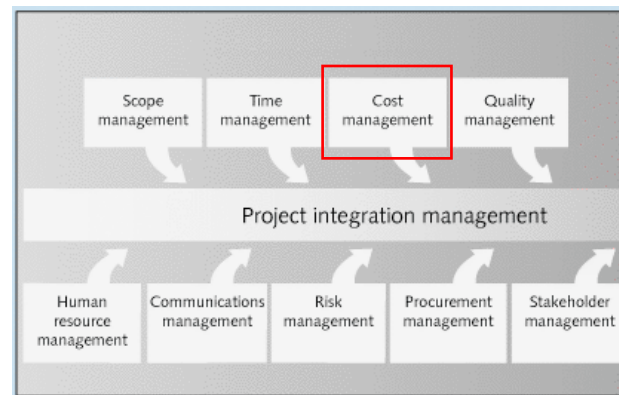
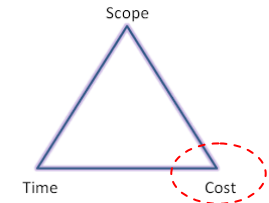


Project Cost Management



Lecturer: Dr. Igor Kharitonenko
igor@uow.edu.au

The Importance of Project Cost Management



- ▶ IT projects have a poor track record for meeting budget goals
- ▶ A cost overrun is the additional percentage or dollar amount by which actual costs exceed estimates
- ▶ A 2011 Harvard Business Review study of IT projects reported an average cost overrun of 27%. The most important finding was the discovery of a large number of massive cost overshoots
 - inaccurate cost estimates at the planning stage
 - mistakes in developing project budgets
 - poor monitoring and control

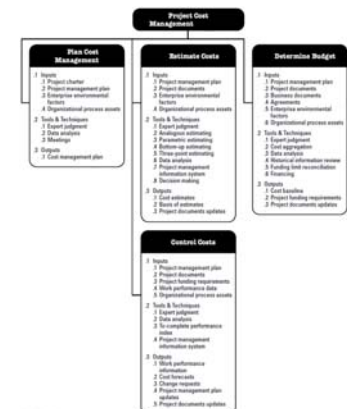


Other industries have the same problem

What is Cost and Project Cost Management?



- ▶ Cost is a resource spent to achieve a specific objective
- ▶ Costs are usually measured in monetary units like dollars
- ▶ Project cost management is a processes required to ensure that the project is completed within an approved budget. Each commercial project must be profitable.
- ▶ Project cost cannot be managed in isolation and is interrelated with the scope management and time management activities
- ▶ The PMBOK Guide defines four major activities that are essential for efficient cost management

