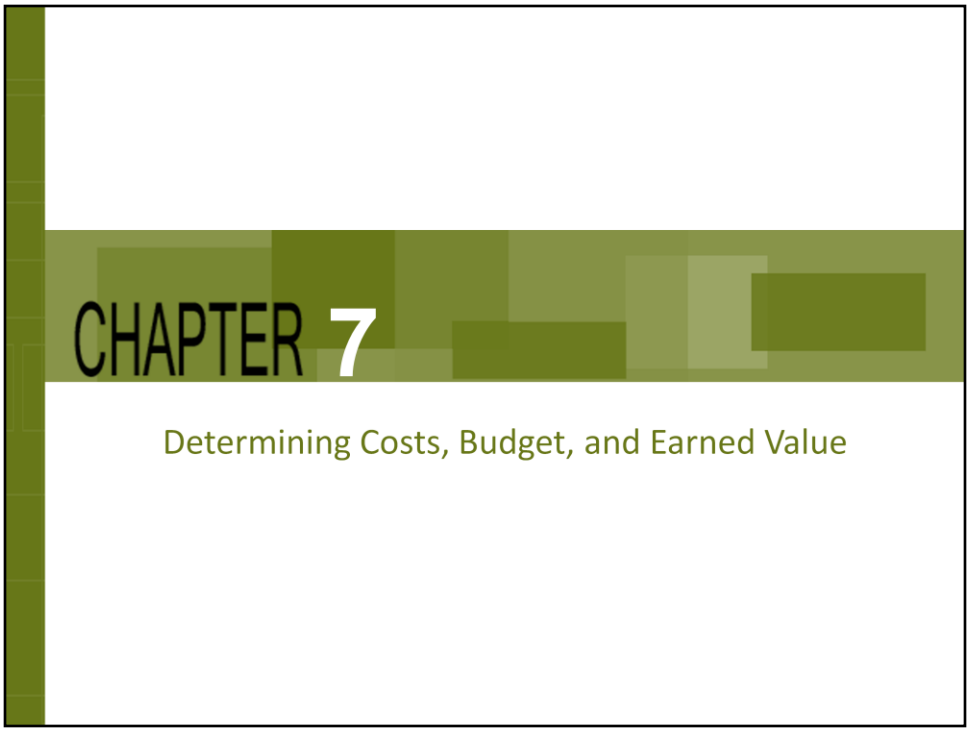


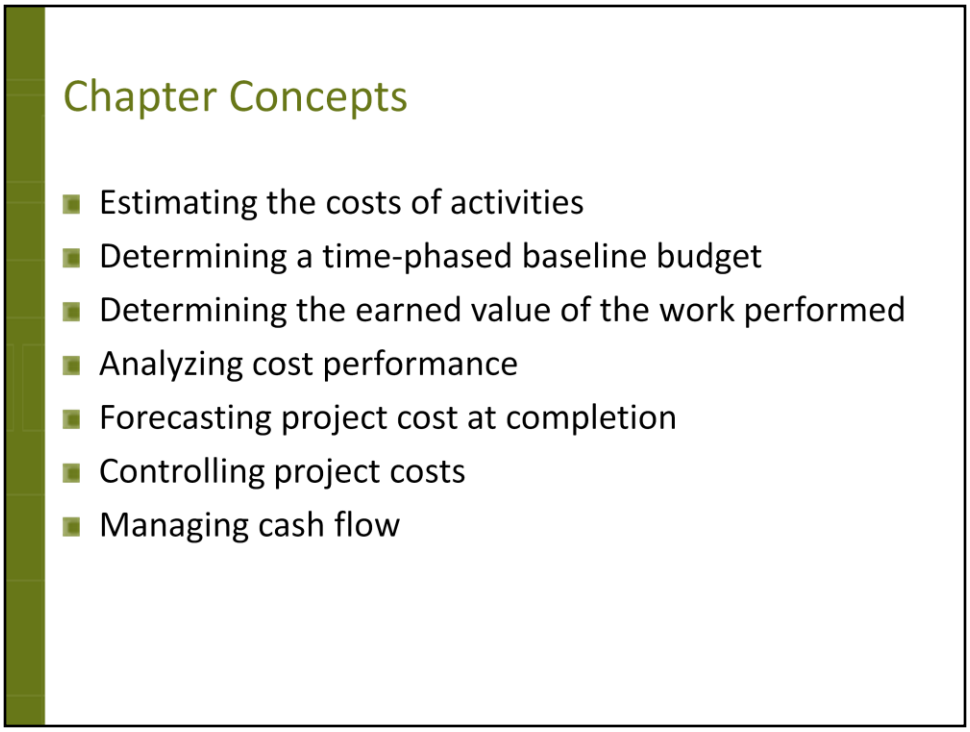
Teaching Strategies

- The two vignettes in this chapter reinforce the importance of using lessons learned to inform future projects, increase consideration of risk management, have change control strategies, set appropriate responsibilities, have a communication plan, have procedures in place for addressing common issues, organize project sites, and align with stakeholders. **(See Premium Deck for Slides.)**
    - The goal is to detect and curb systematic cost underestimation and manage scope changes to avoid cost and schedule overruns.
- Tell students a story of a project that spent its entire budget but has not finished all the tasks.
    - Have students determine what could have been done to avoid the situation, remedy the situation, or absorb the cost overruns.
- Have students use a work breakdown structure to work out the costs of a project they will complete during the semester.
    - Have students estimate the earned value at different stages of the project life cycle.
- Have students simulate actual completion dates for the consumer market study in Microsoft Project to see how they accumulated actual costs and earned value change over time.

Optional Supplemental Activities

- Have the students read the real-world vignettes for the chapter and create plans for managing the costs of projects.
- Have the student read the chapter and answer all of the Reinforce Your Learning questions and the end-of-chapter questions.
- Have students read the Plan of Attack vignette from Chapter 4.
    - The project manager worked through the project plan to have the cost of the project to be within the sponsor's budget by deleting any "nice to have" features and keeping the essential features.
- Explore the articles on the PMFORUM site and in the PWWorldToday website. Have the

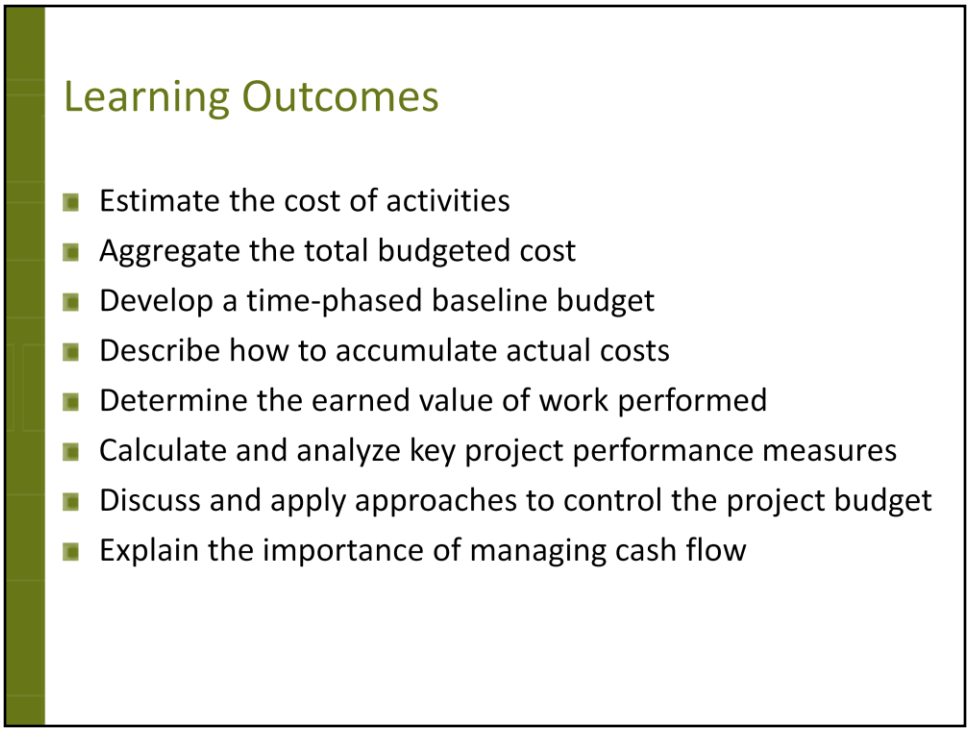
students try to contact the author of an article to ask questions about how the author manages costs associated with a project.



Chapter Concepts

Based on the material in this chapter, students will become familiar with:

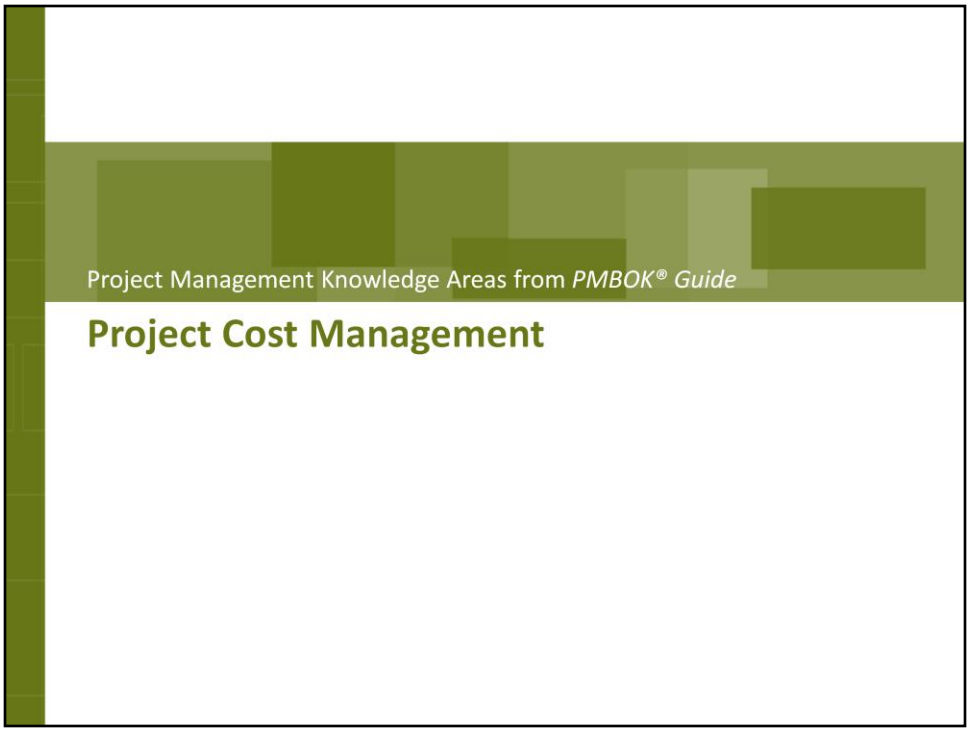
- Estimating the costs of activities
- Determining a time-phased baseline budget
- Determining the earned value of the work performed
- Analyzing cost performance
- Forecasting project cost at completion
- Controlling project costs
- Managing cash flow



Learning Outcomes

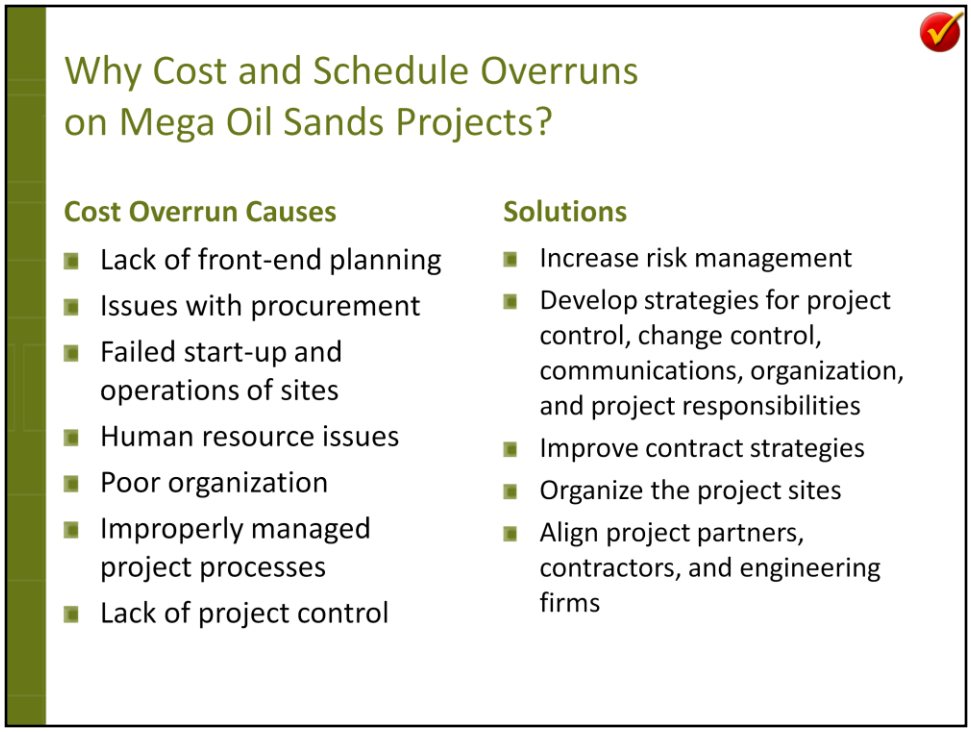
After studying this chapter, students should be able to:

