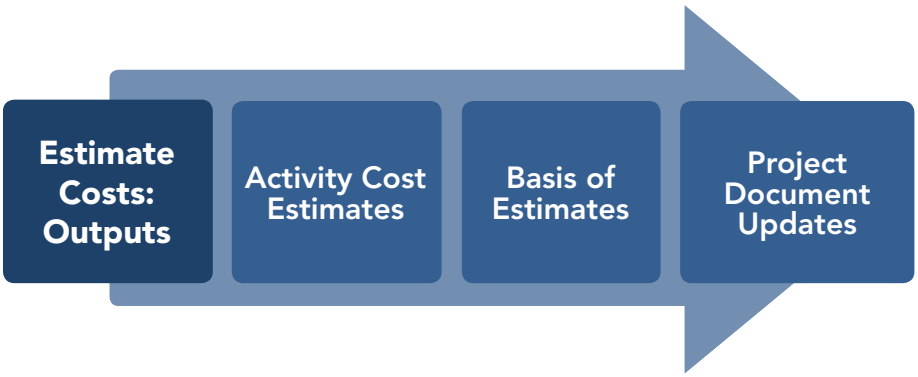
Cost estimating methods may include analysis of what the project should cost, based on the responsive bids from qualified vendors. Where projects are awarded to a vendor under competitive processes, additional cost estimating work can be required of the project team to examine the price of individual deliverables and to derive a cost that supports the final total project cost.

7.2.2.10 Group Decision-Making Techniques

Team-based approaches can be useful for improving duration estimates.

7.2.3 Estimate Costs: Outputs

This process will create the following outputs:



7.2.3.1 Activity Cost Estimates

These are quantitative assessments of the probable costs required to complete project work. They are estimated for all resources that are applied to the activity cost estimate including, direct labor, materials, equipment, services, facilities, information technology, and special categories such as an inflation allowance or a cost contingency reserve.

Indirect costs, if they are included in the project estimate, can be included at the activity level or at higher levels.

7.2.3.2 Basis of Estimates

This should provide a clear and complete understanding of how the cost estimate was derived including: the basis of the estimate, all assumptions made, any known constraints, indication of the range of possible estimates, and the confidence level of the final estimate.

7.2.3.3 Project Document Updates

The risk register will be updated to include the estimated costs of risk responses.

7.3 Determine Budget

This is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline. This baseline includes all authorized budgets, but excludes management reserves.

The inputs, tools and techniques, and outputs of this process are described below.

Inputs	Tools & Techniques	Outputs
Cost Management Plan	Cost Aggregation	Cost Performance Baseline
Scope Baseline	Reserve Analysis	Project Funding Requirements
Activity Cost Estimates	Expert Judgment	Project Document Updates
Basis of Estimates	Historical Relationships	
Project Schedule	Funding Limit Reconciliation	
Resource Calendars		
Risk Register		
Agreements		
Organizational Process Assets		

7.3.1 Determine Budget: Inputs

The most important inputs to this process are the estimates determined in the previous process '7.2 Estimate Costs'. Other important inputs come from other knowledge areas such as Scope, Time, Human Resource, Risk, and Procurement Management. This process requires the following inputs:

7.3.1.1 Cost Management Plan

This plan describes how the project costs will be managed and controlled.

7.3.1.2 Scope Baseline

As described in the previous process '7.2 Estimate Costs', the scope baseline is a component of the project management plan and includes the product descriptions, acceptance criteria, key deliverables, project boundaries, assumptions, and constraints about the project.

