

Project Cost Management



Information Technology
PROJECT MANAGEMENT | 7e

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SCOPE • SCHEDULE • COST • QUALITY • RISK • COMMUNICATIONS • PROCUREMENT • INTEGRATION • HUMAN RESOURCES • INFORMATION TECHNOLOGY • LEGAL & CONTRACTS • PROJECT CLOSURE

What is Cost and Project Cost Management?

- **Cost** is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange.
- Costs are usually measured in monetary units like dollars, Rupees..Etc..
- **Project cost management** includes the processes required to ensure that the project is completed within an approved budget.

Project Cost Management Processes

- **Planning cost management** :determining the policies, procedures, and documentation that will be used for planning, executing, and controlling project cost.
- **Estimating costs**: developing an approximation or estimate of the costs of the resources needed to complete a project
- **Determining the budget**: allocating the overall cost estimate to individual work items to establish a baseline for measuring performance
- **Controlling costs**: controlling changes to the project budget

Figure 7-1. Project Cost Management Summary

Planning

Process: **Plan cost management**

Outputs: Cost management plan

Process: **Estimate costs**

Inputs: Activity cost estimates, resource requirements, project documents, project management plan updates

Process: **Determine budget**

Outputs: Cost baseline, project funding requirements, project documents updates

Monitoring and Controlling

Process: **Control costs**

Outputs: Work performance information, cost performance reports, project management plan updates, organizational process assets updates

Project Finish

Project Start

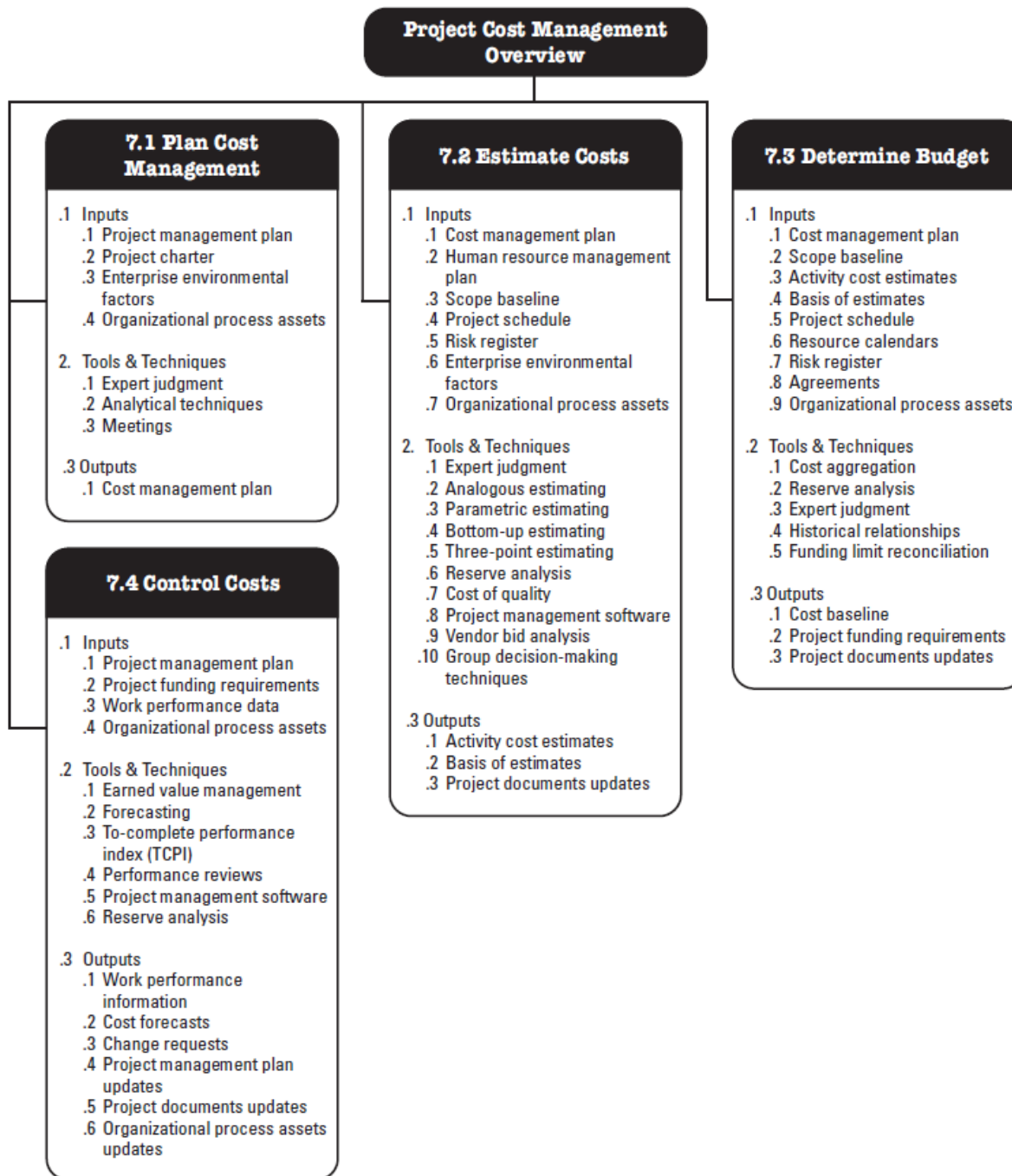


Figure 7-1. Project Cost Management Overview

Introducing the cost management processes

To make sure that they don't go over budget, Jeff, Charles, and Alice sit down and come up with detailed estimates of their costs. Once they have that, they add up the cost estimates into a budget and then they track the project according to that budget while the work is happening.



Estimate Costs process

This means figuring out exactly how much you expect each work activity you are doing to cost. So each activity is estimated for its time and materials cost, and any other known factors that can be figured in.

You need to have a good idea of the work you're going to do and how long it will take to do that work.



Determine Budget process

Here's where all of the estimates are added up and baselined. Once you have figured out the baseline, that's what all future expenditures are compared to.