- Estimate the cost of activities
- Aggregate the total budgeted cost
- Develop a time-phased baseline budget
- Describe how to accumulate actual costs
- Determine the earned value of work performed
- Calculate and analyze key project performance measures
- Discuss and apply approaches to control the project budget
- Explain the importance of managing cash flow



Project Management Knowledge Areas from PMBOK® Guide

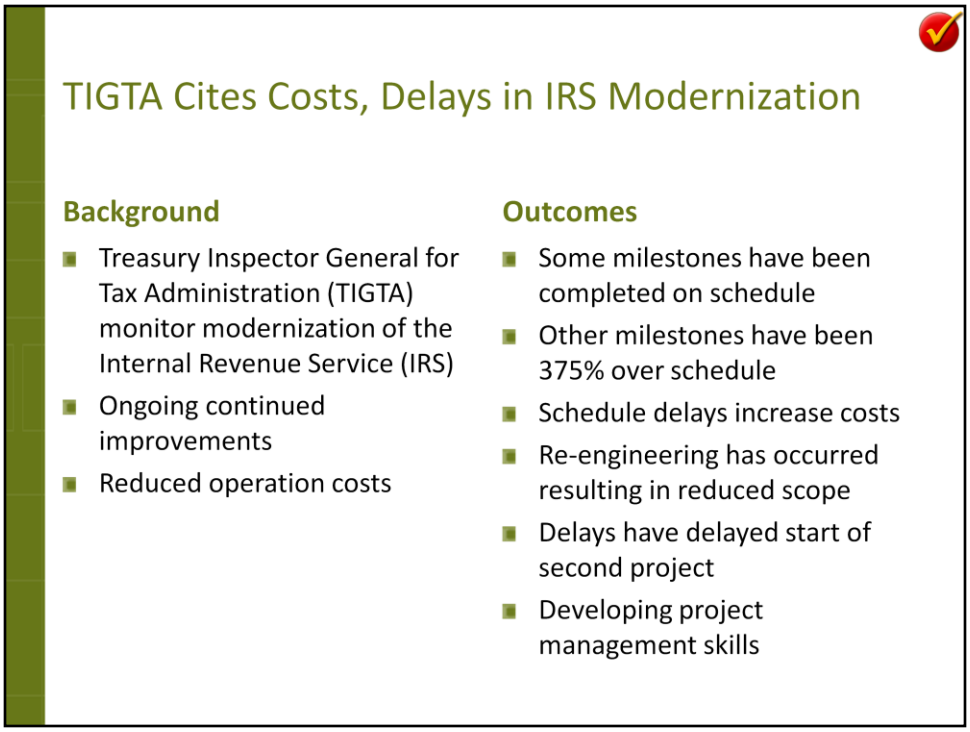
Concepts in this chapter support the following Project Management Knowledge Areas of *the PMI Guide to the Project Management Body of Knowledge (PMBOK® Guide*):
Project Cost Management



Vignette A: Why Cost and Schedule Overruns on Mega Oil Sands Projects?

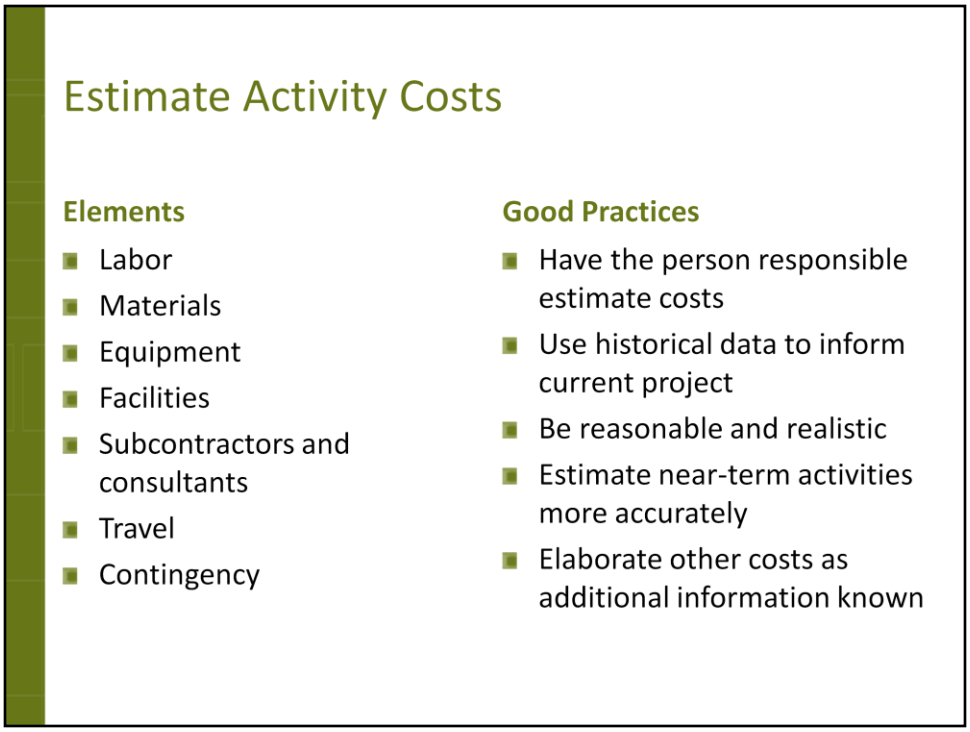
- One of the world's largest deposits of hydrocarbons is located in the oil sands of Alberta, Canada. Current technology can recover 175 billion barrels of the 1.6 trillion barrels of oil locked in the sandy bitumen.
- The Alberta oil sands development projects range between $8 and $10 billion of capital investment and employ thousands of workers.
- Environmental impacts, water requirements, supply availability, adequate labor, construction productivity, energy requirements, infrastructure constraints, and market conditions are challenges that each oil sands development project faces.
- Cost overruns of up to 100 percent of the original cost estimates have occurred on projects.
    - The cost and schedule overruns have been the result of management deficiencies related to managing scope, quality, time, cost, productivity, materials, and leadership.
- The primary reasons for the cost overruns have been a lack of front-end planning, issues with procurement, failed start-up and operations of sites, human resource issues, poor organization, improperly managed project processes, and a lack of project control.
- An investigation of the cost overruns revealed unrealistic and overly optimistic original cost estimates for the projects.
- The majority of the issues point to costs associated with labor.
    - The costs for attracting and maintaining a labor force in northern Alberta, Canada, were grossly underestimated.
- Camp development and operational costs, as well as the transportation costs required to move the labor force from the camp to remote regions for the projects were underestimated.
- Shortages of skilled labor and lower-than-expected productivity led to higher-than-planned overtime costs.
    - Competition for the best workers also increased the labor cost rates.
- The fast-tracking that occurred during the construction phase cost firms $120 to $180 per hour, which was much greater than the costs associated with the engineering effort.
- Costs associated with materials and facilities were improperly determined.
    - Variations in materials pricing, specifically metals that experienced a 100 percent price increase, were underestimated
    - Firms lacked a contingency plan when materials became too expensive
- The goal is to detect and curb systematic cost underestimation and to manage scope changes and schedule deviations as early as possible to avoid these cost and schedule overruns.
- Project teams are working to avoid these cost and schedule overruns in the future by:
    - Increasing their consideration of risk management
    - Developing strategies for project control, change control, communications, organization, and project responsibilities
    - Improving contract strategies for management, design, construction, and disputes

- Organizing the project sites and layouts to reduce wasted time and lost productivity
- Aligning project partners, contractors, and engineering firms



Vignette B: TIGTA Cites Costs, Delays in IRS Modernization

- The Treasury Inspector General for Tax Administration (TIGTA) has been monitoring the modernization of the Internal Revenue Service (IRS).
    - The IRS has antiquated systems and processes that are costly to operate.
- As part of continued improvements and to help reduce operation costs, the IRS developed a modernization program that includes annual goals.
    - Some milestones have been completed on schedule
    - Others have been 375% over schedule
- Schedule delays increase costs
- To help meet milestones, TIGTA has had to re-engineer the project plan; meaning it made changes in the project plan that resulted in a reduced project scope.
- Delays have kept the IRS from addressing a second project that is to be completed.
- Good project management skills related to schedule and cost estimation will help to set realistic milestones in the future.



Estimate Activity Costs

The total project cost is often estimated during the initiating phase of the project, or when the project charter or a proposal is prepared.

- The estimated cost for each specific activity can include the following elements:
  - Labor: Estimated costs for the various classifications of people who are expected to work on the project
    - Are based on the estimated work time (not necessarily the same as the activity estimated duration) and the dollar labor rate for each person or classification
  - Materials: Are the estimated costs of materials that the project team or contractor needs to purchase for the project
  - Equipment: The equipment that must be purchased as part of the project
  - Facilities: Special facilities or additional space for the project team; for security reasons; to store materials; or to build, assemble, and test the project end item (deliverable)
  - Subcontractors and consultants: Are outsourced when project teams or contractors do not have the expertise or resources to conduct certain project tasks
  - Travel: Travel (other than local travel) may be required during the project
  - Contingency (also referred to as reserves): Funds set aside to cover unexpected situations that may come up during the project
    - Such as items that may have been overlooked when the initial project scope was defined, activities that may have to be redone because they may not work the first time (redesigns), or a high probability or high impact risk that may occur
- There are a number of good practices that project managers should keep in mind when estimating costs
  - Have the person responsible for the task estimate costs
  - Use historical data to inform the current project because you can learn from past projects' mistakes
  - Be reasonable and realistic
  - Estimate near-term activities as accurately as possible
    - Although, at the beginning of the project, it may not be possible to estimate the costs for all activities with a high degree of confidence regarding accuracy.

- This is especially true for longer-term projects
    - Elaborate other costs as additional information becomes available

Consumer Market Study Project Estimated Costs

FIGURE 7.1 Estimated Activity Costs for Consumer Market Study Project

ACTIVITY	NAME	WORK DAYS	LABOR $ RATE	LABOR COSTS	MATERIALS COSTS	TRAVEL COSTS	TOTAL COSTS
1. Identify Target Consumers	Susan	3	$260	$780			$780
2. Develop Draft Questionnaire	Susan	10	260	2,600			2,600
3. Pilot-Test Questionnaire	Susan	20	260	5,200		$3,000	8,200
4. Review Comments & Finalize Questionnaire	Susan	5	260	1,300			1,300
5. Prepare Mailing Labels	Steve	2	200	400			400
6. Print Questionnaire	Steve	1	200	200	$1,700		1,900
7. Develop Data Analysis Software	Andy	12	300	3,600			3,600
8. Develop Software Test Data	Susan	2	260	520			520
9. Mail Questionnaire & Get Responses	Steve	5	200	1,000	7,800		8,800
10. Test Software	Andy	5	300	1,500			1,500
11. Input Response Data	Jim	7	400	2,800			2,800
12. Analyze Results	Jim	8	400	3,200			3,200
13. Prepare Report	Jim	10	400	4,000			4,000
		90		**$27,100**	**$9,500**	**$3,000**	**$39,600**

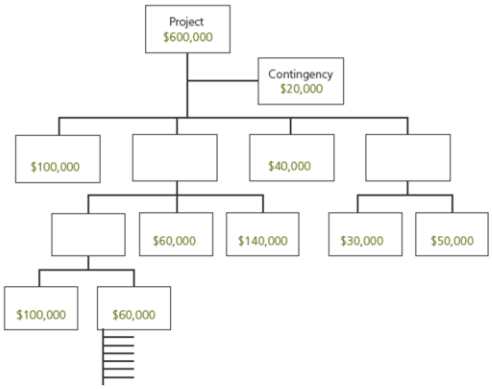
Consumer Market Study Project Estimated Costs

- The figure on this slide depicts the estimated costs for each activity in the consumer market study project.

Aggregate Total Budgeted Cost

- Establish a TBC for each work package (Step 1)
- Determine the process
  - Top-down
  - Bottom-up
- If sum of initial estimates exceeds sponsor budget, then reduce costs and recalculate

FIGURE 7.2 Work Breakdown Structure with Work Package Budgets



Aggregate Total Budgeted Cost

- Allocating total project costs to the appropriate work packages will establish a total budgeted cost (TBC) for each work package.
- There are two approaches to establishing the TBC for each work package: top-down and bottom-up.
- Often, the sum of the initial estimated costs is greater than the sponsor's budget sponsor.
  - Several iterations of working out the costs may b required to reduce the costs to within an acceptable level.
- The figure on this slide illustrates the cost allocations for a $600,000 project.
  - The costs are assigned to each work package.
- When the budgets for all the work packages are summed up, they cannot exceed the total project budgeted cost.