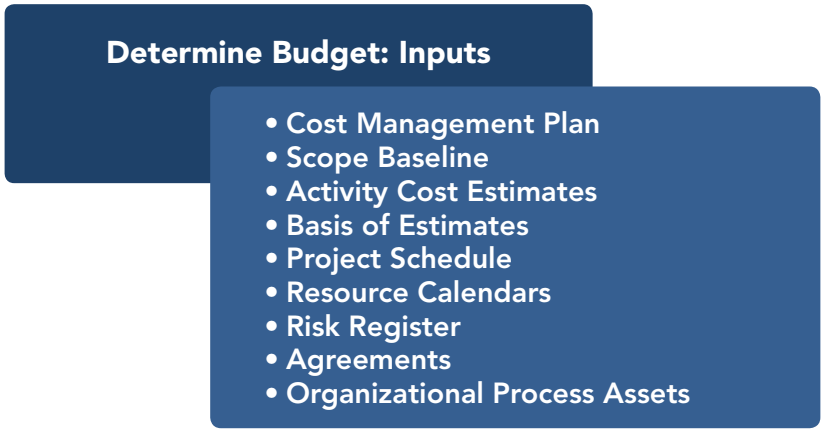
It may also include requirements with contractual and legal implications for health, safety, security, performance, environmental, insurance, intellectual property rights, licenses, and permits.

7.3.1.3 Activity Cost Estimates

These are outputs from the previous process '7.1 Estimate Costs'.

7.4.1.4 Basis of Estimates

Supporting detail for cost estimates should be specified as described above. Any basic assumptions dealing with the inclusion or exclusion of indirect costs in the project budget are specified in the basis of estimates.



7.3.1.5 Project Schedule

As described in the previous process '7.1 Estimate Costs', the project schedule includes a planned start date and planned finish date for each activity as well as the resources required. This information can be used to aggregate costs to the calendar periods in which the costs are planned to be incurred.

7.3.1.6 Resource Calendars

These provide information on which resources are assigned to the project and when they are assigned. This information can be used to indicate resource costs over the duration of the project.

7.3.1.7 Risk Register

This is an output of process '11.2 Identify Risks' and is used to aggregate costs for risk responses to obtain the contingency reserves for the project.

7.3.1.8 Agreements

This is an output of Procurements Management process 12.2 and applicable contract information and costs relating to products, services, or results that have been purchased are included when determining the budget.

7.3.1.9 Organizational Process Assets

These are the processes or process-related assets that can be used in this process including: Existing formal and informal cost budgeting-related policies, procedures, and guidelines, as well as cost budgeting tools, and reporting methods.

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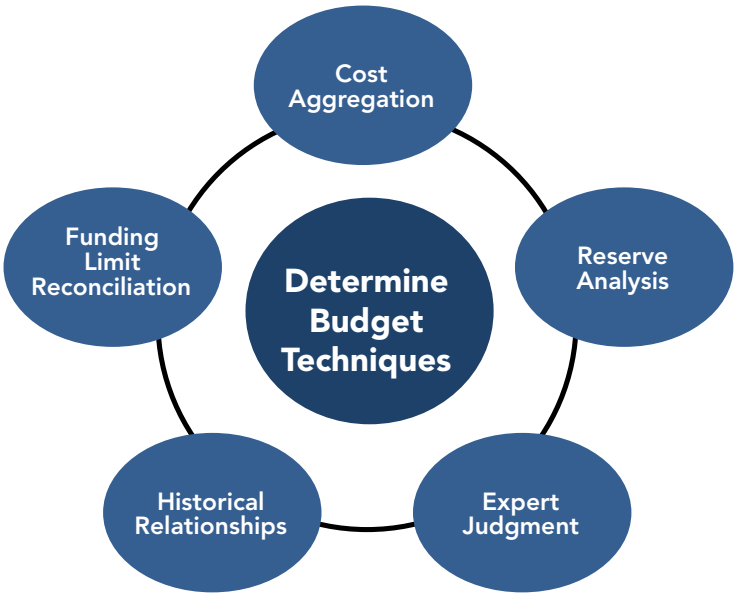
7.3.2 Determine Budget: Tools and Techniques

There are five tools and techniques that can be used.



7.3.2.1 Cost Aggregation

Cost estimates are aggregated by work packages in accordance with the WBS. The work package cost estimates are then aggregated for the higher component levels of the WBS (such as control accounts) and ultimately for the entire project.