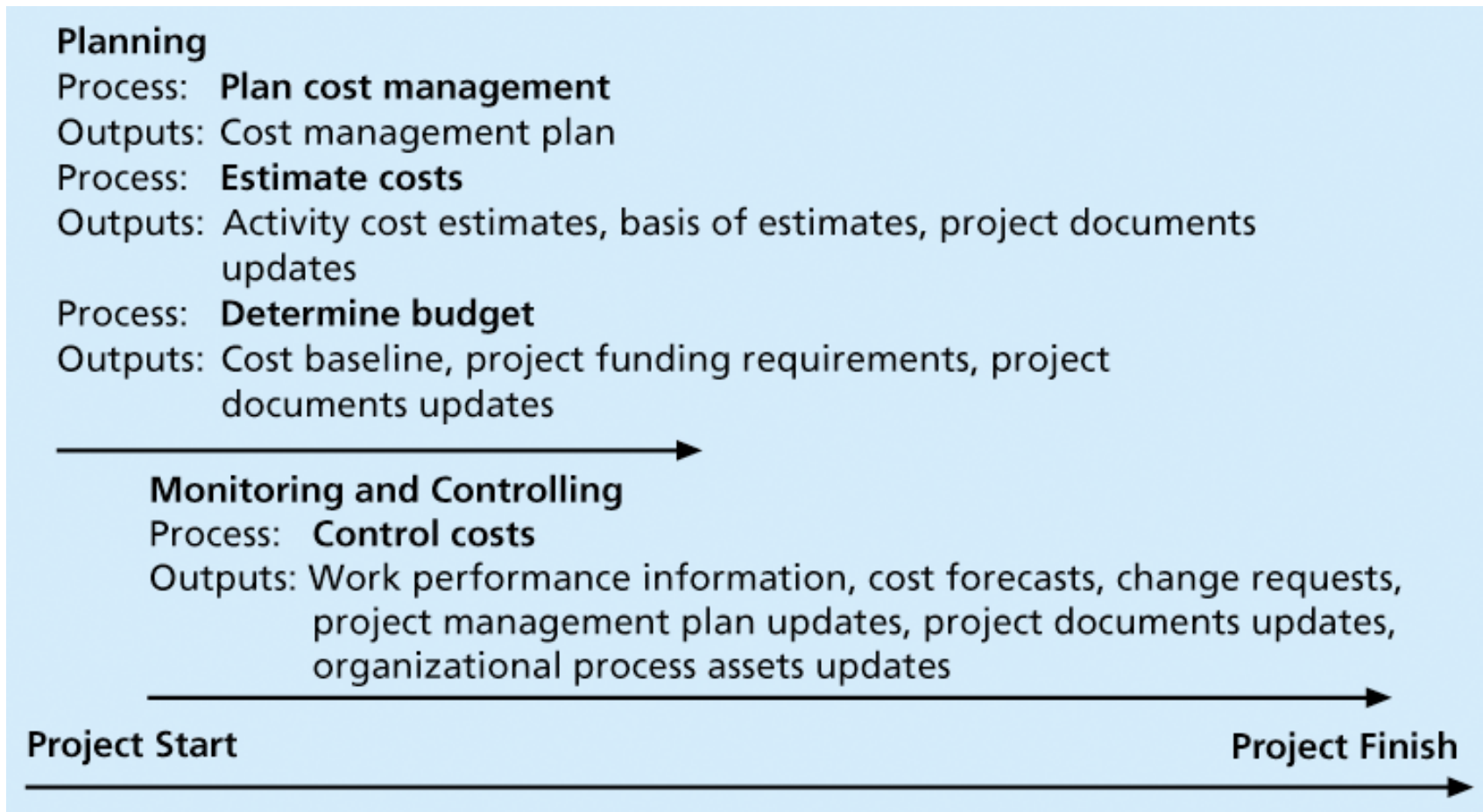


Project Cost Management Processes

- ▶ **Planning cost management:** preparing policies, procedures and documents that will be used for planning, executing, and controlling project cost
- ▶ **Estimating costs:** estimate costs of the resources that need to be allocated to individual work items
- Determining the budget:** calculation of the overall cost estimate to establish a baseline for monitoring project progress
- ▶ **Controlling costs:** controlling changes to the project budget

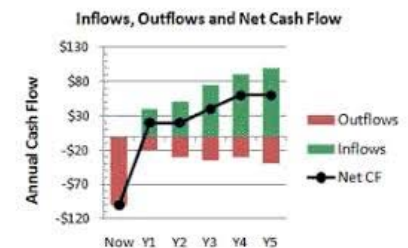


Figure 7-1. Project Cost Management Summary



Basic Principles of Cost Management

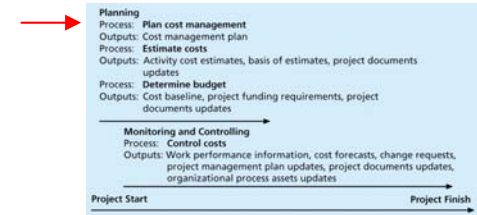
- ▶ Project selection, initiation and termination depend on decisions made by company's executives
- ▶ Most members of executive boards better understand and are more interested in financial terms than IT issues, so IT project managers must understand basic financial terms
 - **Profits** are revenues minus expenditures
 - **Profit margin** is the ratio of profits to revenues
 - **Life cycle costing** considers distribution of project cost throughout its life cycle
 - **Cash flow analysis** determines the estimated costs and benefits for a project and the resulting cash flow to make sure the company will not run out of money before the project is complete