Packaging Machine Project
Aggregate Total Budgeted Cost

FIGURE 7.3 Network Diagram for the Packaging Machine Project

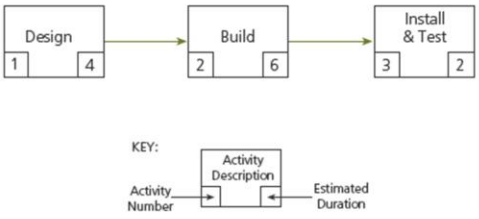
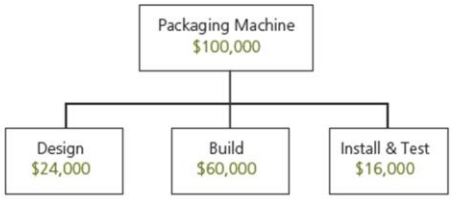
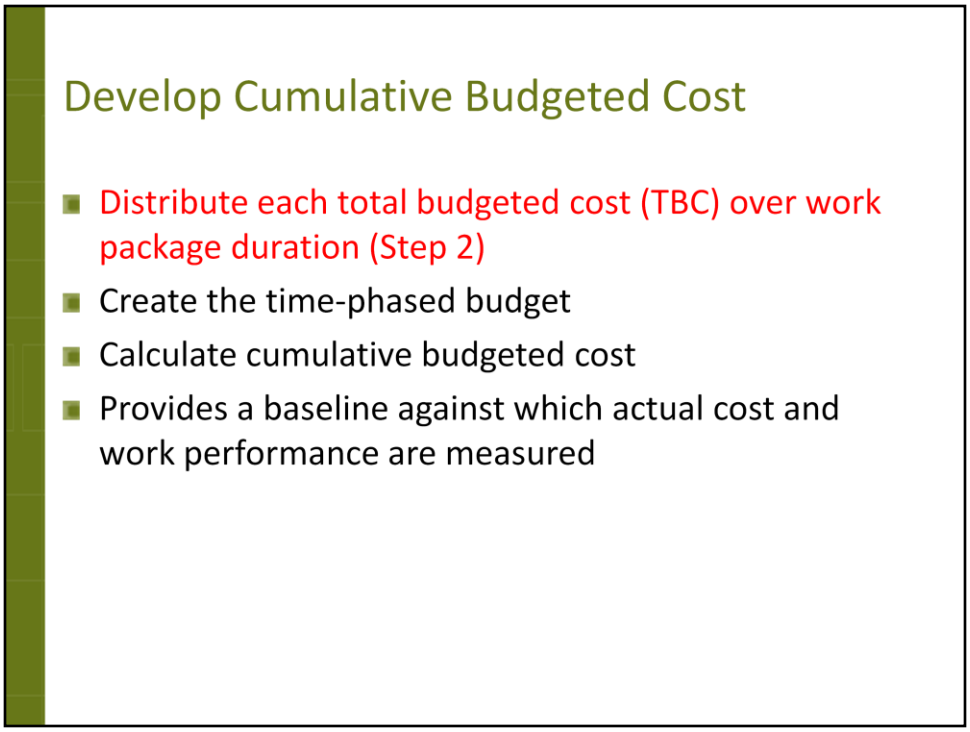


FIGURE 7.4 Work Breakdown Structure for the Packaging Machine Project



Packaging Machine Project Aggregate Total Budgeted Cost

- The two figures on this slide depict the network diagram and the work breakdown structure, with costs assigned.
- You will see this example repeatedly throughout the remainder of this chapter.



Develop Cumulative Budgeted Cost

Once a total budgeted cost has been established for each work package, the second step in the project budgeting process is to distribute each TBC over the duration of its work package.

- The cost determined for each period is based on when the activities that make up the work package are scheduled to be performed to create the time-phased budget.
- The cumulative budgeted cost (CBC) is the amount that was budgeted to accomplish the work that was scheduled to be performed up to that point in time.
- The CBC for the entire project or each work package provides a baseline against which actual cost and work performance can be compared at any time during the project.
- It is important to use the cumulative budget as the standard against which actual cost is compared.

Packaging Machine Project
Develop Cumulative Budgeted Cost

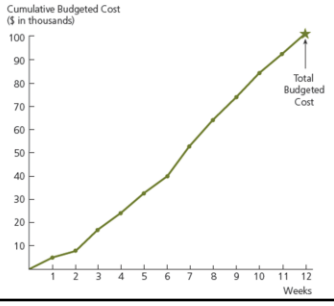
- Determine budgeted cost by period
- Graph the cumulative budgeted cost curve

FIGURE 7.5 Budgeted Cost by Period for the Packaging Machine Project

		Week											
	TBC	1	2	3	4	5	6	7	8	9	10	11	12
Design	24	4	4	8	8								
Build	60					8	8	12	12	10	10		
Install & Test	16											8	8
Total	100	4	4	8	8	8	8	12	12	10	10	8	8
Cumulative		**4**	**8**	**16**	**24**	**32**	**40**	**52**	**64**	**74**	**84**	**92**	**100**

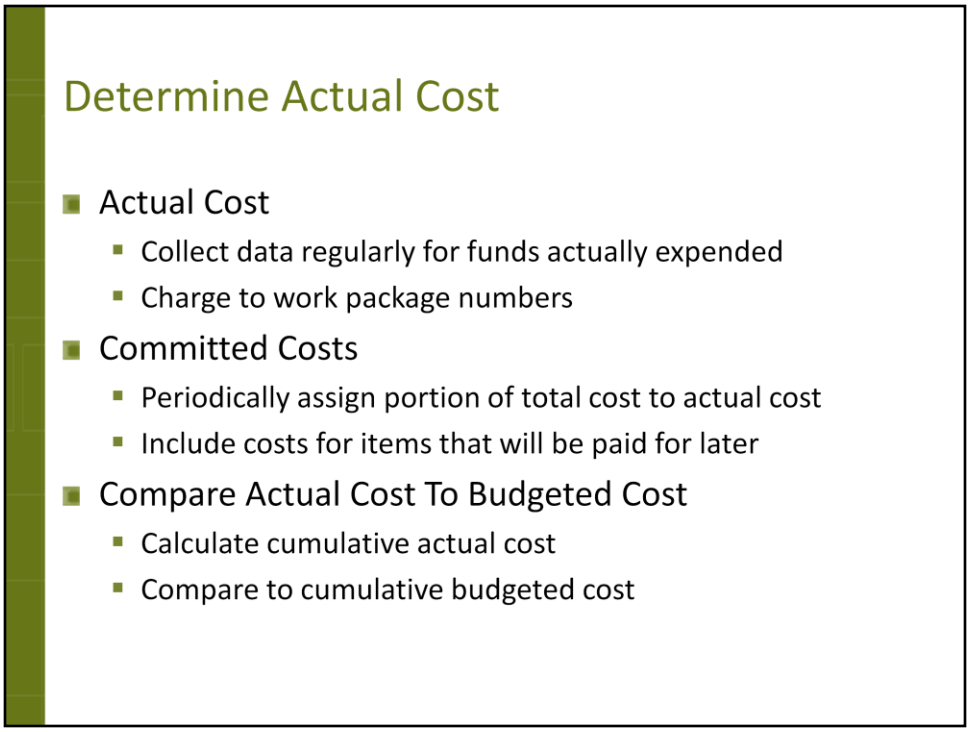
Amounts are in thousands of dollars.

FIGURE 7.6 Cumulative Budgeted Cost Curve for the Packaging Machine Project



Packaging Machine Project Develop Cumulative Budgeted Cost

- The two figures on this slide depict the development of the cumulative budgeted cost for a packaging machine project.
- The figure on the top shows the budgeted cost by period for the packaging machine project.
- The figure on the bottom shows the cumulative budgeted cost curve for the packaging machine project.
    - The points on the graph correspond to the cumulative total shown in the figure on the top.



Determine Actual Cost

- Once the project starts, it is necessary to keep track of actual cost and committed cost so that they can be compared to the CBC.
- To keep track of *actual cost* on a project, it is necessary to set up a system to collect, on a regular and timely basis, data on funds actually expended.
    - Large projects have charge codes assigned to different work package numbers to determine how the actual costs compare to the planned costs.
- In many projects, large dollar amounts are expended for materials or services (such as on subcontractors or consultants) that are used over a period of time longer than one cost reporting period.
    - These committed costs need to be treated in a special way so that the system periodically assigns a portion of their total cost to actual cost.
    - Committed costs are also known as *commitments* or *encumbered costs*.
    - Costs are committed when an item is ordered even though actual payment may take place at some later time.
- Cumulative actual cost (CAC) should be then be calculated.
    - As data are collected on actual cost, including portions of any committed cost, they need to be totaled by work package so that they can be compared to the cumulative budgeted cost.

Packaging Machine Project Determine Actual Cost

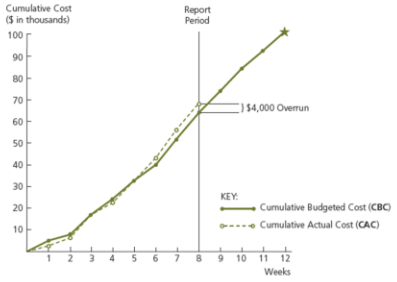
- End of Week 8
  - Planned cost = $64,000
  - Actual cost = $68,000
- Compare CAC with CBC

FIGURE 7.7 Actual Cost by Period for the Packaging Machine Project

	Week								Total Expended
	1	2	3	4	5	6	7	8	
Design	2	5	9	5	1				22
Build				2	8	10	14	12	46
Install & Test									0
Total	2	5	9	7	9	10	14	12	**68**
Cumulative	**2**	**7**	**16**	**23**	**32**	**42**	**56**	**68**	**68**

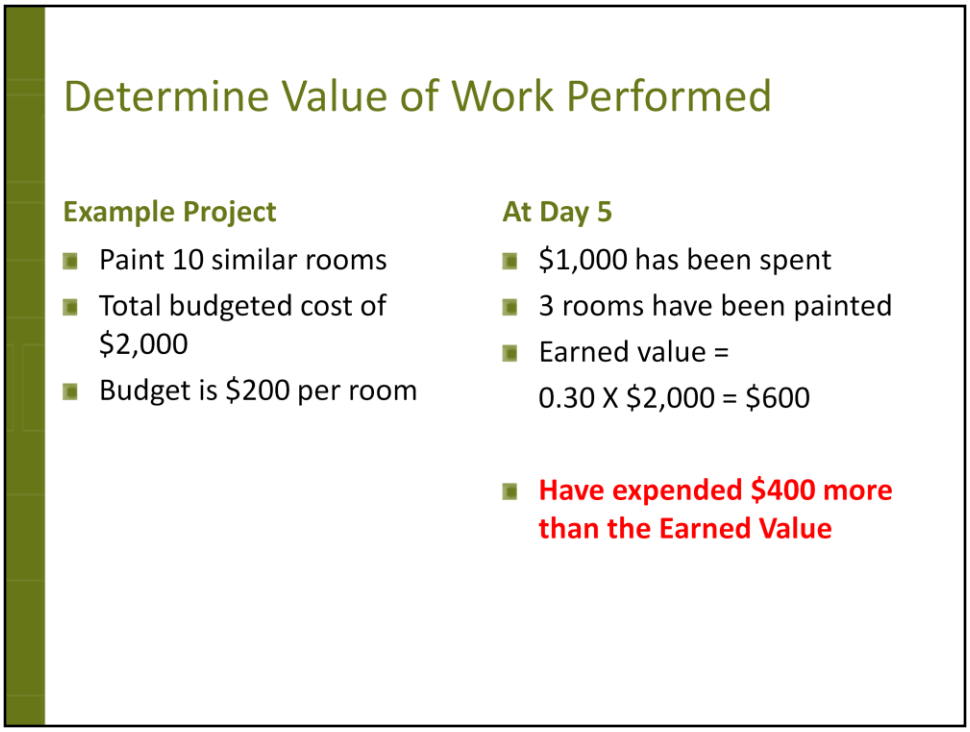
Amounts are in thousands of dollars.

FIGURE 7.8 Cumulative Budgeted and Actual Costs for the Packaging Machine Project



Packaging Machine Project Determine Actual Cost

- The figure on the top indicates that at the end of week 8 of the packaging machine project, $68,000 has actually been expended, although only $64,000 was budgeted.
- With the CAC values, it's possible to draw a cumulative actual cost curve, which you see in the figure on the bottom of this slide.



Determine Value of Work Performed

Let's take a moment to think about an example of determining the value of work performed.

- Consider a project that involves painting ten similar rooms over ten days (one room per day) for a total budgeted cost of $2,000.
- This makes the budget $200 per room.
- At of the end of day 5, you determine that $1,000 has been spent, which is on track monetarily. The problem is that only three rooms have been painted.

Earned value, the value of the work actually performed, is a key parameter that must be determined throughout the project.

- Determining the earned value involves collecting data on the percent completed for each work package and then converting this percentage to a dollar amount by multiplying the TBC of the work package by the percent complete.
- In many cases, the estimate is subjective.
- It is important that the person estimating the percent complete not only assess how much work has been performed. but also consider what work remains to be done.

For example, in the project involving painting ten rooms for $2,000:

- If three rooms are completed, that means that 30 percent of the work has been performed.
- The earned value is: 0.30 x $2,000 = $600
- This means that the project has expended $400 more than the earned value by

day 5.