7.3.2.2 Reserve Analysis

This can establish both the contingency reserves and the management reserves for the project.

- Contingency reserves are allowances for unplanned but potentially required changes that can result from realized risks identified in the risk register.
- Management reserves are budgets reserved for unplanned changes to project scope and cost.

7.3.2.3 Expert Judgment

This expertise is provided by any group or individual with specialized knowledge or training, and is available from many sources, including: other units within the organization, con-

sultants, stakeholders, including customers or sponsors, professional and technical associations, industry groups, subject matter experts, and project management office (PMO).

7.3.2.4 Historical Relationships

This refers to using historical data from other projects in which costs are known for the same or similar activities.

7.3.2.5 Funding Limit Reconciliation

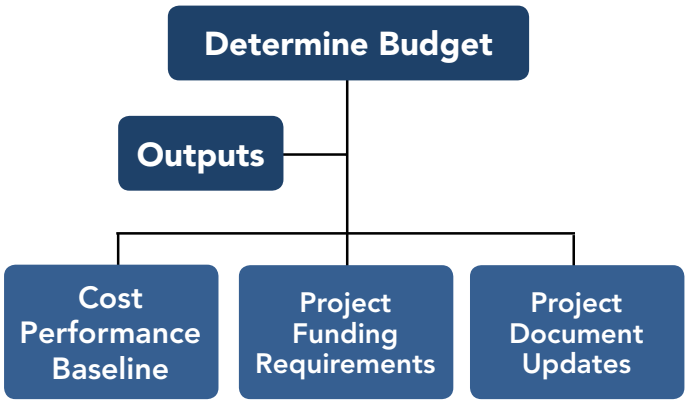
The expenditure of funds should be reconciled with any funding limits on the commitment of funds for the project. A variance between the funding limits and the planned expenditures will sometimes mean rescheduling the work to level out the rate of expenditures. This can be accomplished by placing imposed date constraints for work into the project schedule.

Cost aggregation of the work packages produces the cost estimate of the project. Adding the cost of risk responses and contingency reserves produces the cost baseline. Adding the management reserves, which are not controlled by the project manager but by management, to the cost baseline, provides the cost budget.

If the funding for the whole project is incremental, then care must be taken to ensure that the project does not run out of money as a result of getting too far ahead of the schedule.

7.3.3 Determine Budget: Outputs

This process will create the following outputs:



7.3.3.1 Cost Performance Baseline

This specifies what costs will be incurred and when. This matters because most projects will not receive their funding as a lump sum at the beginning but will be financed according to a monthly or quarterly budget. This means that the project manager will need to indicate when funds need to be available.

The simplest way to produce a cost baseline would be to aggregate all of the anticipated costs of the project and assume that they would be needed in proportion to the planned timescale.

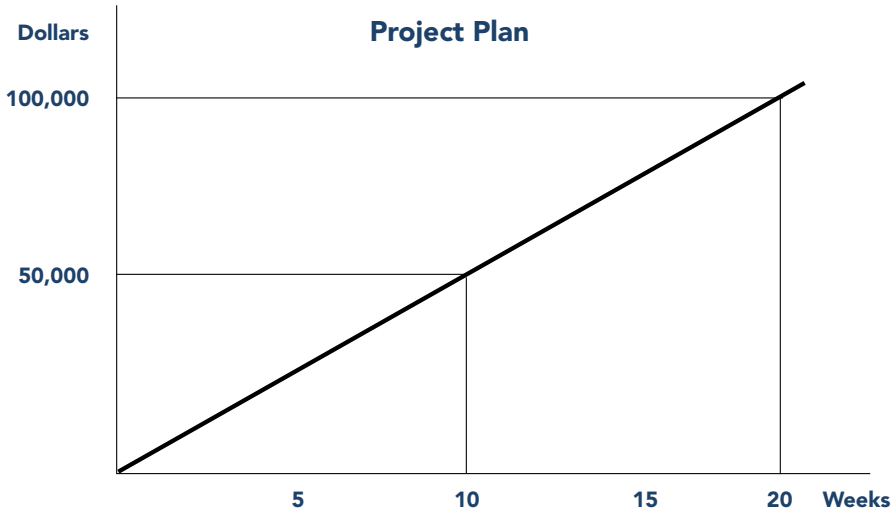
For example,

Project Total cost was $100,000

Project planned to take 20 weeks

Then a simple cost graph could be produced with the vertical axis calibrated in dollars and the horizontal axis calibrated in weeks.