Types of Costs and Benefits

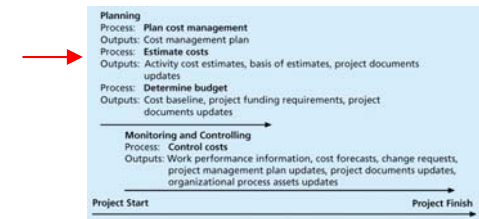
- ▶ **Tangible costs or benefits** are those costs or benefits that an organization can easily measure in dollars
- ▶ **Intangible costs or benefits** are costs or benefits that are difficult to measure in monetary terms
- ▶ **Direct costs** are costs that can be directly related to producing the products and services of the project
- ▶ **Indirect costs** are costs that are not directly related to the products or services of the project, but are indirectly related to performing the project
- ▶ **Reserves** are dollars included in a cost estimate to mitigate cost risk by allowing for future situations that are difficult to predict
 - **Contingency reserves** - for future situations that are partially planned
 - **Management reserves** allow for future situations that are unpredictable

Planning Costs Management



- ▶ The first step is to define the process explaining how the project costs will be managed
- ▶ The project team can use expert judgment, analytical techniques, and meetings to develop the Cost Management Plan
- ▶ Cost Management Plan may include:
 - Level of accuracy and units of measure (e.g. rounded to \$100)
 - Control thresholds (cost deviation threshold to act, e.g. 10%)
 - Rules of progress measurement (how often, explanations)
 - Reporting formats (format and frequency of cost reports)
 - Process descriptions (cost management process)

Estimating Costs



- ▶ Cost estimate is a prediction of how much the project will cost upon completion given the information available now
- ▶ Basic tools and techniques for cost estimates:
 - **Analogous estimates:** use the actual cost of a previous, similar project as the basis for estimating the cost of the current project
This technique is used when only limited information is available.
 - **Bottom-up estimates:** involve estimating individual work items or activities and summing them to get a project total
This technique is used when a detailed WBS is available
 - **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs
This technique is used when an accurate model can be created
May not be suitable for innovative projects

There are many other techniques that are mostly empirical



Estimating Costs

- ▶ Several cost estimates may need to be prepared depending what they will be used for
- ▶ Estimates are typically revised and become more accurate as time progresses

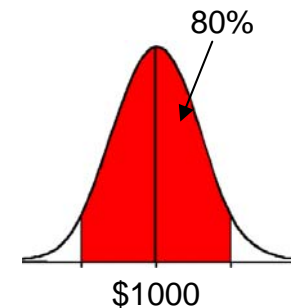
TYPE OF ESTIMATE	WHEN DONE	WHY DONE	HOW ACCURATE
Rough Order of Magnitude (ROM)	Very early in the project life cycle, often 3–5 years before project completion	Provides estimate of cost for selection decisions	–50% to +100%
Budgetary	Early, 1–2 years out	Puts dollars in the budget plans	–10% to +25%
Definitive	Later in the project, less than 1 year out	Provides details for purchases, estimates actual costs	–5% to +10%

Typical costs estimation issues

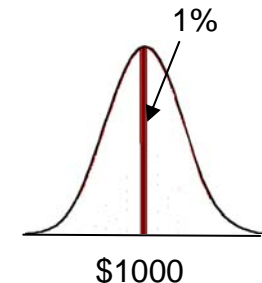
- ▶ Estimates are done too quickly
Accurate estimation is a complex process that requires significant efforts and time
- ▶ Estimates are done too early and too far
It's important to avoid premature estimates beyond the degree to which a project is clearly defined
- ▶ People lack estimating experience
Misunderstanding of accounting and financial basics
- ▶ Human beings are biased toward underestimation
Do not rely on the best case scenario
Actual IT staff productivity is usually 75-80 % of their time at work
- ▶ Affected by management desires
There can be political or financial reasons to tune some numbers

Estimating Costs

- ▶ There are several characteristics for judging quality of project cost estimates:
 - **Accuracy:** a cost estimate is only as useful as it is accurate. Use appropriate techniques and revise estimates as the project scope and schedule become more detailed
 - **Confidence level:** Even the best estimates contain some degree of uncertainty. Use statistical methods to measure the amount of variance and communicate to stakeholders.
 - **Credibility:** Stakeholders need to know that estimates have been obtained using established techniques. Increase the credibility of by incorporating expert judgments.
 - **Documentation:** Document all assumptions and techniques used for cost estimating. Formal project documents prevent misunderstanding and blaming if something goes wrong.