Packaging Machine Project
Determine Value of Work Performed

FIGURE 7.9 Cumulative Percent Complete by Period for the Packaging Machine Project

	Week							
	1	2	3	4	5	6	7	8
Design	10	25	80	90	100	100	100	100
Build	0	0	0	5	15	25	40	50
Install & Test	0	0	0	0	0	0	0	0

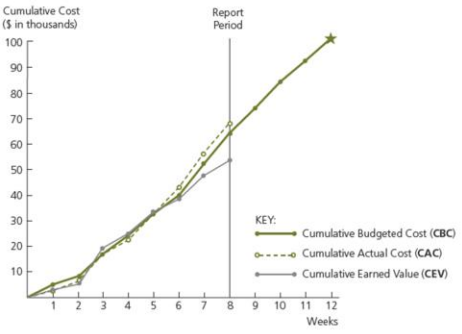
Amounts are cumulative percent complete.

FIGURE 7.10 Cumulative Earned Value by Period for the Packaging Machine Project

		Week							
	TBC	1	2	3	4	5	6	7	8
Design	24	2.4	6	19.2	21.6	24	24	24	24
Build	60				3	9	15	24	30
Install & Test	16								
Cumulative	100	**2.4**	**6**	**19.2**	**24.6**	**33**	**39**	**48**	**54**

Amounts are in thousands of dollars.

FIGURE 7.11 Cumulative Budgeted and Cumulative Actual Costs, and Cumulative Earned Value for the Packaging Machine Project



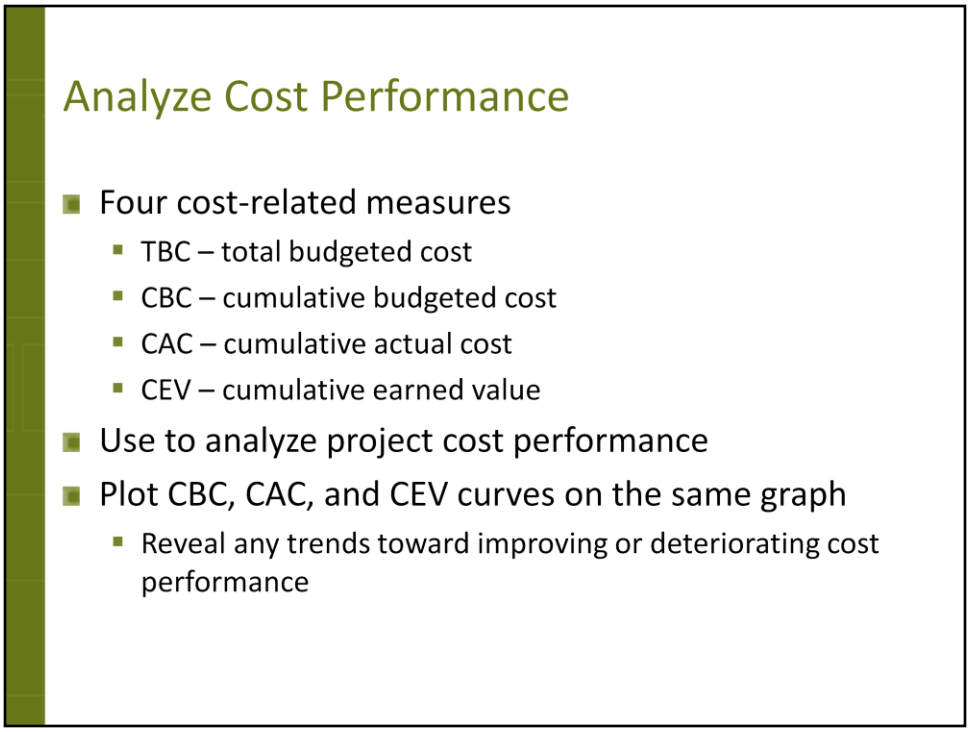
Packaging Machine Project Determine Value of Work Performed

Here we see three figures that will help us understand how to determine the value of work performed on the packaging project.

- The figure in the top left depicts the cumulative percent complete by period for the packaging machine project.
- The figure on the bottom left depicts the cumulative earned value by period for the packaging machine project.

To help you understand the different costs visually, the figure on the right illustrates the CBC, CAC, and CEV for the entire project.

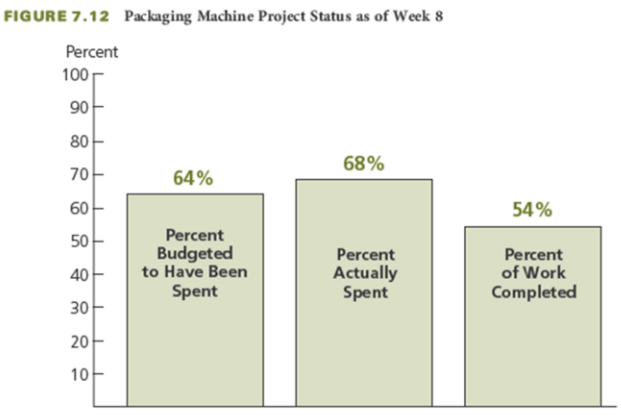
- You will note that the CAC is running above the CBC, and the CEV is running below the CBC.



Analyze Cost Performance

- There are four cost-related measures that are used to analyze project cost performance:
  - TBC (total budgeted cost)
  - CBC (cumulative budgeted cost)
  - CAC (cumulative actual cost)
  - CEV (cumulative earned value)
- One can analyze cost performance by plotting the CBC, CAC, and CEV curves on the same graph, as we just saw in the previous slide.
- Plotting the curves can help to reveals trends toward improving or deteriorating cost performance.

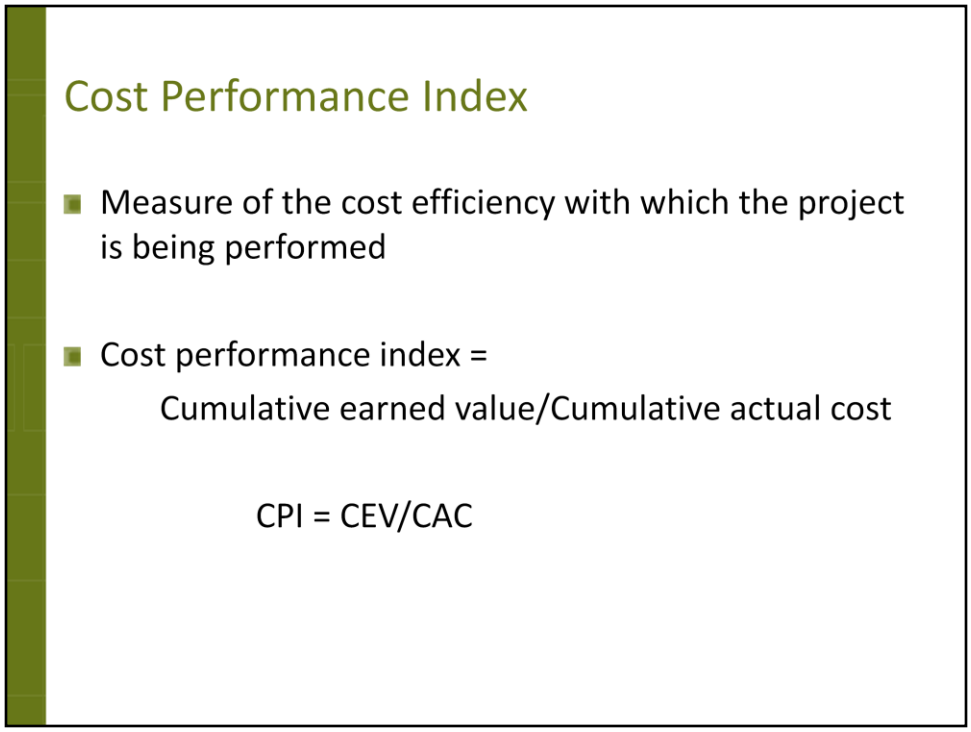
Packaging Machine Project Analyze Cost Performance



Packaging Machine Project Analyze Cost Performance

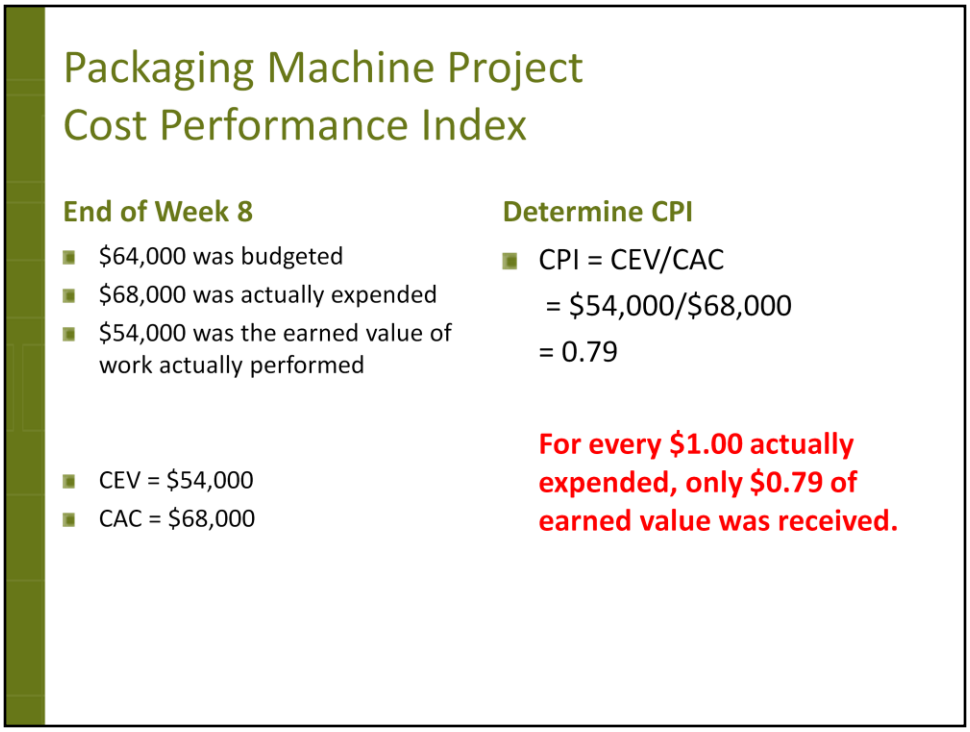
This figure shows the packaging machine project status, as of the end of week 8:

- 64% of funds were budgeted to have been spent
- 68% of overall funds were actually spent
- 54% of the total work was completed



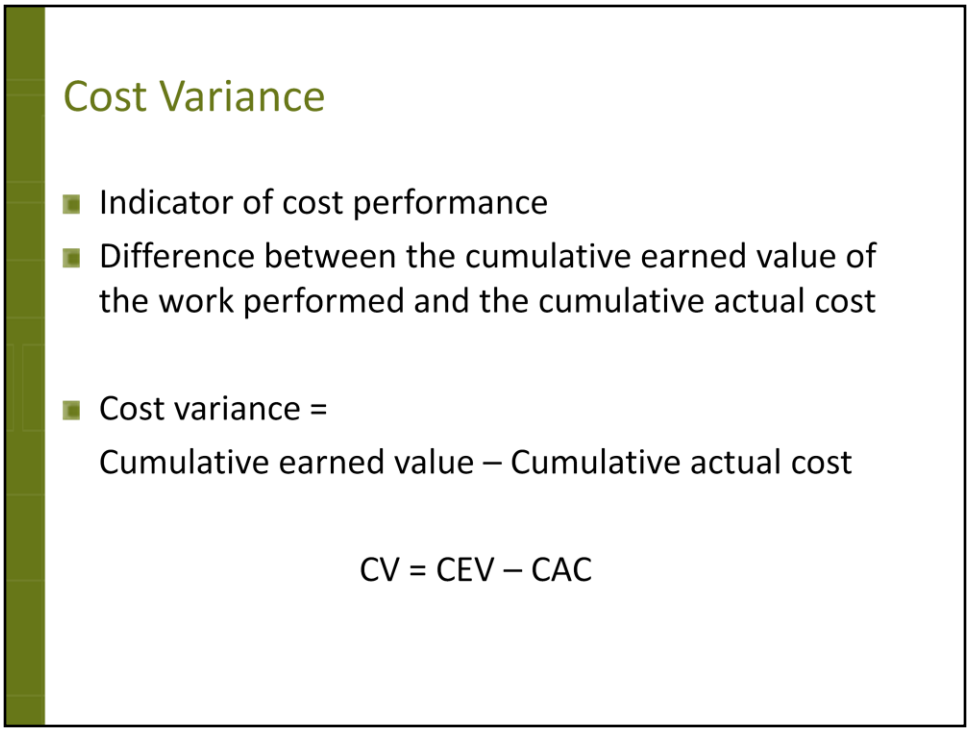
Cost Performance Index

- The cost performance index (CPI) is a measure of the cost efficiency with which the project is being performed.
- The formula for determining the CPI is:
    - Cost performance index = Cumulative earned value/Cumulative actual cost (or CPI = CEV/CAC)