This is just like the scope baseline from Chapter 5 or the schedule baseline from Chapter 6.



Control Costs process

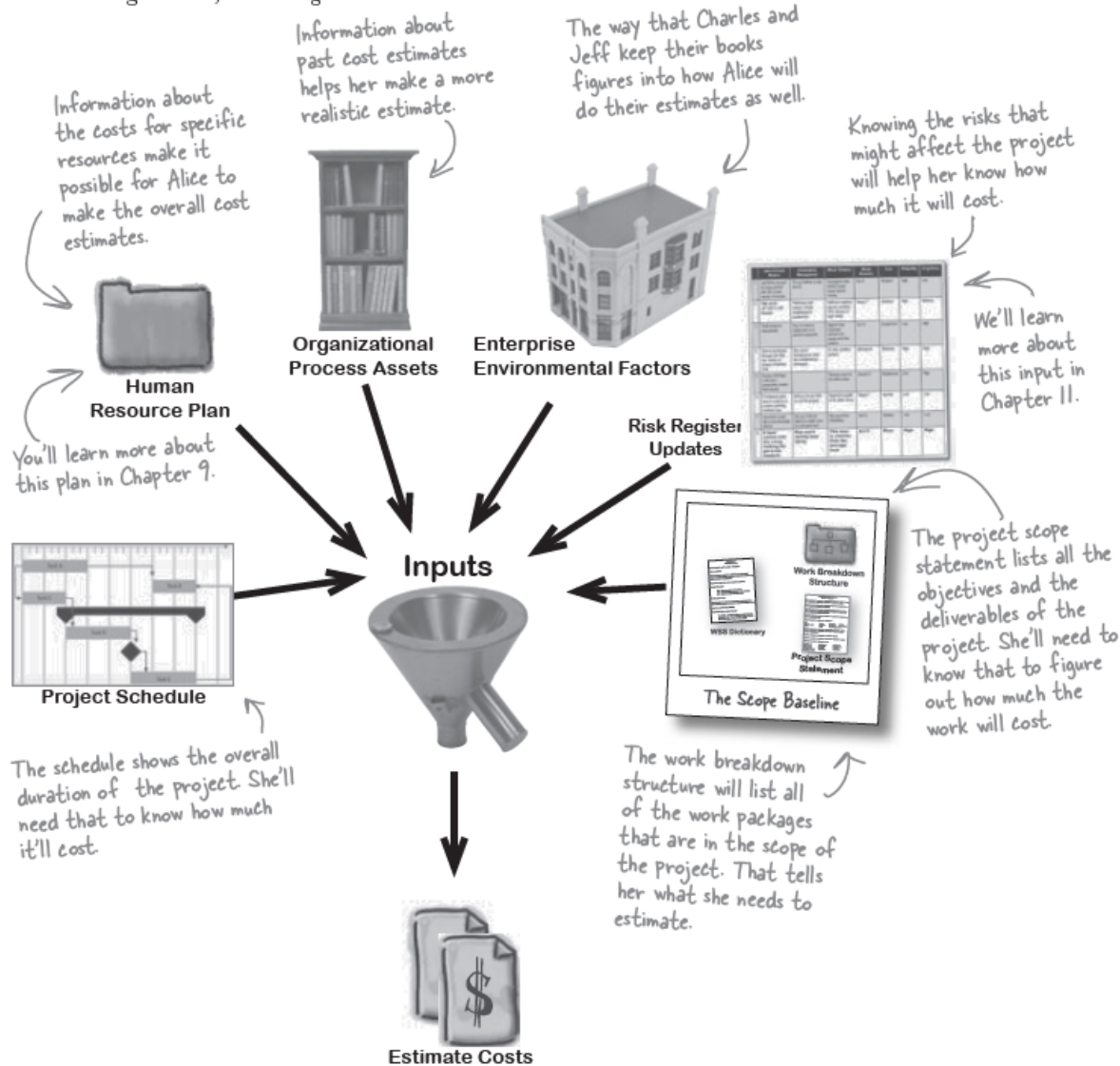
This just means tracking the actual work according to the budget to see if any adjustments need to be made.

Controlling costs means always knowing how you are doing compared to how you thought you would do.

What Alice needs before she can Estimate Costs



Alice wants to keep the Lounge project's costs under control, and that starts with the **Estimate Costs** process. Before Alice can estimate costs, she needs the scope baseline. Once she knows who's doing what work, and how long it'll take, she can figure out how much it will cost.



A. Bottom-Up Estimating

B. Analogous Estimating

C. Expert Judgment

1. The Starbuzz across the street opened just a few months ago. Alice sits down with the contractor who did the work there and asks him to help her figure out how much it will cost. He takes a look at the equipment Charles and Jeff want to buy and the specs for the cabinets and seating and tells her what she can afford to do with the budget she has.

Tool:

2. Alice creates a spreadsheet with all of the historical information from similar remodeling projects that have happened on her block. She sits down and types in the guys' desired furnishings and the square footage of the room to generate an estimated cost.

Tool:

3. Before Alice finishes her schedule, she gathers all of the information she has about previous projects' costs (like how much labor and materials cost). She also talks to a contractor, who gives valuable input.

Tool:

D. Parametric Estimating

E. Three-Point Estimates

4. Alice sits down and estimates each and every activity and resource that she is going to need. Then she adds up all of the estimates into "rolled-up" categories. From there she adds up the categories into an overall budget number.

Tool:

5. Jeff sets up an appointment with the same contractor his friend used for some remodelling work. The contractor comes to the house, takes a look at the room, and then gives an estimate for the work.

Tool:

6. Alice figures out a best case scenario, a likely scenerio and a worst case scenario. Then she used a formula to come up with an expected cost for the project.

Tool:



Sharpen your pencil Solution

Did you work out which estimating tool from Time Management Alice is using when she estimates costs in each of these scenarios?

1: B. Analogous Estimating.

Since Alice is using the contractor's experience with a similar project to figure out how long her project will take, she is assuming that her project will go like the Starbuzz one did.

2: D. Parametric Estimating.