Probability that the cost estimate is within the confidence interval



Estimating IT project costs

- ▶ Cost estimation for IT development projects is best conducted as a combination of analogous and bottom-up techniques
- ▶ Analogous and bottom-up cost estimation techniques do not adapt well to Agile project frameworks
- ▶ As Agile development supports fixed-time sprints and teams of a known size, parametric estimating techniques are more appropriate

*cost of a sprint = pay rate * team size * sprint duration*

- ▶ Because Agile frameworks presume scope changes, it is difficult to pre-plan the number of sprints needed on system design for innovative projects

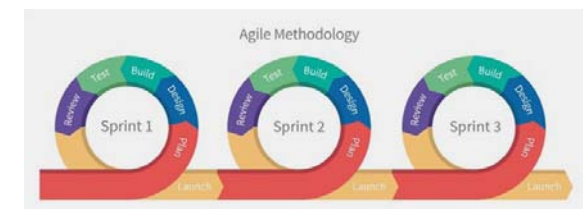


Figure 7-2. Surveyor Pro Project Cost Estimate

Surveyor Pro Project Cost Estimate Created October 5

	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 2 Totals	% of Total
WBS Items					
1. Project Management				\$306,300	20%
Project manager	960	\$100	\$96,000		
Project team members	1920	\$75	\$144,000		
Contractors (10% of software development and testing)			\$66,300		
2. Hardware				\$76,000	5%
2.1 Handheld devices	100	\$600	\$60,000		
2.2 Servers	4	\$4,000	\$16,000		
3. Software				\$614,000	40%
3.1 Licensed software	100	\$200	\$20,000		
3.2 Software development*			\$594,000		
4. Testing (10% of total hardware and software costs)			\$69,000	\$69,000	5%
5. Training and Support				\$202,400	13%
Trainee cost	100	\$500	\$50,000		
Travel cost	12	\$700	\$8,400		
Project team members	1920	\$75	\$144,000		
6. Reserves (20% of total estimate)			\$253,540	\$253,540	17%
Total project cost estimate				\$1,521,240	

*See software development estimate.

Figure 7-3. Surveyor Pro Software Development Estimate

1. Labor Estimate	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	Calculations
Contractor labor estimate	3000	\$150	\$450,000	$3000 * 150$
Project team member estimate	1920	\$75	\$144,000	$1920 * 75$
Total labor estimate			\$594,000	Sum above two values
2. Function point estimate	Quantity	Conversion Factor	Function Points	Calculations
External inputs	10	4	40	$10 * 4$
External interface files	3	7	21	$3 * 7$
External outputs	4	5	20	$4 * 5$
External queries	6	4	24	$6 * 4$
Logical internal tables	7	10	70	$7 * 10$
Total function points			175	Sum above function point values
Java 2 language equivalency value			46	Assumed value from reference
Source lines of code (SLOC) estimate			8,050	$175 * 46$
Productivity \times KSLOC ^{Penalty} (in months)			29.28	$3.13 * 8.05^{1.072}$ (see reference)
Total labor hours (27 hours/function point)*			4,725	$27 * 175$
Cost/labor hour (\$120/hour)			\$120	Assumed value from budget expert
Total function point estimate			\$567,000	$4,725 * 120$

* Based on historical data

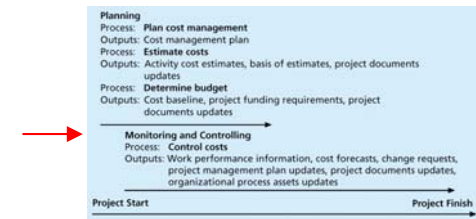
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Determining the Budget