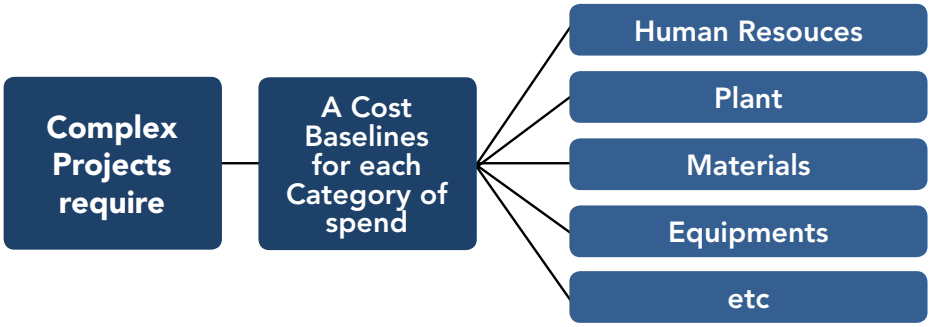
You could produce a simple cost graph by assuming that the planned cost per day was linear, that is as a straight line coming from the origin to a point that is aligned to $100,000 on the vertical axis and 20 weeks on the horizontal axis as shown:



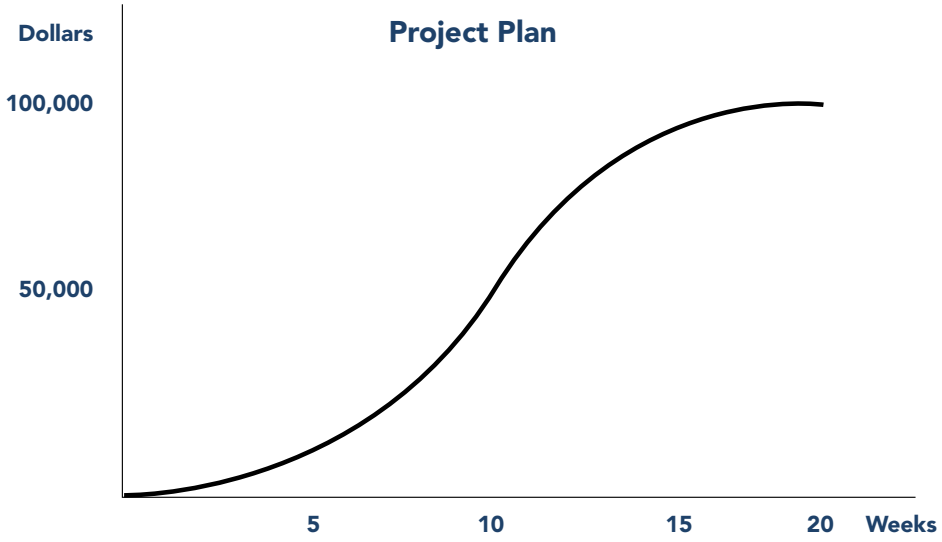
We have just created the cost performance baseline for that project as it takes the estimated project expenditures and aligns them with dates on the calendar. This allows the

organization to plan for cash flow and to make suitable arrangements in advance so that the funds are available when needed and not before.

This might be accurate enough for a very simple project where both the labor and material costs were fairly constant from day-to-day. But for projects with any degree of complexity it is necessary to produce separate cost baselines for different categories of expenditure, such as human resources at different labor rates, plant, materials and other equipment.