In this one Alice is just applying some numbers particular to her project to some historical information she has gathered from other projects and generating an estimate from that.

3: C. Expert Judgment.

Expert judgment often involves going back to historical information about past projects as well as consulting with experts or using your own expertise.

4: A. Bottom-Up Estimating.

Starting at the lowest level and rolling up estimates is bottom-up estimating. Alice started with the activities on her schedule and rolled them up to categories and finally to a budget number.

5: B. Analogous Estimating.

This is another example of asking somebody who has direct experience with this kind of work to give an estimate.

6: E. Three-Point Estimates

Alice came up with the three estimates and then performed the PERT calculation on them.

Other tools and techniques used in Estimate Costs

A lot of times you come into a project and there is already an expectation of how much it will cost or how much time it will take. When you make an estimate really early in the project and you don't know much about it, that estimate is called a **Rough Order of Magnitude** estimate. (You'll also see it called a **ROM**, or a **ballpark estimate**.) It's expected that it will get more refined as time goes on and you learn more about the project. Here are some more tools and techniques used to estimate cost:

This estimate is *REALLY* rough! It's got a range of -50% to +50%, which means it can be anywhere from half to one and a half times the actual cost! So you only use it at the very beginning of the project.



Project Management Estimating Software

Project managers will often use specialized estimating software to help come up with cost estimates (like a spreadsheet that takes resource estimates, labor costs, and materials costs and performs calculations).



Vendor Bid Analysis

Sometimes you will need to work with an external contractor to get your project done. You might even have more than one contractor bid on the job. This tool is all about evaluating those bids and choosing the one you will go with.

You'll see this in action when we look at risk management in Chapter 11.



Reserve Analysis

You need to set aside some money for cost overruns. If you know that your project has a risk of something expensive happening, better to have some cash laying around to deal with it. Reserve analysis means putting some cash away just in case.

Cost of Quality

You will need to figure the cost of all of your quality-related activities into the overall budget, too. Since it's cheaper to find bugs earlier in the project than later, there are always quality costs associated with everything your project produces. Cost of Quality is just a way of tracking the cost of those activities.

Since the next chapter is all about quality, you'll be learning a lot about this in Chapter 8.

Cost of Quality is how much money it takes to do the project right.

Now Alice knows how much the Lounge will cost

Once you've applied all of the tools in this process, you'll get an estimate for how much your project will cost. It's always important to keep all of your supporting estimate information, too. That way, you know the assumptions you made when you were coming up with your numbers.

Estimate Cost Outputs

Outputs



Activity Cost Estimates

This is the cost estimate for all of the activities in your activity list. It takes into account resource rates and estimated duration of the activities.



Activity Cost Estimates

Basis of Cost Estimates

Just like the WBS has a WBS Dictionary, and the Activity List has Activity Attributes, the cost estimate has supporting detail called the **Basis of Cost Estimates**. Here is where you list out all of the rates and reasoning you have used to come to the numbers you are presenting in your estimates.



Basis of Cost Est

Updates to Project Documents

Along the way, you might find that you need to change the way you measure and manage cost. These updates allow you to make changes to the Project Management Plan to deal with those improvements.



Project Up

Requested changes

As you figure out how much the activities will cost, you may realize that the scope or schedule or risk register or anything else you have baselined needs to change. When that happens, you need to create a change request and send it through the change control system.



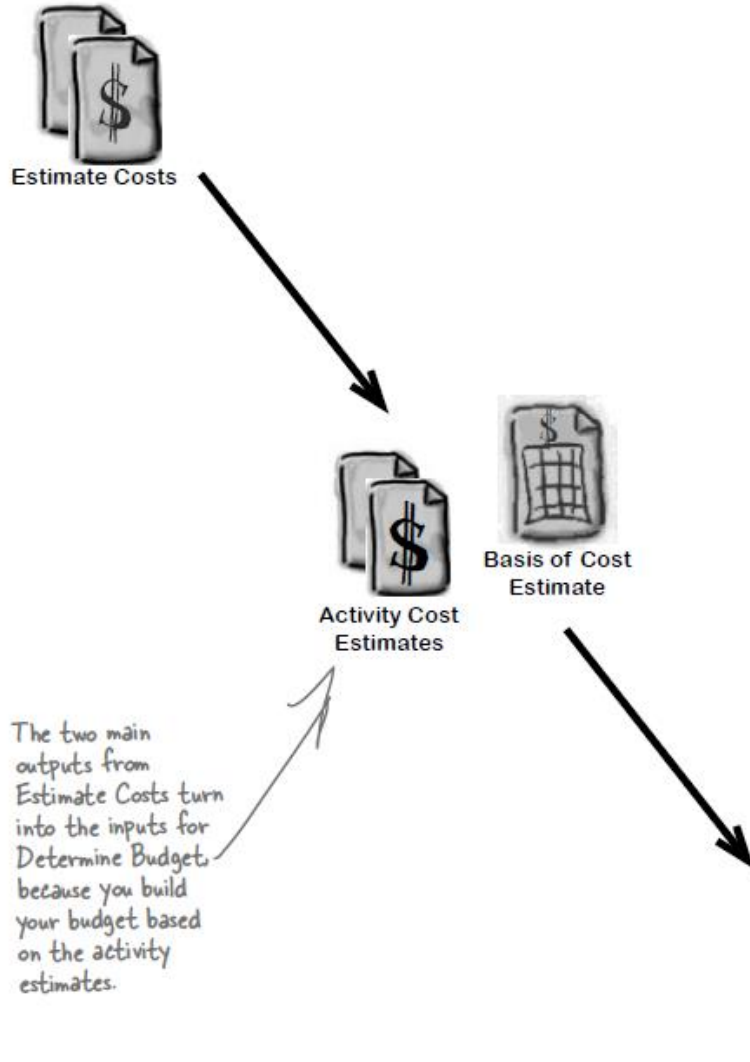
Change Request

Supporting detail for activity cost estimates may include:

- Documentation of the basis of the estimate (i.e., how it was developed),
- Documentation of all assumptions made,
- Documentation of any known constraints,
- Indication of the range of possible estimates (e.g., €10,000 (±10%) to indicate that the item is expected to cost between a range of values), and
- Indication of the confidence level of the final estimate.