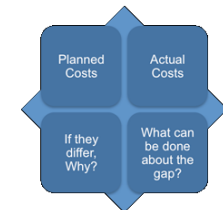
- ▶ Cost budgeting involves allocating the project cost estimate to individual work items distributed over time
- ▶ The WBS and the schedule provide an input to the cost budgeting process
- ▶ The goal of the planning stage is to produce a **cost baseline**
 - a time-phased budget that project managers use to measure and monitor cost performance

WBS Items	1	2	3	4	5	6	7	8	9	10	11	12	Totals
1. Project Management													
1.1 Project manager	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	96,000
1.2 Project team members	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	144,000
1.3 Contractors		6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	66,300
2. Hardware													
2.1 Handheld devices				30,000	30,000								60,000
2.2 Servers				8,000	8,000								16,000
3. Software													
3.1 Licensed software				10,000	10,000								20,000
3.2 Software development		60,000	60,000	80,000	127,000	127,000	90,000	50,000					594,000
4. Testing			6,000	8,000	12,000	15,000	15,000	13,000					69,000
5. Training and Support													
5.1 Trainee cost									50,000				50,000
5.2 Travel cost									8,400				8,400
5.3 Project team members							24,000	24,000	24,000	24,000	24,000	24,000	144,000
6. Reserves				10,000	10,000	30,000	30,000	60,000	40,000	40,000	30,000	3,540	253,540
Totals	20,000	86,027	92,027	172,027	223,027	198,027	185,027	173,027	148,427	90,027	80,027	53,567	1,521,240

Controlling Costs



- ▶ Project cost control includes
 - Monitoring costs
 - Informing project stakeholders of required project changes that will affect project costs and need their approval
 - Ensuring that only appropriate project changes are included in a revised cost baseline
- ▶ Project cost monitoring and control is carried out according to the Cost Management Plan
- ▶ Cost performance reports and cost forecasts cannot be practically useful without efficient cost control techniques that take into account all factors affecting project progress
 - You may have spent more, but you're progressing ahead of the schedule



Earned Value Management (EVM)

- ▶ **EVM** is a project performance measurement technique that integrates scope, time, and cost to measure progress
- ▶ Given a **baseline**, you can determine how well the project is meeting its goals and accurately forecast project performance problems
- ▶ Earned Value Management allows the project manager to answer the following three questions:
 - Where have we been?
 - Where are we now?
 - Where are we going?



Earned Value Management Terms

To use EVM, you need to use the following measurements:

- ▶ The **planned value (PV)** is a part of the estimated project cost that has been planned to be spent at any given point in project timeline

Example: Now, six months after the start of the project, a project manager should report that he has spent \$10 000 of the budget according to the plan

- ▶ **Actual cost (AC)** is the actual costs spent at any given point in project timeline

Example: Now, six months after the start of the project, a project manager reports that he has actually spent \$15 000 of the budget (instead of \$10 000)

- ▶ The **earned value (EV)** is the value of work actually completed at any given point in project timeline

Example: Now, six months after the start of the project, a project manager reports that he has actually completed 75% of work for the project that has a budget \$20 000. Thus, $EV = 0.75 * \$20\,000 = \$15\,000$

Rate of Performance

- ▶ **Rate of performance (RP)** is the ratio of actual work completed to the percentage of work planned to be completed at any given time during the life of the project or activity