For this reason the cost performance baseline may consist of several sub-baselines, which can be aggregated to produce totals. In most projects the rate of expenditure is not linear but follows an 'S' shaped curve as shown.



The reason for this is that the rate of spent at the beginning and end of the project is typically lower than that during the execution phase.

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7.3.3.2 Project Funding Requirements

These are derived from the cost baseline described above and need to reflect the cash-flow needs of the project including management reserves and contingencies. They are an important output, because they may require the project schedule to be adjusted to the necessities of the periodic project funding requirements.

7.3.3.3 Project Document Updates

These include the activity cost estimates, risk register and project schedule.

7.4 Control Costs

This is the process of monitoring the status of the project to update the project budget and managing changes to the cost baseline. It involves taking the cost baseline and performance data about what has actually been done in order to determine the work accomplished against the amount spent.

Monitoring the expenditure of funds without regard to the value of work being accomplished for such expenditures has little value to the project other than to allow the project team to stay within the authorized funding. The key to effective cost control is the management of the approved cost performance baseline and the changes to that baseline.

For those projects that are funded at various stages during the project, funding requirements will need to be taken into account so that the project doesn't get to the point that funding is temporarily unavailable.

The inputs, tools and techniques, and outputs of this process are described below.

Inputs	Tools & Techniques	Outputs
Project Management Plan	Earned Value Management	Work Performance Information
Project Funding Requirements	Forecasting	Cost Forecasts
Work Performance Information	To-complete Performance Index (TCPI)	Change Requests
Organizational Process Assets	Performance Reviews	Project Management Plan Updates
	Project Management Software	Project Document Updates
	Reserve Analysis	Organizational Process Assets Updates

7.4.1 Control Costs: Inputs

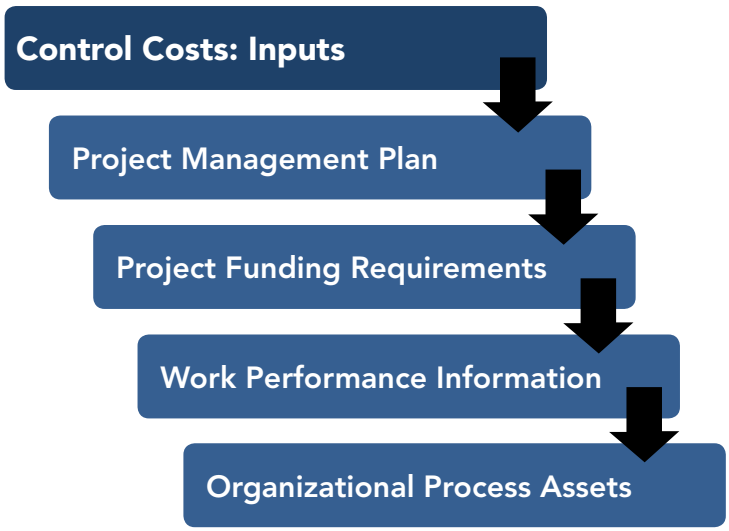
This process requires the following inputs:

7.4.1.1 Project Management Plan

The project management plan described above contains the cost performance baseline, which can be compared with actual results to determine if a change, corrective action or preventive action is necessary. It also contains the cost management plan that describes how the project costs will be managed and controlled.

7.4.1.2 Project Funding Requirements

As described in the previous process '7.2 Determine Budget', these are derived from the cost baseline described above and need to reflect the cash-flow needs of the project including management reserves and contingencies.



7.4.1.3 Work Performance Information

This includes information about project progress and also includes costs that have been authorized and incurred, and estimates for completing project work.