The Determine Budget process

Once Alice has cost estimates for each activity, she's ready to put a budget together. She does that using the **Determine Budget** process. Here's where you take the estimates that you came up with and build a budget out of them. You'll build on the Activity Cost Estimates and Basis of Cost Estimate that you came up with in Estimate Costs.



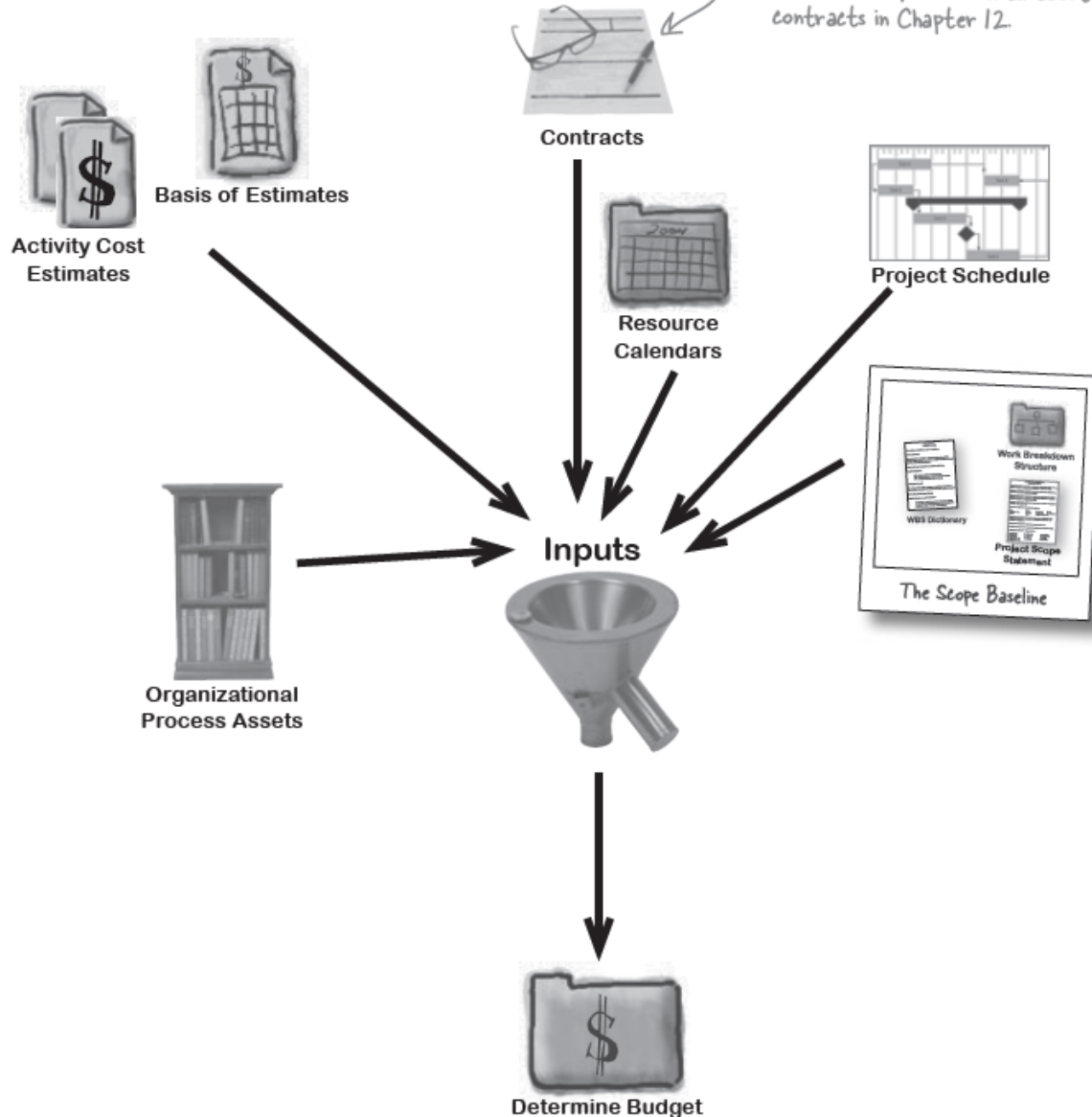
You use the outputs from the last process where you created estimates as inputs to this one. Now you can build your budget.

Determine Budget
Input

What you need to build your budget

The **inputs** to Determine Budget are largely the same ones that you saw in Estimate Costs, with the notable additions of Activity Cost Estimates and Basis of Cost Estimate.

If you're doing work that's been contracted, then your contract will have information (like fees or rates) that you'll need to take into account. You'll learn all about contracts in Chapter 12.

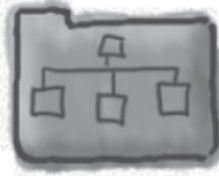


Determine budget: how to build a budget



1 Roll up your estimates into control accounts

This tool is called **cost aggregation**. You take your activity estimates and roll them up into control accounts on your Work Breakdown Structure. That makes it easy for you to know what each work package in your project is going to cost.



Outputs



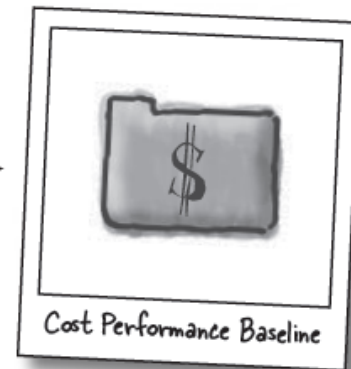
2 Come up with your reserves

When you evaluate the risks to your project, you will set aside some cash reserves to deal with any issues that might come your way.



5 Build a baseline

Just like your scope and schedule baselines, a **Cost Performance Baseline** is a snapshot of the planned budget. You compare your actual performance against the baseline so you always know how you are doing versus what you planned.