Packaging Machine Project Cost Performance Index

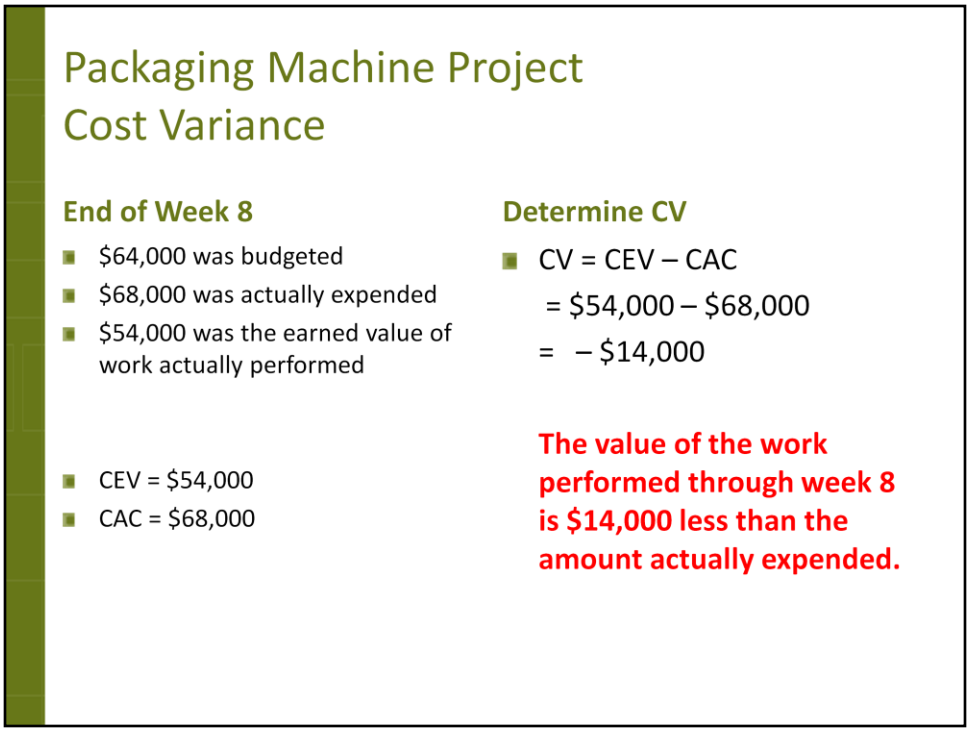
- Let's take a minute to look at the CPI for the packaging machine project.
- Remember that the CPI is calculated by: Cost performance index = Cumulative earned value/Cumulative actual cost (CPI = CEV/CAC)
- In the packaging machine project, the CPI as of week 8 is: CPI = $54,000/$68,000 = 0.79
    - This ratio indicates that for every $1.00 actually expended, only $0.79 of earned value was received.
- When the CPI dips below 1.0 or is trending smaller, corrective action should be taken.



Cost Variance

Another indicator of cost performance is cost variance (CV), which is the difference between the cumulative earned value of the work performed and the cumulative actual cost.

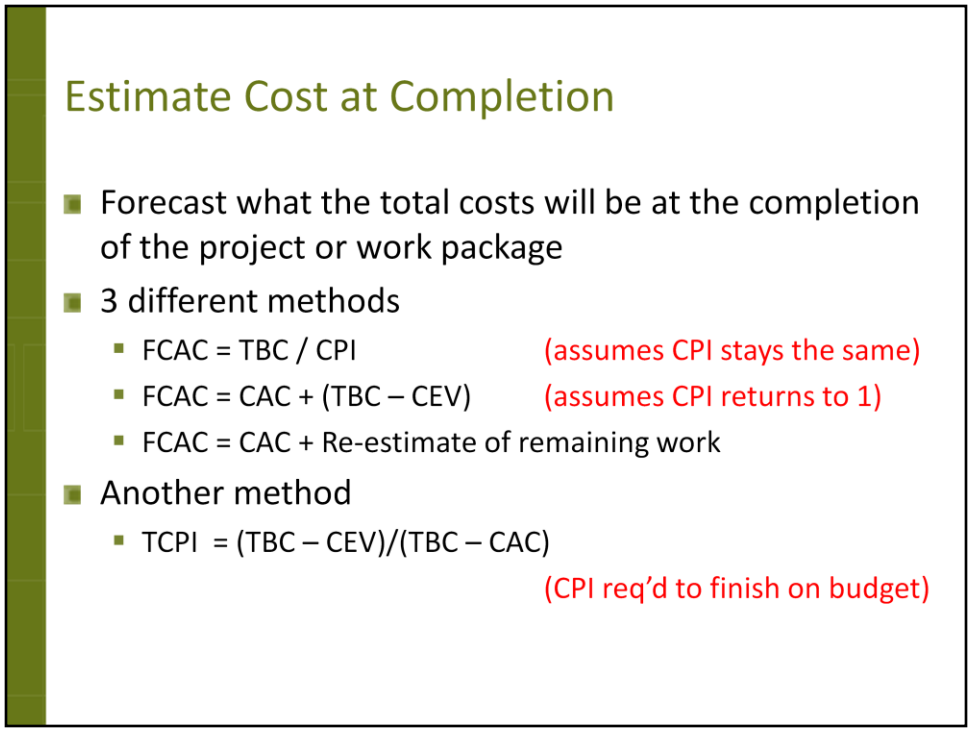
- Cost variance = Cumulative earned value – Cumulative actual cost (or CV = CEV – CAC)



Packaging Machine Project Cost Variance

In the packaging machine project, the cost variance as of week 8 is: CV = $54,000 – $68,000 = –$14,000

- This calculation indicates that the value of the work performed through week 8 is $14,000 less than the amount actually expended.



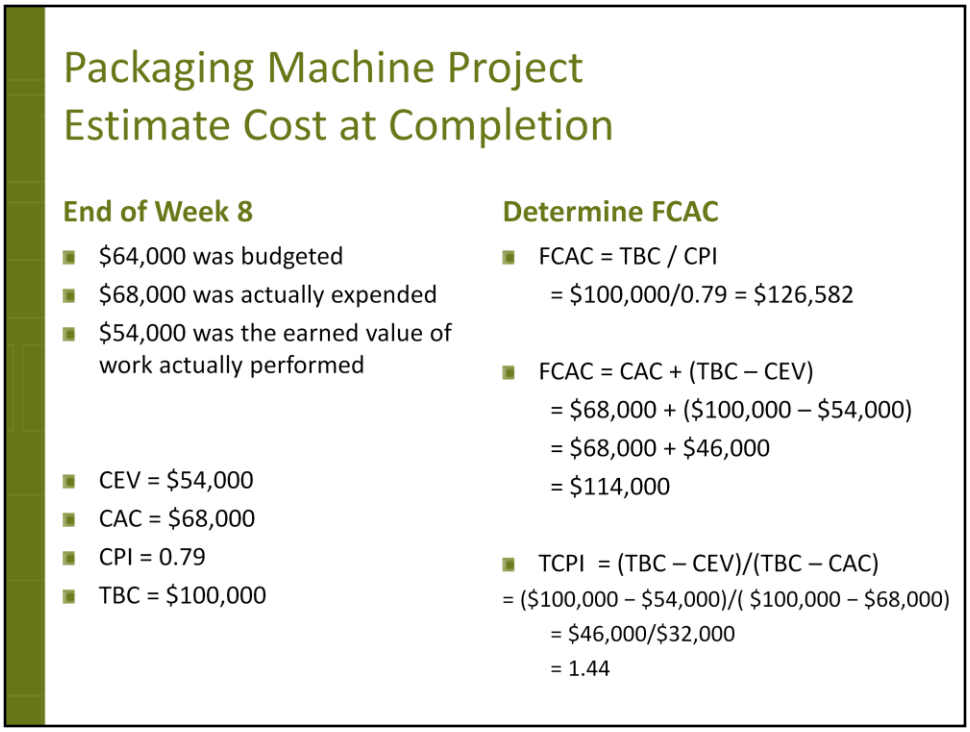
Estimate Cost at Completion

Based on analysis of actual cost, it is possible to forecast what the total costs will be at the completion of the project or work package.

There are three different methods for determining the forecasted cost at completion (FCAC).

- The first method assumes that the work to be performed on the remaining portion of the project or work package will be done at the same rate of efficiency as the work performed up to that point.
    - Forecasted cost at completion = Total budgeted cost/Cost performance index
- A second method for determining the FCAC assumes that, regardless of the efficiency rate the project or work package has had in the past, the work to be performed on the remaining portion of the project or work package will be in line with the budget.
    - Forecasted cost at completion = Cumulative actual cost+ (Total budgeted cost – Cumulative earned value)
- A third method for determining the forecasted cost at completion is to re-estimate the costs for all the remaining work to be performed and then add this re-estimate to the cumulative actual cost.
    - FCAC = CAC + Re-estimate of remaining work to be performed
- Another measure for estimating cost at completion is the to-complete performance index (TCPI)

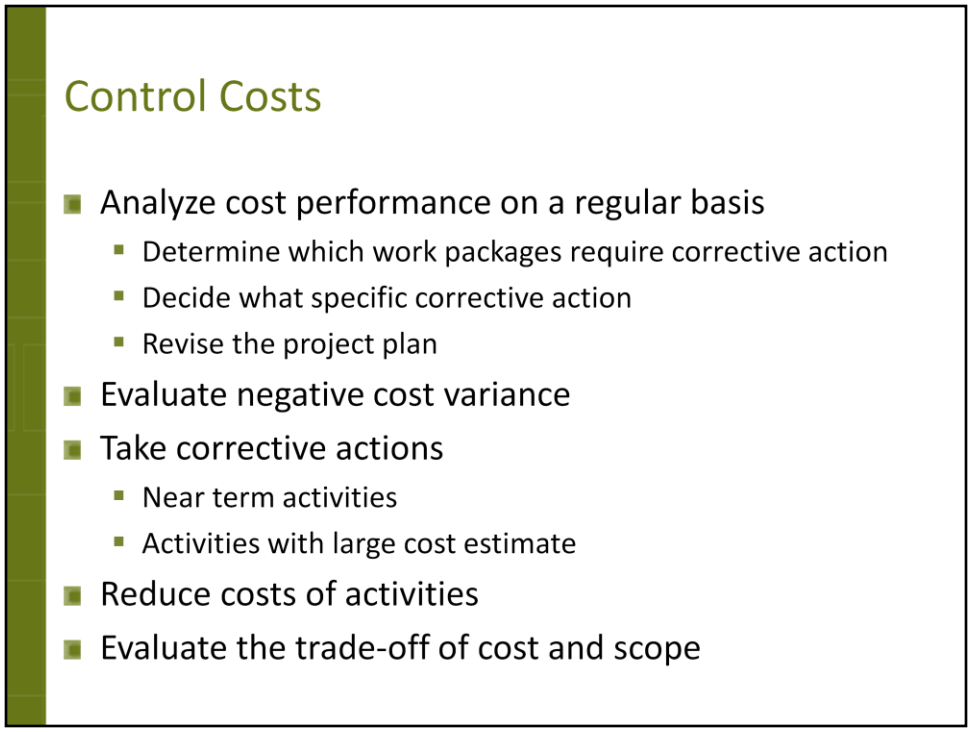
- It is calculated as: TCPI = (TBC – CEV)/(TBC – CAC)



Packaging Machine Project Estimate Cost at Completion

Let us look that the packaging machine project again and apply the methods we just learned for determining the forecasted cost at completion.

- Using the first method, the forecasted cost at completion is: FCAC = $100,000/0.79 = $126,582
- Using the second method, the forecasted cost at completion is: FCAC = $68,000 + ($100,000 – $54,000)= $68,000 + $46,000= $114,000
- We can also use the to-complete performance index (TCPI) to determined the FCAC.
    - Using this method, the to-complete performance index is: TCPI = ($100; 000 − $54; 000)/($100; 000 − $68; 000)= $46,000/$32; 000= 1:44



Control Costs

- The key to effective cost control is to analyze cost performance on a regular and timely basis.
    - It is crucial that cost variances and inefficiencies be identified early so that corrective action can be taken before the situation gets worse.