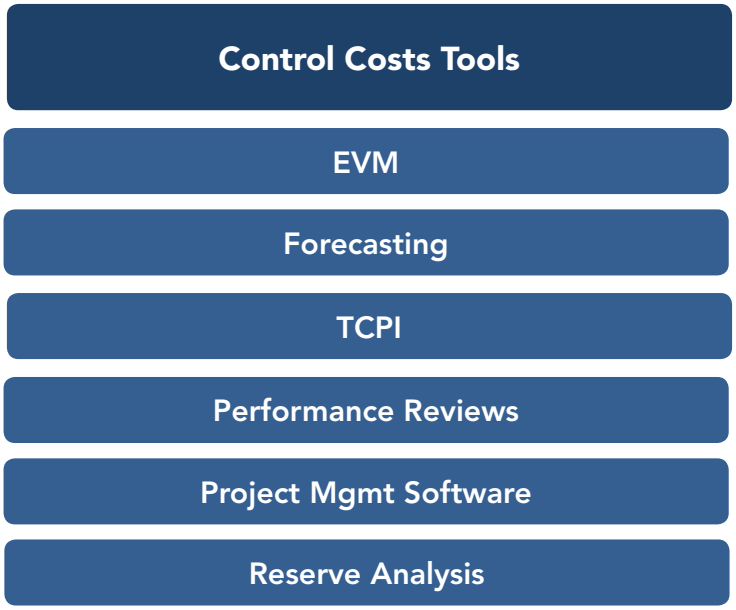
7.4.1.4 Organizational Process Assets

These include existing formal and informal cost control-related policies, procedures and guidelines, cost control tools and the monitoring and reporting methods to be used.

7.4.2 Control Costs: Tools and Techniques

Earned value management (EVM), forecasting, the TCPI (To-Complete Performance Index), and performance reviews are the main techniques used, along with the project management software. Earned value management takes a snapshot of the present moment to see how the project is doing.

The techniques of forecasting and TCPI shows how the future of the project will evolve given how the project is doing now. The performance reviews compare the past performance with the present performance to see how the project has evolved up until the present moment.



Reserve analysis takes into account the "extra layers" on top of the cost estimates, the contingency reserves (which are added to the cost estimates to get the cost baseline) and the management reserves (which are added to the cost baseline to get the project budget).

It should be decided whether any unused reserves are going to be left in the project budget, or whether they will be taken out.

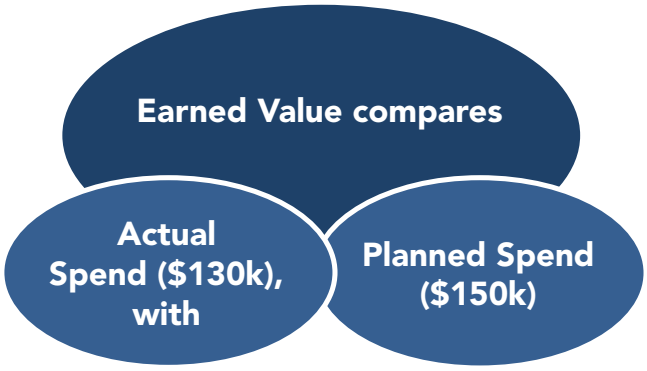
7.4.2.1 Earned Value Management (EVM)

This is described by the PMBOK® as a key technique used to determine the current status of a project in terms of time and money. It is defined as follows:

> ***'Earned value management (EVM) is a methodology that combines scope, schedule, and resource measurements to assess project performance and progress.***
>
> ***It is a commonly used method of performance measurement for projects. It integrates the scope baseline with the cost baseline, along with the schedule baseline, to form the performance baseline, which helps the project management team assess and measure project performance and progress.***
>
> ***It is a project management technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project.'***

The PMBOK® is very keen on EVM but in reality not every organization uses it. Even if yours does not, it is still worth taking the time to understand it because it can help you to determine for yourself how a project is progressing in circumstances where you need to provide objective figures to your senior management or other stakeholders.

EVM is described in detail in the Earned Value Management Checklist, which can be downloaded free from www.free-management-ebooks.com



The earned value compares the money spent ($130k) with what should have been spent ($150k). This means that:

Work to the notional value of $140k has been done but,

$130k has actually been spent.

Therefore, the project is $10k under its planned cost at this point.