Your company's management plans for project overruns!

Just because you plan out a budget in your Cost Performance Baseline, that doesn't mean your project is 100% guaranteed to fall inside that budget. It's common for a company to have a standard policy for keeping a **management reserve** to cover unexpected, unplanned costs. When you need to get your project funded, that funding has to cover both the budget in your Cost Performance Baseline *and* the management reserve.

3 Use your expert judgment

Here's where you compare your project to historical data that has been collected on other projects to give your budget some grounding in real-world experience, and you use your own expertise and the expertise of others to come up with a realistic budget to cover your project's costs.



It's true that not everybody has access to historical data to do a check like this. But, for the purposes of the test, you need to know that it's a tool for making your budget accurate.

4 Make sure you haven't blown your limits

This tool is **Funding Limit Reconciliation**. Since most people work in companies that aren't willing to throw unlimited money at a project, you need to be sure that you can do the project within the amount that your company is willing to spend.

If you blow your limit, you need to replan or go to your sponsor to figure out what to do. It could be that a scope change is necessary, or the funding limit can be increased.

6 Figure out funding requirements

It's not enough to have an overall number that everyone can agree to. You need to plan out how and when you will spend it, and document those plans in the **project funding requirements**. This output is about figuring out how you will make sure your project has money when it's needed, and that you have enough to cover unexpected risks as well as known cost increases that change with time.



So these requirements need to cover both the budget and the management reserve.

7 Update your project documents

Once you have estimated and produced your baseline and funding requirements, you need to update your cost management plan with anything you learned along the way.





What tool or technique is Alice using to build the budget?

1. Alice reads a newspaper article that says that there has been a sharp increase in lumber costs recently. She knows this wasn't in her contractor's original plan and decides to put a few hundred dollars aside to deal with the price hike if it should happen.

- Parametric estimating Reserve Analysis Cost aggregation Funding Limit Reconciliation

2. Jeff helps Alice add up all of the estimates they have done into control accounts so that they can figure out how much the stereo installation is going to cost versus the entertainment center building.

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3. Once the budget is close to done, Alice looks over their financial plans for the year to be sure that they can afford everything at the time that it is needed.

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Answers: 1. Reserve Analysis 2. Cost aggregation 3. Funding Limit Reconciliation



BULLET POINTS: AIMING FOR THE EXAM

- **Parametric Estimation** is used in Estimate Costs and Determine Budget.
- **Cost Aggregation** is rolling up costs from the work package level to the control account level so that the numbers can be followed down through the WBS hierarchy.
- **Control Accounts** are high-level WBS items that are used to track cost estimates. They do not represent activities or work packages. They represent the cost of the work packages and activities that appear under them in the WBS.
- The main output of Estimate Costs is the Activity Cost Estimate and the Basis of Cost Estimate. The main output of Determine Budget is the Cost Performance Baseline and Project Funding Requirements.
- You will get questions on the exam asking you to select between projects using **Net Present Value (NPV)** or **Benefit Cost Ratio (BCR)**. Always choose the project with the biggest NPV or BCR!
- **Lifecycle Costing** means estimating the money it will take to support your product or service when it has been released.
- **Rough Order of Magnitude Estimation** is estimating with very little accuracy at the beginning of a project and then refining the estimate over time. It's got a range of -50% to +50%.
- A **Management Reserve** is money set aside to cover unplanned, unexpected costs. Your project's funding requirements need to cover both the budget in the Cost Performance Baseline and the management reserve.

Sharpen your pencil Solution

Using what you already know about the Control Scope and Control Schedule processes, can you take a guess at what each of these inputs will be used for?

Control Budget Inputs



Cost Performance Baseline

The cost performance baseline is what you compare all of your actual performance information to. This is the amount you budgeted for. Any changes that need to be made to the budget need to be made to this baseline.



Project funding requirements

On top of the baseline cost, you have added some reserves to deal with known risks. You've also spread your budget out, so that you always have money when you need it. Changes to your project might also mean changes to your funding requirements.



Cost Management Plan

You may find that you need to change the PM Plan and its cost management sub-plan as a result of information coming from your project. So, you'll need to evaluate your work performance information in relation to it.



Work Performance Information

This is the actual data being generated by your project. It tells how are you spending your budget right now. You'll need this information to figure out if you need to make any changes to stay on track.



Performance reports

Like the work performance information, performance reports give actual information on how your project is doing. You will use them to figure out whether or not you need to change your budget to deal with issues that have come up.

A few new tools and techniques

The tools in Control Costs are all about helping you figure out where to make changes so you don't overrun your budget.

Tools

Earned Value Management

Here's where you measure how your project is doing compared to the plan. This involves using the earned value formulas to assess your project.

You'll learn more about the formulas in just a few pages!

To-Complete Performance Index

The to-complete performance index (TCPI) is a calculation that you can use to help you figure out how well your project needs to perform in the future in order to stay on budget.

You'll learn more about TCPI, too!

Performance Reviews

Reviews are meetings where the project team reviews performance data to examine the variance between actual performance and the baseline. Earned value management is used to calculate and track the variance. Over time, these meetings are a good place to look into trends in the data.

Forecasting

Use the information you have about the project right now to predict how close it will come to its goals if it keeps going the way it has been. Forecasting uses some earned value numbers to help you come up with preventative and corrective actions that can keep your project on the right track.

Project Management Software

You can use software packages to track your budget and make it easier to know where you might run into trouble.

Variance Analysis

Throughout your project, you are looking at how you are doing as compared to your plan. The variance between planned and actual performance needs to be carefully analyzed so you can head off problems before they make your project go over budget.

Forecasting and performance measurement are very important! You use them to find the changes you need to make in your project.

Earned Value Management

Look at the schedule to figure out your budget

The tools in Control Costs are all about helping you figure out where to make changes so you don't overrun your budget.