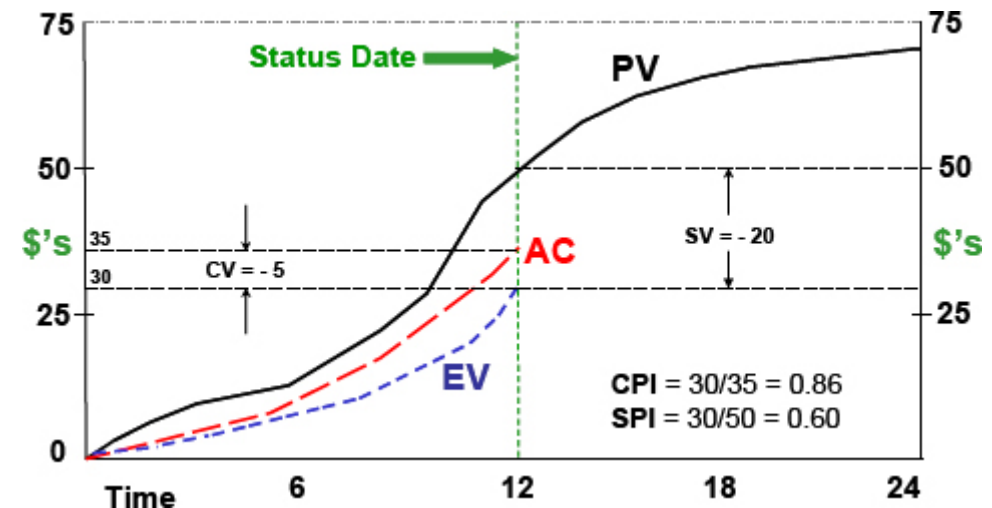
Example: Installation of a server is planned for 1 week. It's actually halfway completed by the end of the week. Therefore, the rate of performance is 50% because by the end of week 1, the planned schedule reflects that the task should be 100 percent complete and only 50 percent of that work has been actually completed

Cost Variance: **$CV = EV - AC$**

Schedule Variance: **$SV = EV - PV$**

Schedule Performance Index: **$SPI = EV/PV$**

Cost Performance Index: **$CPI = EV/AC$**



An example

- ▶ According to the project plan, server installation should take one week and cost a total of \$10 000
- ▶ It actually took two weeks with the cost of \$20 000
- ▶ \$15,000 of the total cost were spent during Week 1 and \$5,000 were spent during Week 2.