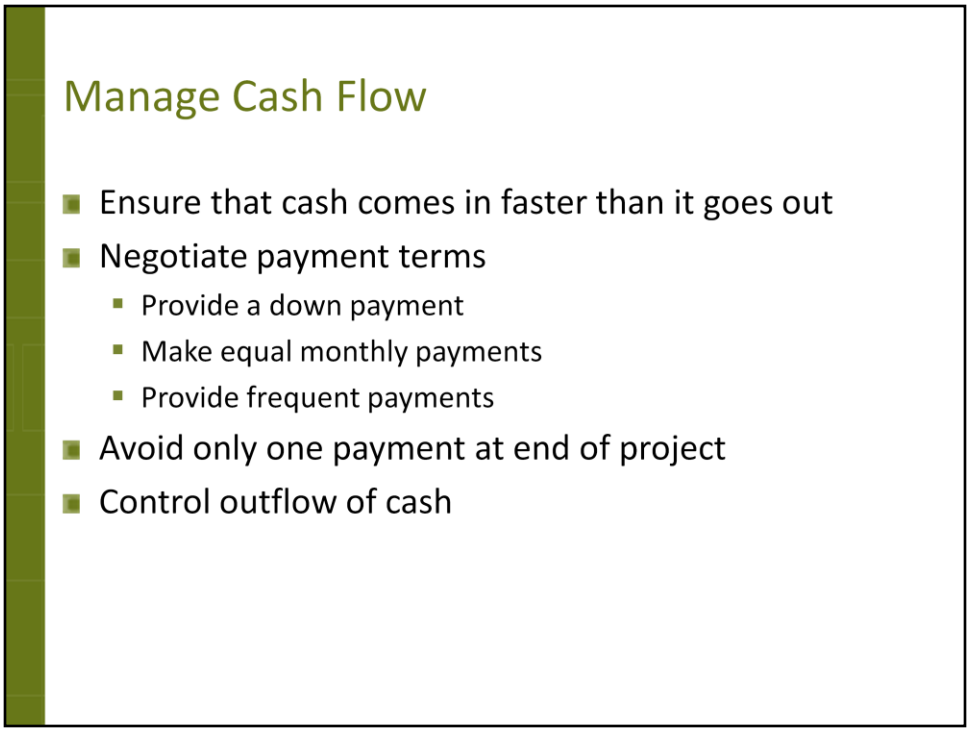
Controlling costs involves the following:

- Analyzing cost performance to determine which work packages may require corrective action
- Deciding what specific corrective action should be taken
- Revising the project plan—including time and cost estimates—to incorporate the planned corrective action
- When evaluating work packages that have a negative cost variance, you should focus on taking corrective actions to reduce the costs of two types of activities:
    - Activities that will be performed in the near term
        - If you put off corrective actions until some point in the distant future, the negative cost variance may deteriorate.
    - Activities that have a large cost estimate
        - Taking corrective measures that reduce the cost of a $20,000 activity by 10 percent will have a larger impact than totally eliminating a $300 activity.
- There are various ways to reduce the costs of activities:
    - One way is to substitute less expensive materials
    - Another is to assign a person with greater expertise or more experience to perform or help with the activity
    - Reducing the scope or requirements is another way
    - Increasing productivity through improved methods or technology

- In many cases, there will be tradeoffs—reducing cost variances may involve a reduction in project scope or a delay in the project schedule.
    - The key to effective cost control is aggressively addressing negative cost variances and cost inefficiencies as soon as they are identified.

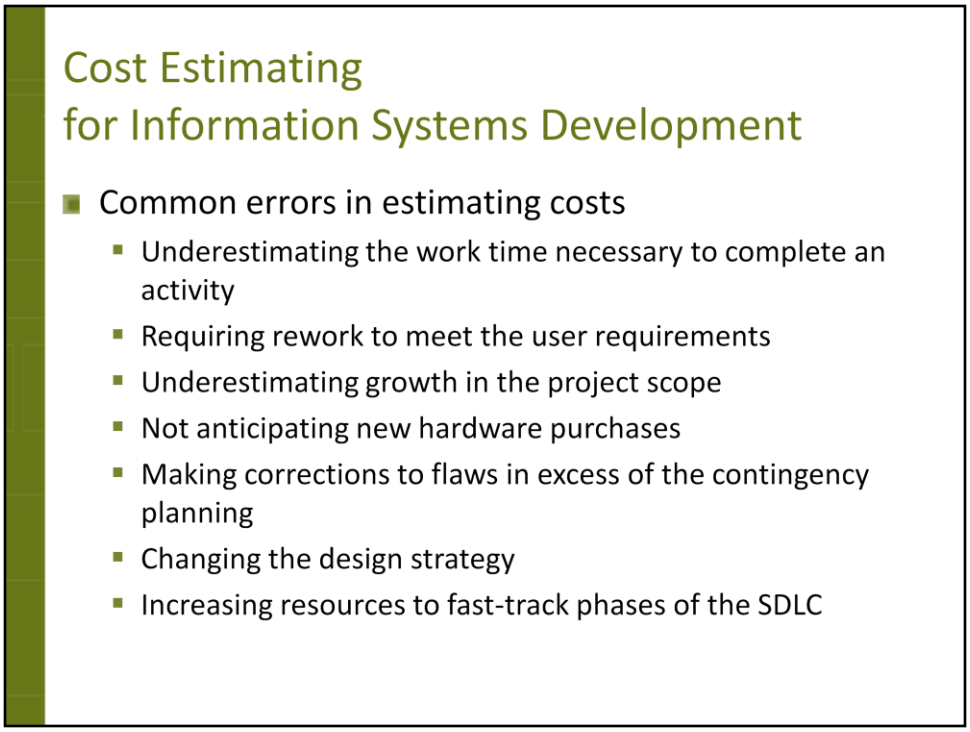
Ways to Reduce Costs of Activities

- Substitute less expensive materials.
- Assign a person with greater expertise to perform or help with the activity.
- Reduce the scope or requirements.
- Increase productivity through improved methods or technology.



Manage Cash Flow

- It is important to manage the cash flow on a project.
    - Managing cash flow involves making sure that sufficient payments are received from the customer in time to cover the costs of performing the project.
- The key to managing cash flow is to ensure that cash comes in faster than it goes out.
- The contractor might try to negotiate payment terms that require the customer to do one or more of the following:
    - Provide a down payment at the start of the project
    - Make equal monthly payments based on the expected duration of the project
    - Provide frequent payments, such as weekly or monthly payments, rather than quarterly payments
- The worst scenario from the contractor's point of view is to have the customer make only one payment at the end of the project.
- On the other hand, the contractor should control its outflow of cash by delaying payments as long as possible until they are due.



Cost Estimating for Information Systems Development

- Chapter 4 defined the information system (IS) as a computer-based system that accepts data as input, processes the data, and produces information required by users. Chapter 5 revealed that much scheduling is conducted in a haphazard manner, resulting in a large number of IS projects not finishing on time. Chapter 6 reinforced the resource requirements planning necessary for people, hardware, software, data, and network resources.
- This chapter addresses cost estimating in an IS project.
    - Accurately estimating costs and including a contingency are essential in creating a realistic budget that allows the contractor to complete the work without cost overruns.
    - Having a good plan and schedule helps to develop good cost estimates and a baseline budget.
- Common errors in estimating costs include:
    - Underestimating the work time necessary to complete an activity
    - Requiring rework to meet the user requirements
    - Underestimating growth in the project scope
    - Not anticipating new hardware purchases
    - Making corrections to flaws that cost more than what was allotted in the contingency planning
    - Changing the design strategy
    - Increasing resources to fast-track phases of the SDLC

IS Example: Estimated Activity Costs

FIGURE 7.13 Estimated Activity Costs for Web-based Reporting System Project

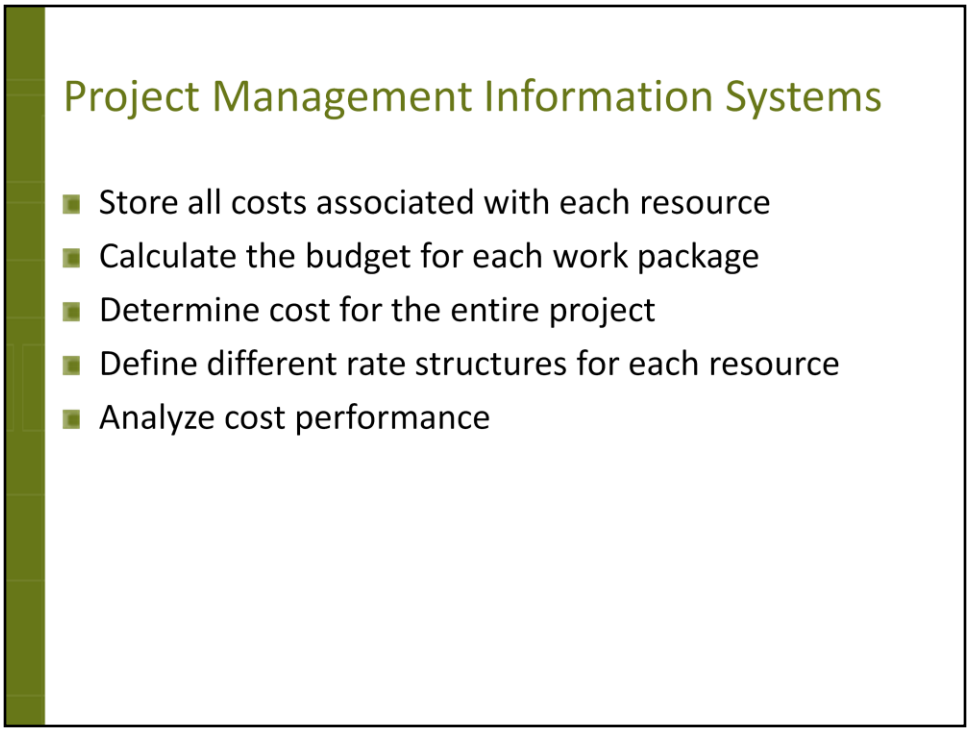
ACTIVITY	PRIMARY RESPONSIBILITY	WORK DAYS	LABOR COSTS	MATERIALS COSTS	TRAVEL COSTS	TOTAL COSTS
1. Gather Data	Beth	3	$4,440			$4,440
2. Study Feasibility	Jack	4	7,360			7,360
3. Prepare Problem Definition Report	Rose	1	1,000			1,000
4. Interview Users	Jim	5	9,200		$6,000	15,200
5. Study Existing System	Steve	8	3,200			3,200
6. Define User Requirements	Jeff	5	1,600			1,600
7. Prepare System Analysis Report	Jim	1	480			480
8. Input & Output	Tyler	8	17,280			17,280
9. Processing & Database	Joe	10	13,600			13,600
10. Evaluation	Cathy	2	3,760			3,760
11. Prepare System Design Report	Sharon	2	1,760			1,760
12. Software Development	Hannah	15	7,120	$500		7,620
13. Hardware Development	Joe	10	9,600			9,600
14. Network Development	Gerri	6	2,400			2,400
15. Prepare System Development Report	Jack	2	960			960
16. Software Testing	Maggie	6	6,720			6,720
17. Hardware Testing	Gene	4	5,120			5,120
18. Network Testing	Greg	4	5,440			5,440
19. Prepare Testing Report	Rose	1	1,760			1,760
20. Training	Jim	4	5,760	1,300		7,060
21. System Conversion	Beth	2	1,200			1,200
22. Prepare Implementation Report	Jack	1	1,560			1,560
Total		104	$111,320	$1,800	$6,000	$119,120

IS Example: Estimated Activity Costs

Recall from Chapters 4, 5, and 6 that Beth Smith was assigned to be project manager by the IS Department of ABC Office Designs.

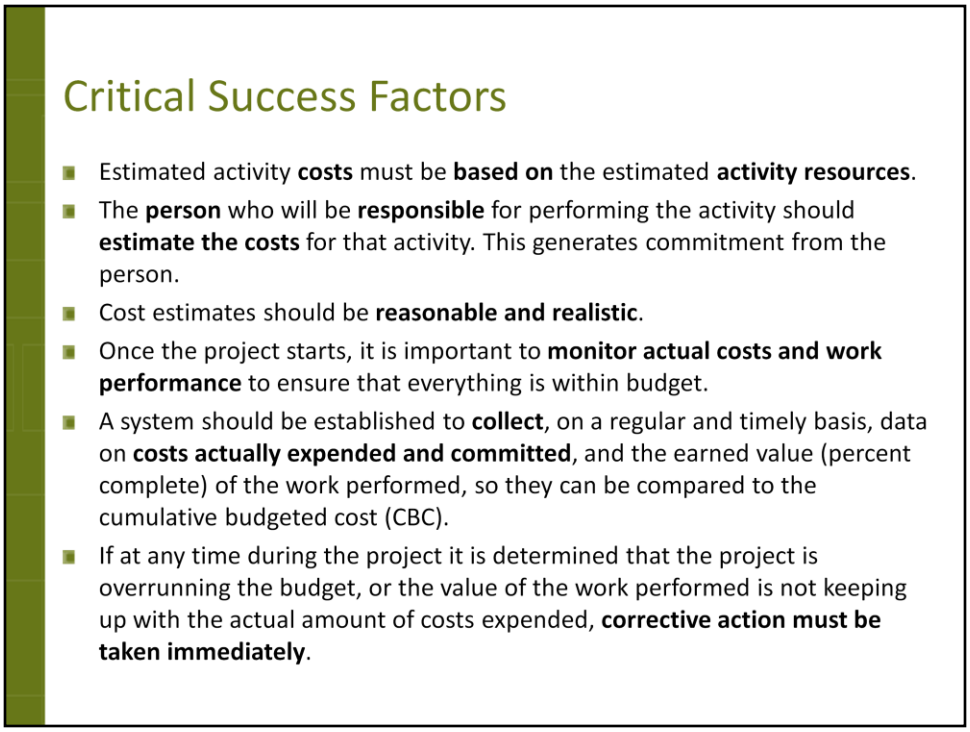
- The figure on this slide depicts the estimated activity costs for the Web-Based Reporting Development project.
    - It has a 5% contingency for cost overruns, fast-tracking of the project, or increased costs of materials or travel for the interviews.
- Chapter 5 described how Beth had scheduled the ES, EF, LS, and LF times for the activities necessary to complete the Web-based reporting system development project for ABC Office Designs.
- Chapter 6 described how Beth and the project team planned the resources for the 60-day schedule for the project. Management approved a budget of $125,000 to complete the project and train the sales staff.
- After confirming with the primary responsible resources that the tasks could be completed with the estimated level of effort on each task, Beth worked with the human resources team to use the hourly wage for each of the employees to determine the labor costs for each of the Web-based Reporting System project activities.
- Beth and the project team estimated the costs associated with traveling to complete user interviews ($3,000), the price of packaged software ($500), and the costs of training materials ($1,300).
- The budgeted costs of the work to complete the project were near the $125,000

limit, even without training the sales staff.