• \$10,000

Budget at completion (BAC)

How much money are you planning on spending on your project? Once you add up all of the costs for every activity and resource, you'll get a final number... and that's the total project budget. If you only have a certain amount of money to spend, you'd better make sure that you haven't gone over!

How to calculate Planned Value

you can figure out the project's planned value.

If you look at your schedule and see that you're **supposed to have done** a certain percentage of the work, then that's the percent of the total budget that you've "earned" so far. This value is known as Planned Value. Here's how you calculate it.

1 First, write down your

BAC—Budget At Completion

This is the *first number you think of* when you work on your project costs. It's the **total budget** that you have for your project—how much you plan to spend on your project.

BAC x

The name "BAC" should make sense—it's the budget of your project when it's complete!

2 Then multiply that by your

Planned % Complete

If the schedule says that your team should have done 300 hours of work so far, and they will work a total of 1,000 hours on the project, then your Planned % Complete is 30%.

BAC x Planned % Complete

Planned % Complete is easy to work out, as it's just the calculation $\frac{\text{Given amount}}{\text{Total amount}}$.

3 The resulting number is your

PV—Planned Value

This is how much of your budget you planned on using so far. If the BAC is \$200,000, and the schedule says your Planned % Complete is 30%, then the Planned Value is $\$200,000 \times 30\% = \$60,000$.

BAC x Planned % Complete = PV

BAC x Planned % Complete = PV

PV = BAC x Planned % Complete

You may also see the Planned Value formula flipped around and written with the PV out front, but it's exactly the same formula.



Sharpen your pencil

Now it's your turn! See if you can figure out BAC and PV for a typical project.

1. You're managing a project to install 200 windows in a new skyscraper and need to figure out your budget. Each week of the project costs the same: your team members are paid a total of \$4,000 every week, and you need \$1,000 worth of parts each week to do the work. If the project is scheduled to last 16 weeks, what's the BAC for the project?

BAC =

Even though we are at the beginning of the project now, we can still figure out what the PV will be in four weeks.

2. What will the Planned % Complete be four weeks into the project?

Planned % Complete =

This is the part that takes some thinking. How do you know what % you are through the project?

3. What should the PV be four weeks into the project?

PV = x =

.....

How to calculate Earned Value

If you could estimate each activity exactly, every single time, you wouldn't need Earned Value. Your schedule would always be perfectly accurate, and you would always be exactly on budget.

But you know that real projects don't really work that way! That's why Earned Value is so useful—it helps you put a number on how far off track your project actually is. And that can be a really powerful tool for evaluating your progress and reporting your results. Here's how you calculate it.

When you do work, you convert the money your sponsor invests in your project into value. So, **Earned Value** is about **how much work you have been able to accomplish with the money you've been given**. When you calculate Earned Value, you're showing your sponsor how much value that investment has earned.

- 1 **First, write down your**

BAC—Budget At Completion

Remember, this is the **total budget** that you have for your project.

- 2 **Then multiply that by your**

Actual % Complete

Say the schedule says that your team should have done 300 hours of work so far, out of a total of 1,000. But you talk to your team and find out they actually completed 35% of the work. That means the actual % complete is 35%.

- 3 **The resulting number is your**

EV—Earned Value

This figure tells you how much your project *actually* earned. Every hour that each team member works adds value to the project. You can figure it out by taking the percentage of the hours that the team has actually worked and multiplying it by the BAC. If the total cost of the project is \$200,000, then the Earned Value is $\$200,000 \times 35\% = \$70,000$.

$$\text{BAC} \times$$

$$\text{BAC} \times \text{Actual \% Complete}$$

If your team actually got 35% of the work done when the schedule says they should only have gotten 30% done, that means they're more efficient than you planned!

$$\text{BAC} \times \text{Actual \% Complete} = \text{EV}$$

Again, you might see the Earned Value formula flipped around and written with the EV out front, but remember, it's exactly the same formula.

$$\text{EV} = \text{BAC} \times \text{Actual \% Complete}$$

Sharpen your pencil



Let's get back to that 16-week project from page 348. In the last exercise you figured out what the project should look like by using planned value. Now you can use Earned Value to figure out if your project is really going the way you planned.

1. Fast forward four weeks into the project installing those 200 skyscraper windows. Fill in the BAC and PV you figured out before. (Check your answer at the top of page 372 to make sure you got it right!)

BAC = PV =

Figure out the actual % complete by dividing the actual work done into the total amount you're planning on

2. You've checked with your team, but they have bad news. The schedule says they were supposed to have installed 50 windows by now, but they only installed 40. Can you figure out the actual % complete?

Actual % Complete = $\frac{\text{.....}}{\text{.....}}$ =
Fill in the number of windows the team's actually installed
Fill in the total number of windows that will be installed over the course of the project.

3. What should the Earned Value be right now?

EV =
Fill in the BAC \times
Fill in the Actual % Complete

4. Look at the planned value, and then look at the Earned Value. Are you delivering all the value you planned on delivering?

Yes No

—————> **Answers on page 372.**



Sharpen your pencil Solution

Let's get back to that 16-week project from page 348.
Can you figure out how to use EV?

1. Fast-forward four weeks into the project installing those 200 skyscraper windows. Fill in the BAC and PV you figured out above. (Check your answer above to make sure you got it right!)

BAC = \$ 80,000

PV = \$ 20,000

2. You've checked with your team, but they have bad news. The schedule says they were supposed to have installed 50 windows by now, but they only installed 40. Can you figure out the actual % complete?

$$\text{Actual \% Complete} = \frac{40}{200} = 20\%$$

← The team installed 40 windows out of a total of 200. That means they're 20% of the way done with the work.

3. What should the Earned Value be right now?

$$\text{EV} = \text{\$ 80,000} \times 20\% = \text{\$ 16,000}$$

4. Look at the planned value, and then look at the Earned Value. Are you delivering all the value you planned on delivering?

Yes

No

← You planned on delivering \$20,000 worth of value, but you've only delivered \$16,000 worth. That means the customer isn't getting all the value he's paying for!

Is your project behind or ahead of schedule?