Table 7-3. Earned Value Calculations for One Activity After Week One

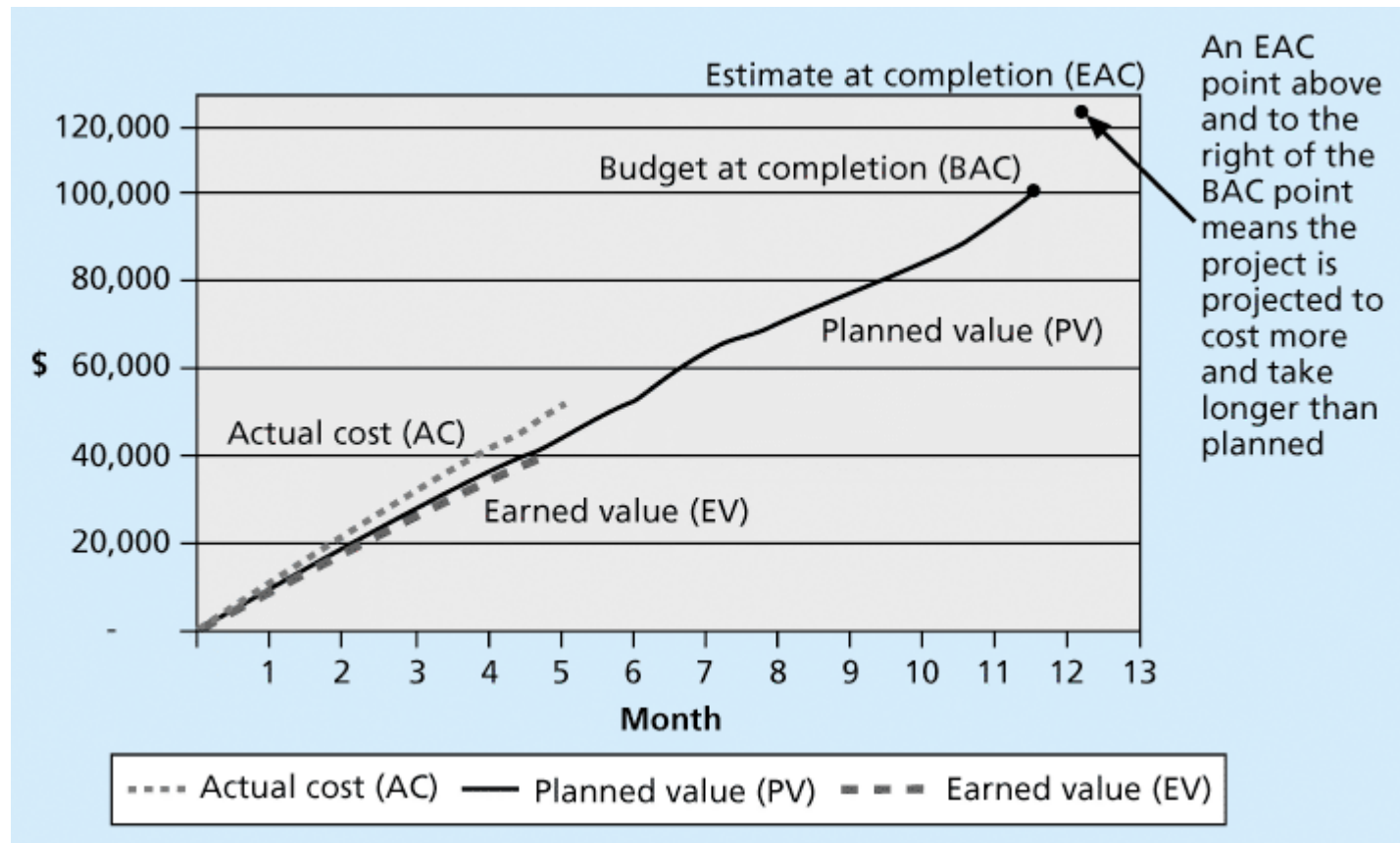
Term	Formula
Earned value (EV)	$EV = PV \text{ to date} * RP$
Cost variance (CV)	$CV = EV - AC$
Schedule variance (SV)	$SV = EV - PV$
Cost performance index (CPI)	$CPI = EV/AC$
Schedule performance index (SPI)	$SPI = EV/PV$
Estimate at completion (EAC)	$EAC = BAC/CPI$
Estimated time to complete	Original time estimate/SPI

	WEEK 1	
Planned Value (PV)	10,000	
Actual Cost (AC)	15,000	
Earned Value (EV)	5,000	$\$10\,000 * 0.5 = \$5\,000$
Cost Variance (CV)	-10,000	$\$5\,000 - \$15\,000 = -10\,000$
Schedule Variance (SV)	-5,000	$\$5\,000 - \$10\,000 = -5\,000$
Cost Performance Index (CPI)	33%	$\$5\,000 / \$15\,000 = 0.33$
Schedule Performance Index (SPI)	50%	$\$5\,000 / \$10\,000 = 0.5$

Rules of Thumb for Earned Value Numbers

- ▶ Negative numbers for cost and schedule variance indicate problems with the project progress
- ▶ CPI and SPI less than 100% indicate problems
- ▶ Problems mean the project is costing more than planned (over budget) or taking longer than planned (behind schedule)
- ▶ The CPI can be used to calculate the **estimate at completion** (EAC)—an estimate of what it will cost to complete the project based on performance measured now. The **budget at completion** (BAC) is the original total budget for the project

Figure 7-5. Earned Value Chart for Project after Five Months



$EAC = BAC / CPI$ this formula for predicting the EAC assumes that current CPI does not change

Using Software to Assist in Cost Management

- ▶ Spreadsheets are a common tool for resource planning, cost estimating, cost budgeting, and cost control
- ▶ Many companies use more sophisticated and centralized financial applications software for cost information
- ▶ Project management software has many cost-related features, especially enterprise PM software
- ▶ Portfolio management software can help reduce costs

Chapter Summary

- ▶ Project cost management is a traditionally weak area of IT projects, and project managers must work to improve their ability to deliver projects within approved budgets
- ▶ Main processes include
 - Plan cost management
 - Estimate costs
 - Determine the budget
 - Control costs

Chapter 7: Project Cost Management