Also the project has only completed $140k of work as opposed to the $150k that was planned.

This means that the project is $10k behind schedule.

It may seem strange to express time in dollars but the reason it makes sense is because 'time is money'.

7.4.2.2 Forecasting

As the project progresses, the project team can develop a forecast for the estimate at completion that may differ from the budget at completion based on the project performance. Earned Value Management method works well in conjunction with manual forecasts of the required estimate at completion costs. The most common approach is a manual, bottom-up summation by the project manager and project team.

7.4.2.3 To-complete Performance Index (TCPI)

This is an earned value term which describes the performance needed for you to achieve your earned value targets, and hence to control cost.

7.4.2.4 Performance Reviews

These compare cost performance over time, schedule activities or work packages overrunning and under running the budget, and estimated funds needed to complete work in progress. They are used to determine those areas where costs are under or over performing, and yet again uses earned value management to compare actual results with the cost baseline and hence the ability to be able to control cost via forecast trends and indexes.

7.4.2.5 Project Management Software

Project management software is often used to help with Earned Value Management, to display graphical trends, and to forecast a range of possible final project results.

7.4.2.6 Reserve Analysis

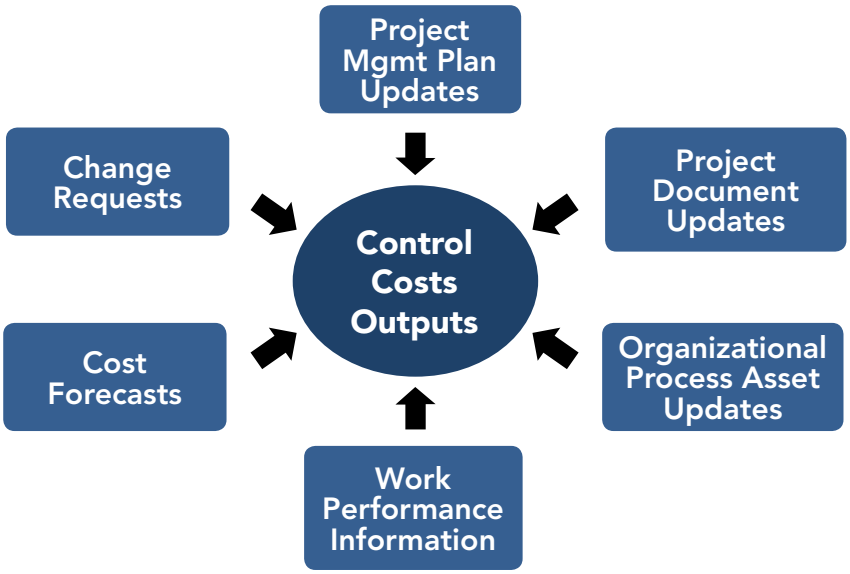
Monitors the status of contingency reserves and management reserves. Unused contingency reserves for probable risk events that do not occur may be removed from the project budget.

7.4.3 Control Costs: Outputs

This process will create the following outputs:

7.4.3.1 Work Performance Information

It is important to capture all of the relevant costs when measuring progress. This information should be communicated to the project team and concerned stakeholders on a regular basis.



7.4.3.2 Cost Forecasts

These determine the extra funding that will be required based on the actual costs accrued so far. Earned Value can help forecast not just remaining costs but also the required total cost for the project. This information should be communicated to the project team and concerned stakeholders on a regular basis.

7.4.3.3 Change Requests

These refer to cost related change requests of course, may be needed if the control cost process shows that the project will be costing more or less than the cost baseline. In this case it changes will be needed to bring the project back on track.

7.4.3.4 Project Management Plan Updates

This relates to any changes such as those to the cost baseline or the cost management plan. It may also relate to other aspects of the project management plan for example a modification to project scope.

7.4.3.5 Project Document Updates

These include cost estimates and are normally needed as a consequence of project plan updates.