Figuring out if you're on track in a small project with just a few people is easy. But what if you have dozens or hundreds of people doing lots of different activities? And what if some of them are on track, some are ahead of schedule, and some of them are behind? It starts to get hard to even figure out whether you're meeting your goals.

Wouldn't it be great if there were an easy way to figure out if you're ahead or behind schedule? Well, good news: that's exactly what earned value is used for!

Schedule Performance Index (SPI)

If you want to know whether you're ahead of or behind schedule, use SPIs. The key to using this is that when you're *ahead of schedule*, you've *earned more value* than planned! So **EV will be bigger than PV**.

To work out your SPI, you just divide your EV by your PV.

$$SPI = \frac{EV}{PV}$$

If SPI is greater than one, that means EV is bigger than PV, so you're ahead of schedule!

If SPI is less than one, then you're behind schedule because the amount you've actually worked (EV) is less than what you'd planned (PV).

Schedule Variance (SV)

It's easy to see how variance works. The **bigger the difference** between *what you planned* and *what you actually earned*, the **bigger the variance**.

So, if you want to know how much ahead or behind schedule you are, just subtract PV from EV.

$$SV = EV - PV$$

Remember, for the sponsor's benefit, we measure this in dollars...

... so if the variance is positive, it tells you exactly how many dollars you're ahead. If it's negative, it tells you how many dollars you're behind.

Are you over budget?

You can do the same thing for your budget that you can do for your schedule. The calculations are almost exactly the same, except instead of using Planned Value—which tells you how much work the schedule says you should have done so far—you use **Actual Cost (AC)**. That's the amount of money that you've spent so far on the project.

Remember, EV measures the work that's been done, while AC tells you how much you've spent so far.

Cost Performance Index (CPI)

$$CPI = \frac{EV}{AC}$$

If you want to know whether you're over or under budget, use CPI.

Cost Variance (CV)

This tells you the difference between what you planned on spending and what you actually spent.

So, if you want to know how much under or over budget you are, just take AC away from EV.

$$CV = EV - AC$$

Remember what CV means to the sponsor: EV says how much of the total value of the project has been earned back so far. If CV is negative, then he's not getting good value for his money.

To-Complete Performance Index (TCPI)

This tells you how well your project will need to perform to stay on budget.

$$TCPI = \frac{(BAC - EV)}{(BAC - AC)}$$

We'll talk about this in just a few pages...



Relax

Measuring your cost difference in dollars is easy, but

what if your schedule variance is negative?

A lot of people worry about that, but it's actually not bad. Planned Value just means that you planned on delivering a certain amount of value to your sponsor at a certain time. An SV of, say, -\$5,000, tells you that you haven't delivered all the value you promised.

The Earned Value Management formulas

Earned Value Management (EVM) is just one of the tools and techniques in the Control Costs process, but it's a big part of PMP exam preparation. When you use these formulas, you're measuring and analyzing how far off your project is from your plan. Remember, think of everything in terms of how much value you're delivering to your sponsor! Take a look at the formulas one more time:

Remember, your sponsor always cares most about what the project is worth to him. BAC says how much value he's getting for the whole project, and EV tells him how much of that value he's gotten so far.

Name	Formula	What it says	Why you use it
BAC—Budget at Completion	No formula – it's the project budget	How much money you'll spend on the project	To tell the sponsor the total amount of value that he's getting for the project
PV—Planned Value	$PV = BAC \times \frac{\text{Planned \% Complete}}{100}$	What your schedule says you should have spent	To figure out what value your plan says you should have delivered so far
EV—Earned Value	$EV = BAC \times \frac{\text{Actual \% Complete}}{100}$	How much of the project's value you've really earned	EV lets you translate how much work the team's finished into a dollar value
AC—Actual Cost	What you've actually spent on the project	How much you've actually spent so far	The amount of money you spend doesn't always match the value you get!
SPI—Schedule Performance Index	$SPI = \frac{EV}{PV}$	Whether you're behind or ahead of schedule	To figure out whether you've delivered the value your schedule said you would
SV—Schedule Variance	$SV = EV - PV$	How much ahead or behind schedule you are	This puts a dollar value on exactly how far ahead or behind schedule you are
CPI—Cost Performance Index	$CPI = \frac{EV}{AC}$	Whether you're within your budget or not	Your sponsor is always most interested in the bottom line!
TCPI—To-Complete Performance Index	$TCPI = \frac{BAC - EV}{BAC - AC}$	How well your project must perform to stay on budget.	This will let you forecast whether or not you can stick to your budget.
CV—Cost Variance	$CV = EV - AC$	How much above or below your budget you are	Your sponsor needs to know how much it costs to get him the value you deliver

Interpret CPI and SPI numbers to gauge your project

The whole idea behind the Earned Value Management is that you can use it to easily put a number on how your project is doing. That's why there will be exam questions that test you on your ability to interpret these numbers! Luckily, it's pretty easy to evaluate a project based on the EVM formulas.



If your project is on track, that means you're delivering the value you promised.

You can tell that your project is on track because the two index numbers—CPI and SPI—are both very close to 1, and the variance numbers—CV and SV—are very close to zero dollars. It's very rare that you'll get exactly to a CPI of 1 or a SV of \$0, but a SPI of 1.02 means you're very close to on time, and a CV of -\$26 means you're very close to on budget.

A lot of PMOs have a rule where a CPI or SPI between 0.95 and 1.10 is absolutely fine!

Sometimes you'll see negative values written in parentheses—in this case, (\$26)

If the SPI is below 1, then your project is behind schedule. But if you see a CPI under 1, your project is over budget!



Ahead of schedule or under budget

You can tell if your project is ahead of schedule or under budget by looking for larger numbers.

If the **CPI** is much **bigger than 1**, it means you're **under budget**. And you can tell how much under by looking at the **CV**—that's what variance is for! It helps you see just how much the actual cost **varies** from the value you were supposed to earn by now.

Being a long way under budget isn't always a good thing. It means you asked for and were given resources that you didn't need—and which your company could have used elsewhere.