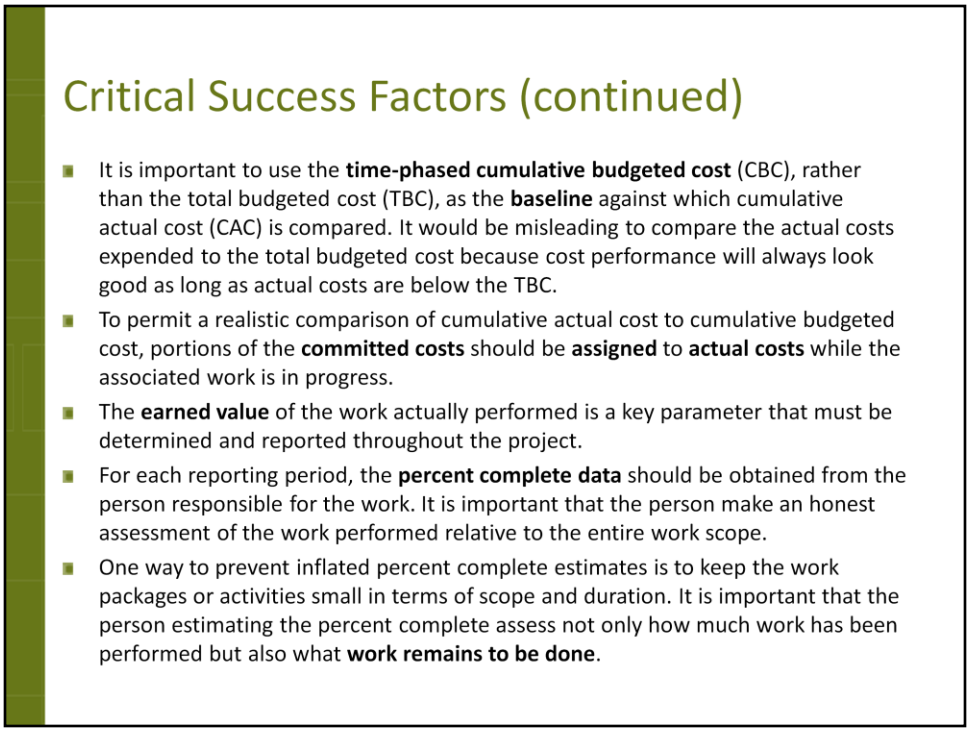
Project Management Information Systems

- All costs associated with each resource in a project can be stored and software will calculate the budget for each work package and for the entire project.
- Project management software usually allows the user to define different rate structures for each resource and when charges for those resources will actually be accrued.
- Cost tables and graphs are often available to help analyze cost performance.
- See Appendix A for a thorough discussion of Project Management Software.



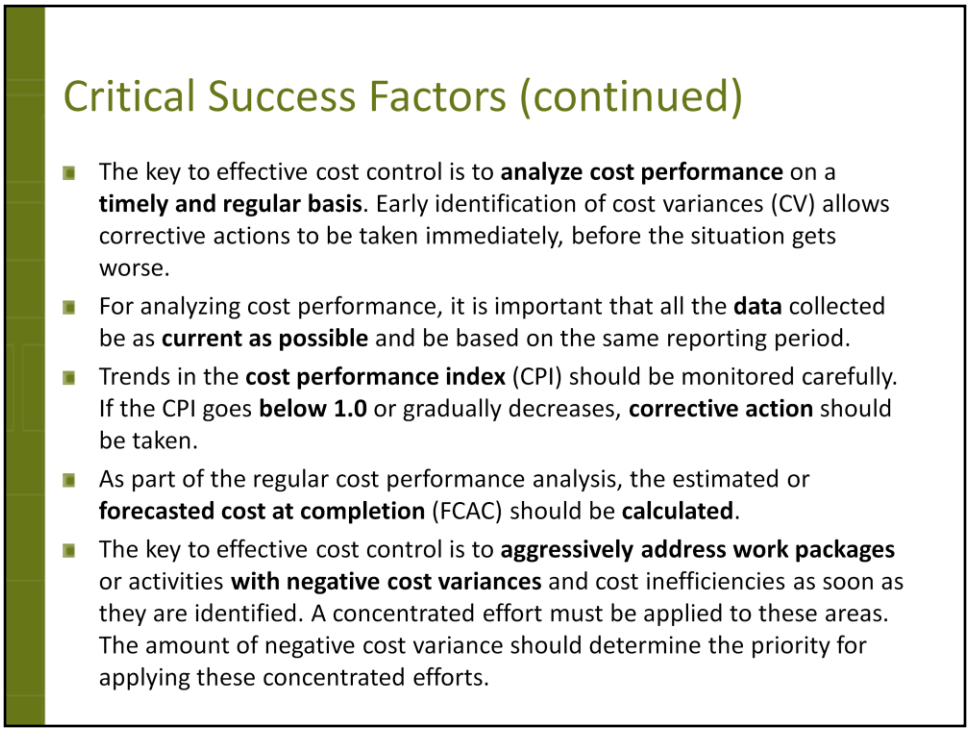
Critical Success Factors

- Estimated activity *costs* must be *based on* the estimated activity *resources*.
- The person who will be *responsible* for performing the activity should *estimate the costs* for that activity. This generates commitment from the person.
- Cost estimates should be *reasonable and realistic*.
- Once the project starts, it is important to *monitor actual costs and work performance* to ensure that everything is within budget.
- A system should be established to *collect*, on a regular and timely basis, data on *costs actually expended and committed*, and the earned value (percent complete) of the work performed, so they can be compared to the cumulative budgeted cost (CBC).
- If at any time during the project it is determined that the project is overrunning the budget, or the value of the work performed is not keeping up with the actual amount of costs expended, *corrective action must be taken immediately*.



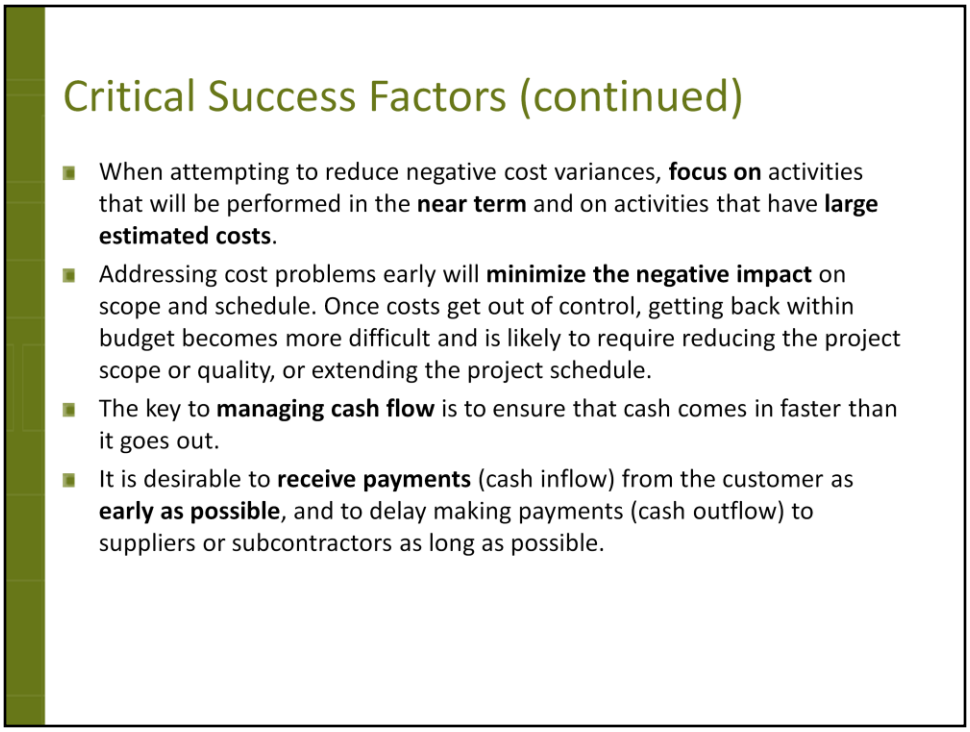
Critical Success Factors (continued)

- It is important to use the *time-phased cumulative budgeted cost* (CBC), rather than the total budgeted cost (TBC), as the baseline against which cumulative actual cost (CAC) is compared. It would be misleading to compare the actual costs expended to the total budgeted cost because cost performance will always look good as long as actual costs are below the TBC.
- To permit a realistic comparison of cumulative actual cost to cumulative budgeted cost, portions of the *committed costs* should be assigned to *actual costs* while the associated work is in progress.
- The *earned value* of the work actually performed is a key parameter that must be determined and reported throughout the project.
- For each reporting period, the *percent complete data* should be obtained from the person responsible for the work. It is important that the person make an honest assessment of the work performed relative to the entire work scope.
- One way to prevent inflated percent complete estimates is to keep the work packages or activities small in terms of scope and duration. It is important that the person estimating the percent complete assess not only how much work has been performed but also *what work remains to be done*.



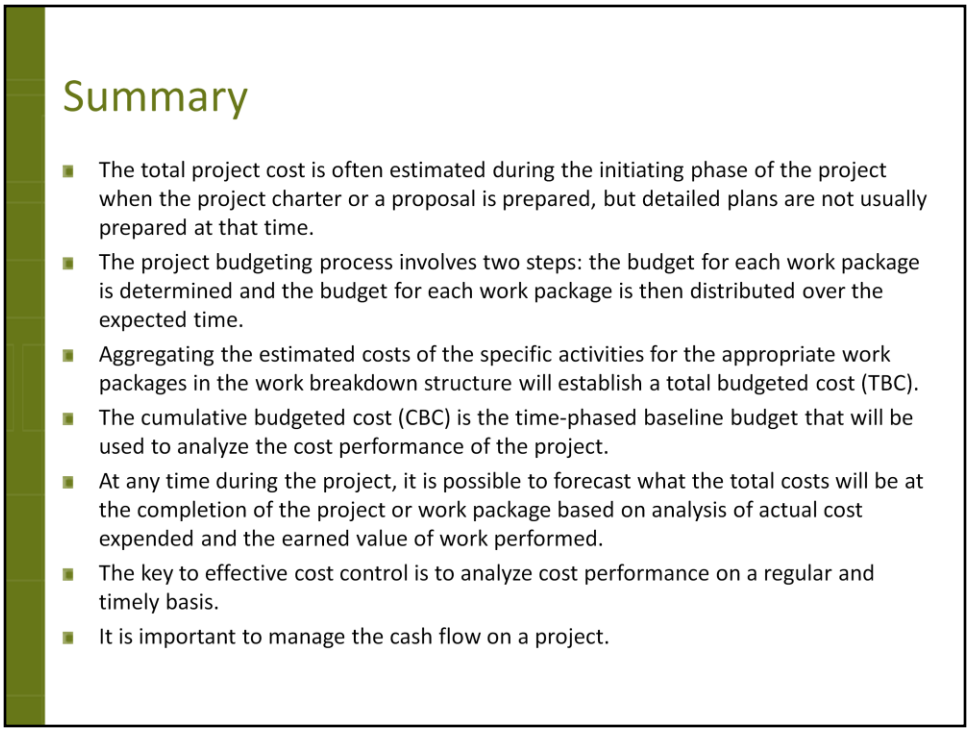
Critical Success Factors (continued)

- The key to effective cost control is to *analyze cost performance* on a *timely and regular basis*. Early identification of cost variances (CV) allows corrective actions to be taken immediately, before the situation gets worse.
- For analyzing cost performance, it is important that *all the data* collected be as *current as possible* and be based on the same reporting period.
- Trends in the *cost performance index* (CPI) should be monitored carefully. If the CPI goes below 1.0 or gradually decreases, corrective action should be taken.
- As part of the regular cost performance analysis, the estimated or *forecasted cost at completion* (FCAC) should be calculated.
- The key to effective cost control is to *aggressively address work packages* or activities with *negative cost variances* and cost inefficiencies as soon as they are identified. A concentrated effort must be applied to these areas. The amount of negative cost variance should determine the priority for applying these concentrated efforts.