7.4.3.6 Organizational Process Assets Updates

These include, causes of variances, corrective action chosen and other types of lessons learned from project cost control in order to improve control cost management in future projects.

If either the Work Performance Information or the Cost Forecasts indicate that there is a variance in either the cost or schedule performance of the project that needs correcting, then a change request may be recommended.

> ***Corrective action aims to reduce the variance***
>
> ***Preventive action aims to prevent the variance from growing larger in the future.***

It may happen, however, that the variance is so large that the cost baseline is determined to be unrealistic, in which case it may be suggested that the cost baseline itself is changed.

In any case, these change requests are outputs of this process, but then are inputs to the process in the Integration Management Knowledge area called process 4.5, Perform Integrated Change Control.

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Summary

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

Cost Management procedures are used to create a budget, and to monitor performance relative to that budget. Effective monitoring requires a focus on the actual and forecast consumption of elements such as people's time, materials, equipment, facilities, etc. There are four processes in this knowledge area.

7.1 Plan Cost Management

This process establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs. The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.

7.2 Estimate Costs

This step involves estimating the costs of each activity in the project. Costs include both human resource and physical resource costs. Because this step often occurs in the planning phase, it is important to understand that the estimated costs are your "best guesses" at the actual costs of each activity.

To get a good guess at the costs you can use one of the following techniques:

- **Analogous Estimating:** estimates are based on past projects. It uses actual costs from a similar finished project to estimate the costs of the new project. The accuracy of these estimates will depend on the similarities between the new project and the old project.
- **Parametric Modeling:** estimates are based on mathematical formulas, typically following a Regression Analysis or Learning Curve model. The accuracy of these estimates depends on the assumptions made.
- **Bottom-up Estimating:** estimates are based on individual work item cost and duration estimates. This involves estimating the smallest activities and then adding them up to create an estimate for the whole project.

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7.3 Determine Budget

Using your best-guess estimates, the next step is to create a realistic project budget. In this step, you will determine the cost baseline and the funding requirements for the project. A good project budget will help you make key decisions with respect to the project schedule and resource allocation constraints.

To determine the project budget, the PMBOK® suggests using several techniques:

- **Cost Aggregation:** requires you to aggregate or combine costs from an activity level to a work package level. The final sum of the cost estimates is applied to the cost baseline.
- **Reserve Analysis:** requires you to create a buffer or reserve to protect against cost overruns. The degree of protection should be equivalent to the risk foreseen in the project. The buffer is part of the project budget, but not included in the project baseline.
- **Historical Data:** requires you to think about estimates from closed projects to determine the budget of the new project. This is very similar to analogous estimation described earlier.
- **Funding Limit Reconciliation:** requires you to adhere to the constraints imposed by the funding limit. The funding limit is based on the limited amount of cash dedicated to your project. To avoid large variations in the expenditure of project funds, you may need to revise the project schedule or the use of project resources.

7.4 Control Costs

Good project managers will carefully monitor the cost of their projects. This includes watching to see where actual cost has varied from estimated cost. Cost control also involves informing the stakeholders of cost discrepancies that vary too much from the budgeted cost.

To effectively control project costs, you will need to regularly monitor and measure the performance of the budget and revise forecasts as required. The PMBOK® suggests several tools and techniques to help control costs:

- **Earned Value Management (EVM):** uses a set of formulas to help measure the progress of a project against the plan.

- **Forecasting:** uses the current financial situation to project future costs. The forecast is based on budgeted cost, total estimated cost, cost commitments, cost to date, and any over or under budgeted costs.
- **To-Complete Performance Index (TCPI):** represents the level of project performance that future work needs to be implemented to meet the budget.
- **Variance Analysis:** involves analyzing the difference or variance between the budgeted costs and the actual costs to indicate whether the project is on budget.
- **Performance Reviews:** used to check the health of a project. Includes an analysis of project costs, schedule, scope, quality, and team morale.

The other project management eBooks in this skill set are available from http://www.free-management-ebooks.com/skills-project.htm:

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