Behind schedule or over budget

A project that's behind schedule or over budget will have lower numbers.

When you see a **SPI** that's between 0 and 1, that tells you that the project is **behind schedule**... and that means you're not delivering enough value to the sponsor! That's when you check the **SV** to see how much less value you're delivering. And the same goes for cost—a **low CPI** means that your project is **over budget**, and **CV** will tell you how much more value you promised to deliver to the sponsor.

CPI and SPI can't be below zero, because they're ratios!



You'll definitely need to be able to calculate Earned Value numbers for the exam! But remember, like planning that trip way back in Chapter 4, the best way to do that is with practice.

Your project has a total budget of \$300,000. You check your records and find that you've spent \$175,000 so far. The team has completed 40% of the project work, but when you check the schedule it says that they should have completed 50% of the work. Calculate the following:

There were two dollar values given in the problem. Which is AC, and which is BAC?

Now you just need to figure out which numbers that you've already calculated are being divided into one another!

The trick is figuring out which percentage you need to put here!

$BAC = \$ \dots\dots\dots$
 $PV = \$ \dots\dots\dots \times \% = \$ \dots\dots\dots$
 $AC = \$ \dots\dots\dots$
 $EV = \$ \dots\dots\dots \times \% = \$ \dots\dots\dots$
 $SV = \$ \dots\dots\dots - \$ \dots\dots\dots = \$ \dots\dots\dots$
 $CV = \$ \dots\dots\dots - \$ \dots\dots\dots = \$ \dots\dots\dots$
 $SPI = \frac{\$ \dots\dots\dots}{\$ \dots\dots\dots} = \dots\dots\dots$
 $CPI = \frac{\$ \dots\dots\dots}{\$ \dots\dots\dots} = \dots\dots\dots$

You're managing a highway construction project. Your total budget is \$650,000, and there are a total of 7,500 hours of work scheduled on the project. You check with your accounting department, and they tell you that you've spent a total of \$400,000. According to the schedule, your crew should have worked 4,500 hours, but your foreman says that the crew was allowed to work some overtime, and they've actually put in 5,100 hours of work. Calculate these Earned Value numbers:

BAC = PV =
 AC = EV =
 SV = CV =
 SPI = CPI =

Answers on page 374.

Your project has a total budget of \$300,000. You check your records and find that you've spent \$175,000 so far. The team has completed 40% of the project work, but when you check the schedule it says that they should have completed 50% of the work. Calculate the following:

$$BAC = \$ 300,000$$

$$PV = \$ 300,000 \times 50\% = \$ 150,000$$

Planned value uses what's on the schedule, earned value is uses what actually happened.

$$AC = \$ 175,000$$

$$EV = \$ 300,000 \times 40\% = \$ 120,000$$

Did you notice how the formulas for SV and SPI use the same numbers? You subtract for one, and divide for the other!

$$SV = \$ 120,000 - \$ 150,000 = \$ -30,000$$

You may have to round the CPI and SPI numbers. Don't worry - since PMP is multiple choice, you'll see a match!

$$CV = \$ 120,000 - \$ 175,000 = \$ -55,000$$

$$SPI = \frac{\$ 120,000}{\$ 150,000} = 0.8$$

The formulas for CV and CPI use the same numbers, too.

$$CPI = \frac{\$ 120,000}{\$ 175,000} = 0.68$$

You're managing a highway construction project. Your total budget is \$650,000, and there are a total of 7,500 hours of work scheduled on the project. You check with your accounting department, and they tell you that you've spent a total of \$400,000. According to the schedule, your crew should have worked 4,500 hours, but your foreman says that the crew was allowed to work some overtime, and they've actually put in 5,100 hours of work. Calculate these Earned Value numbers:

$$BAC = \$ 650,000$$

4,500 out of a total of 7,500 hours you planned to work:
 $4,500 \div 7,500 = 60\%$

$$PV = \$ 650,000 \times 60\% = \$ 390,000$$

$$AC = \$ 400,000$$

Do the same for actual hours:
 $5,100 \div 7,500 = 68\%$

$$EV = \$ 650,000 \times 68\% = \$ 442,000$$

$$SV = \$ 442,000 - \$ 390,000 = \$ 52,000$$

$$CV = \$ 442,000 - \$ 400,000 = \$ 42,000$$

$$SPI = \frac{\$ 442,000}{\$ 390,000} = 1.13$$

$$CPI = \frac{\$ 442,000}{\$ 400,000} = 1.11$$

Forecast what your project will look like when it's done

There's another piece of the Earned Value Management, and it's part of the last tool and technique in Cost Management: **forecasting**. The idea behind forecasting is that you can use Earned Value to come up with a pretty accurate prediction of what your project will look like when it's at completion.

If you know your CPI now, you can use it to predict what your project will actually cost when it's complete. Let's say that you're managing a project with a CPI of 0.8 today. If you assume that the CPI will be 0.8 for the rest of the project—and that's not an unreasonable assumption when you're far along in the project work—then you can predict your total costs when the project is complete. We call that **Estimate at Completion (EAC)**.

There are a bunch of different ways to calculate EAC, but this one is sufficient for the PMP exam.

If your CPI is below 1, that means you're running over budget—which will give you an EAC that's larger than your current budget.

$$EAC = \frac{BAC}{CPI}$$

If your CPI is above 1, you're running under budget, so the estimate will end up smaller than your BAC.

Once you've got an estimate, you can calculate a variance!

There are two useful numbers that you can compute with the EAC. One of them is called **Estimate to Complete** (ETC), which tells you how much more money you'll probably spend on your project. And the other one, **Variance at Completion** (VAC), predicts what your variance will be when the project is done.

$$ETC = EAC - AC$$

Since EAC predicts how much money you'll spend, if you subtract the AC, you'll find out how much money the rest of the project will end up costing.

$$VAC = BAC - EAC$$

If you end up spending more than your budget, the VAC will be negative... just like CV and SV!

You can use EAC, ETC, and VAC to predict what your Earned Value numbers will look like when your project is complete.