Critical Success Factors (continued)

- When attempting to reduce negative cost variances, *focus on* activities that will be performed in the *near term* and on activities that have *large estimated costs*.
- Addressing cost problems early will *minimize the negative impact* on scope and schedule. Once costs get out of control, getting back within budget becomes more difficult and is likely to require reducing the project scope or quality, or extending the project schedule.
- The key to *managing cash flow* is to ensure that cash comes in faster than it goes out.
- It is desirable to *receive payments* (cash inflow) from the customer as *early as possible*, and to delay making payments (cash outflow) to suppliers or subcontractors as long as possible.



Summary

- The *total project cost* is often estimated during the *initiating phase* of the project when the project charter or a proposal is prepared, but *detailed plans* are *not* usually *prepared at that time*.
- The *project budgeting process* involves *two steps*: the budget for each work package is determined and the budget for each work package is then distributed over the expected time.
- Aggregating the estimated costs of the specific activities for the appropriate work packages in the work breakdown structure will establish a *total budgeted cost* (TBC).
- The *cumulative budgeted cost* (CBC) is the time-phased baseline budget that will be used to analyze the *cost performance of the project*.
- At any time during the project, it is possible to *forecast* what the *total costs* will be at the completion of the project or work package based on analysis of actual cost expended and the earned value of work performed.
- The key to *effective cost control* is to analyze cost performance on a regular and timely basis.
- It is important to *manage the cash flow* on a project.

Appendix (is testable!)

Time-Cost Trade-Off

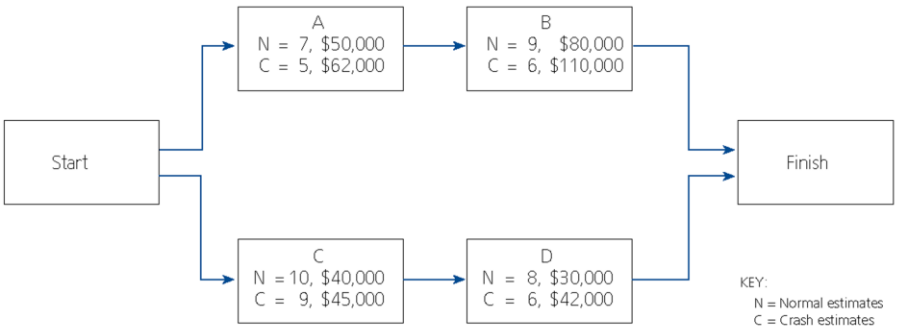
- Each activity can have two pairs of duration and cost estimates
  - **Normal time and cost**
    - Time to complete under normal conditions
    - Cost if done in normal time
  - **Crash time and cost**
    - Shortest possible length to complete the activity
    - Cost if done in crash time

Time-Cost Trade-Off (cont.)

- Assumptions
  - Activity duration can be shortened by applying more resources with an associated cost
  - Crash time is the shortest possible duration
  - Resources for acceleration are available
  - Relationship between time and cost is linear

$$\text{cost per time period} = \frac{\text{Crash cost} - \text{Normal Cost}}{\text{Normal time} - \text{Crash time}}$$

Network with Normal and Crash Times and Their Costs



A: Max accel:

Cost/wk:

B: Max accel:

Cost/wk

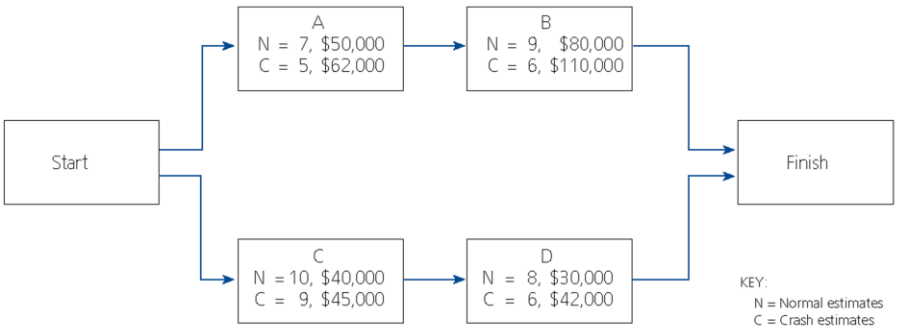
C: Max accel:

Cost/wk:

D: Max accel:

Cost/wk:

Network with Normal and Crash Times and Their Costs



A: Max accel: 2 weeks

Cost/wk: $6k

B: Max accel: 3 weeks

Cost/wk $10k

C: Max accel: 1 week

Cost/wk: $5k

D: Max accel: 2 weeks

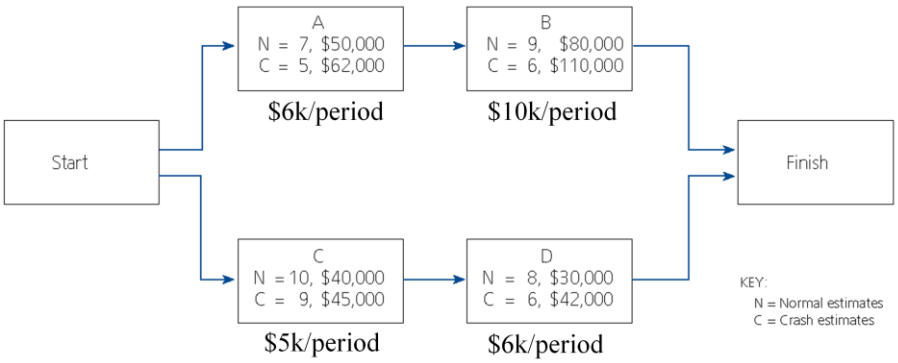
Cost/wk: $6k

Time-Cost Trade-Off (cont.)

- **Objective of time-cost trade-off**
  - Determine shortest completion time
  - By crashing activities with smallest cost increase
- **Method:**
  - Shorten project duration one period at a time
  - Crash only activities on critical path(s) with lowest cost per period increase
  - Until get shortest possible project completion time

Project duration: 18 weeks **Project cost: $200,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

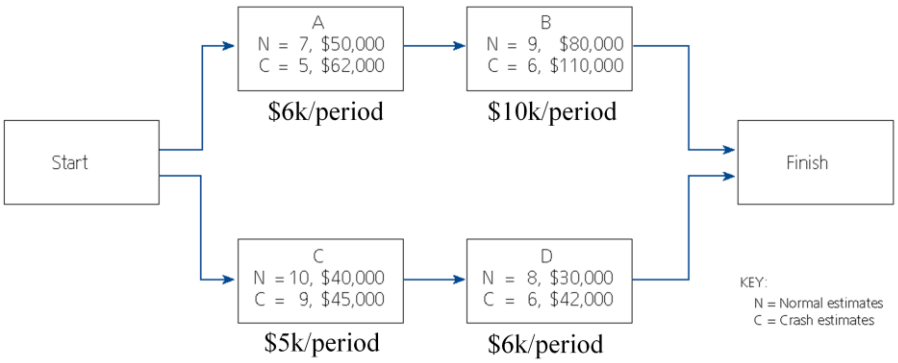
CP:

Which activity to accelerate:

New duration: **New cost:**

Project duration: 18 weeks **Project cost: $200,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

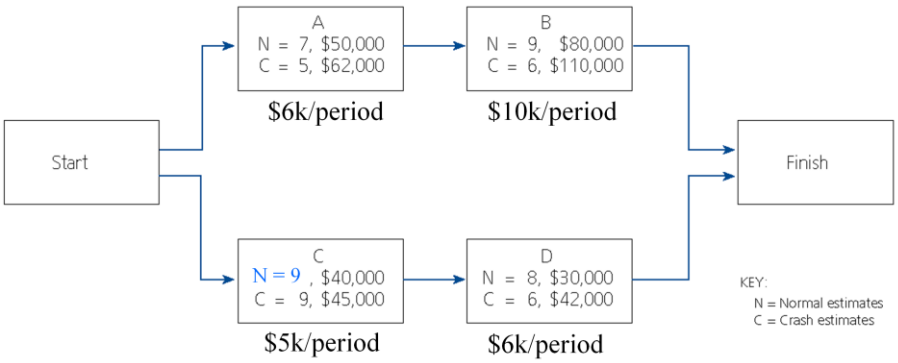
CP: C-D

Which activity to accelerate: C

New duration: 17 **New cost: $205,000**

Project duration: 17 weeks **Project cost: $205,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

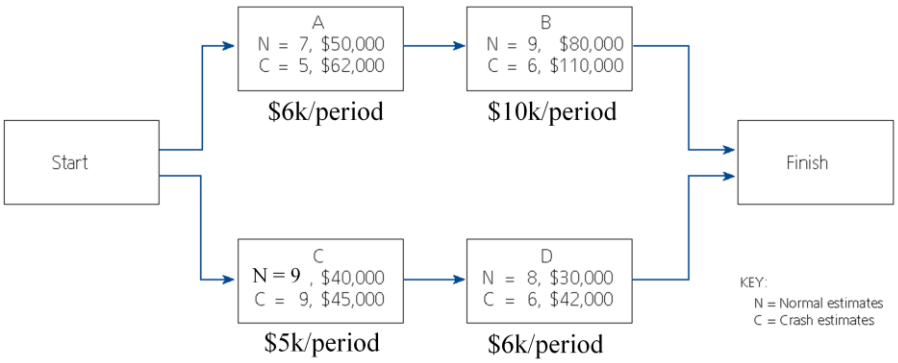
CP:

Which activity to accelerate:

New duration: **New cost:**

Project duration: 17 weeks **Project cost: $205,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

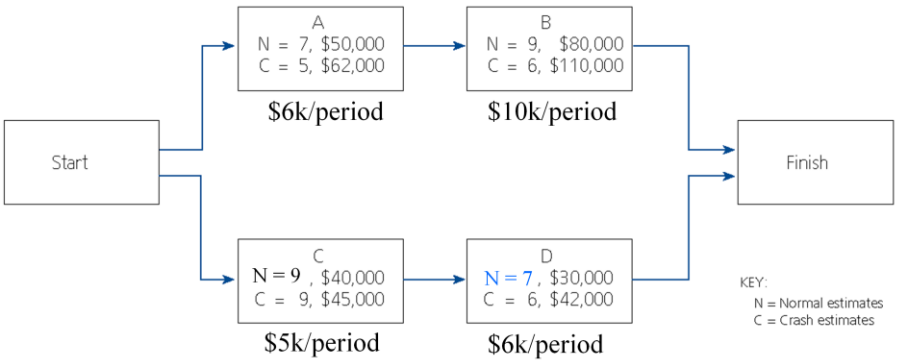
CP: C-D

Which activity to accelerate: D

New duration: 16 **New cost: $211,000**

Project duration: 16 weeks **Project cost: $211,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

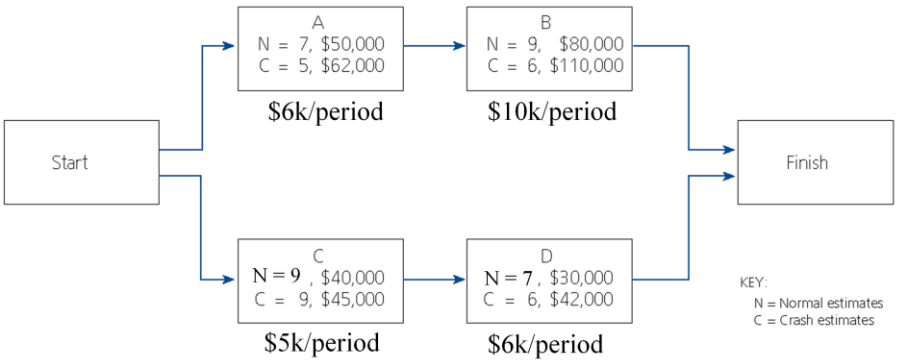
CP:

Which activity to accelerate:

New duration: **New cost:**

Project duration: 16 weeks **Project cost: $211,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

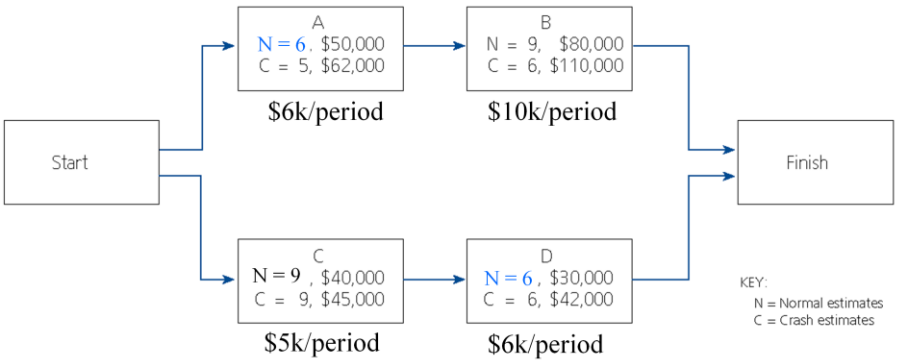
CP: A-B and C-D

Which activity to accelerate: A and D

New duration: 15 wks **New cost: $223,000**

Project duration: 15 weeks **Project cost: $223,000**

Network with Normal and Crash Times and Their Costs



Reduce by 1 wk

CP:

Which activity to accelerate:

New duration: **New cost:**