Chapter 7:
Project Cost Management

Information Technology Project Management, Fourth Edition

Learning Objectives

- Understand the importance of project cost management.
- Explain basic project cost management principles, concepts, and terms.
- Discuss different types of cost estimates and methods for preparing them.

Learning Objectives

- Understand the processes involved in cost budgeting and preparing a cost estimate and budget for an information technology project.
- Understand the benefits of earned value management and project portfolio management to assist in cost control.
- Describe how project management software can assist in project cost management.

The Importance of Project Cost Management

- IT projects have a poor track record for meeting budget goals.
- The 2003 CHAOS studies showed the average cost **overrun** (the additional percentage or dollar amount by which actual costs exceed estimates) was 43 percent.
- U.S. lost $55 billion in IT projects in 2002 from cancelled projects and overruns compared to $140 billion in 1994.

What Went Wrong?

According to the *San Francisco Chronicle's* front-page story, "Computer Bumbling Costs the State $1 Billion," the state of California had a series of expensive IT project failures in the late 1990s, costing taxpayers nearly $1 billion…It was ironic that the state that was leading in the creation of computers was also the state most behind in using computer technology to improve its services.

The Internal Revenue Service (IRS) managed a series of project failures that cost taxpayers over $50 billion a year—roughly as much money as the annual net profit of the entire computer industry.

Connecticut General Life Insurance Co. sued PeopleSoft over an aborted installation of a finance system.

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, such as dollars.
- **Project cost management** includes the processes required to ensure that the project is completed within an approved budget.

Project Cost Management Processes

- **Cost estimating**: Developing an approximation or estimate of the costs of the resources needed to complete a project.
- **Cost budgeting**: Allocating the overall cost estimate to individual work items to establish a baseline for measuring performance.
- **Cost control**: Controlling changes to the project budget.

Basic Principles of Cost Management

- Most members of an executive board have a better understanding and are more interested in financial terms than IT terms, so IT project managers must speak their language.
  - **Profits** are revenues minus expenses.
  - **Life cycle costing** considers the total cost of ownership, or development plus support costs, for a project.
  - **Cash flow analysis** determines the estimated annual costs and benefits for a project and the resulting annual cash flow.

Table 7-1. Cost of Software Defects

When Defect Is Detected	Typical Costs of Correction
User Requirements	$100 – $1,000
Coding/Unit Testing	$1,000 or more
System Testing	$7,000 – $8,000
Acceptance Testing	$1,000 – $100,000
After Implementation	Up to millions of dollars

It is important to spend money up-front on IT projects to avoid spending a lot more later.

Basic Principles of Cost Management

- **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.
- **Sunk cost** is money that has been spent in the past; when deciding what projects to invest in or continue, you should *not* include sunk costs.

Basic Principles of Cost Management

- **Learning curve theory** states that when many items are produced repetitively, the unit cost of those items decreases in a regular pattern as more units are produced.
- **Reserves** are dollars included in a cost estimate to mitigate cost risk by allowing for future situations that are difficult to predict.
  - **Contingency reserves** allow for future situations that may be partially planned for (sometimes called **known unknowns**) and are included in the project cost baseline.
  - **Management reserves** allow for future situations that are unpredictable (sometimes called **unknown unknowns**).

Cost Estimating

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints.
- It's important to know the types of cost estimates, how to prepare cost estimates, and typical problems associated with IT cost estimates.

Table 7-2. Types of Cost Estimates

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	–25% to +75%
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%

Cost Management Plan

- A **cost management plan** is a document that describes how the organization will manage cost variances on the project.
- A large percentage of total project costs are often labor costs, so project managers must develop and track estimates for labor.

Table 7-3. Maximum Departmental Headcounts by Year

Department	1994	1995	1996	1997	1998	Totals
Information Systems	24	31	35	13	13	116
Marketing Systems	3	3	3	3	3	15
Reservations	12	29	33	9	7	90
Contractors	2	3	1	0	0	6
Totals	41	66	72	25	23	227

A large percentage of the costs of many IT projects are human resource costs.

Cost Estimation Tools and Techniques

- Basic tools and techniques for cost estimates:
  - **Analogous** or **top-down estimates**: Use the actual cost of a previous, similar project as the basis for estimating the cost of the current project.
  - **Bottom-up estimates**: Involve estimating individual work items or activities and summing them to get a project total.
  - **Parametric modeling**: Uses project characteristics (parameters) in a mathematical model to estimate project costs.
  - **Computerized tools**: Tools, such as spreadsheets and project management software, that can make working with different cost estimates and cost estimation tools easier.

Constructive Cost Model (COCOMO)

- Barry Boehm helped develop the COCOMO models for estimating software development costs.
- Parameters include:
  - **Function points**: Technology-independent assessments of the functions involved in developing a system.
  - **Source Lines of Code** (**SLOC**): A human-written line of code that is not a blank line or comment.
- Boehm suggests that only parametric models do not suffer from the limits of human decision-making.

Typical Problems with IT Cost Estimates

- Developing an estimate for a large software project is a complex task that requires a significant amount of effort.
- People who develop estimates often do not have much experience.
- Human beings are biased toward underestimation.
- Management might ask for an estimate, but really desire a bid to win a major contract or get internal funding.

Sample Cost Estimate

- See pages 262-266 for a detailed example that describes how to create a cost estimate for the Surveyor Pro project described in the opening case.
- Before creating an estimate, know what it will be used for, gather as much information about the project as possible, and clarify the ground rules and assumptions for the estimate.
- If possible, estimate costs by major WBS categories.
- Create a cost model to make it easy to change and document the estimate.

Figure 7-1. Surveyor Pro Project Cost Estimate

Surveyor Pro Project Cost Estimate Created October 5, 2006

	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 1 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 7-2. Surveyor Pro Software Development Estimate

Surveyor Pro Software Development Estimate Created October 5, 2006

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 languange equivalency value			46	Assumed value from reference
Source lines of code (SLOC) estimate			8,050	175*46
Productivity*KSLOC^Penalty (in months)			29.28	3.13*8.05^1.072 (see reference)
Total labor hours (160 hours/month)			4,684.65	29.28*160
Cost/labor hour ($120/hour)			$120	Assumed value from budget expert
Total function point estimate			**$562,158**	4684.65*120

**Approach based on paper by William Roetzheim, "Estimating Software Costs," Cost Xpert Group, Inc. (2003) using the COCOMO II default linear productivity factor (3.13) and penalty factor (1.072).

Cost Budgeting

- Cost budgeting involves allocating the project cost estimate to individual work items over time.
- The WBS is a required input for the cost budgeting process because it defines the work items.
- Important goal is to produce a **cost baseline**:
  - A time-phased budget that project managers use to measure and monitor cost performance.

Figure 7-3. Surveyor Pro Project Cost Baseline

Surveyor Pro Project Cost Baseline Created October 10, 2006*

WBS Items	1	2	3	4	5	6	7	8	9	10	11	12	Totals
1. Project Management													
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
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
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			594,000
4. Testing			6,000	8,000	12,000	15,000	15,000	13,000		69,000			69,000
5. Training and Support													
Trainee cost									50,000				50,000
Travel cost									8,400				8,400
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	753,027	80,027	53,567	1,521,240

*See the lecture slides for this chapter on the companion Web site for a larger view of this and other figures in this chapter.

Cost Control

- Project cost control includes:
  - Monitoring cost performance.
  - Ensuring that only appropriate project changes are included in a revised cost baseline.
  - Informing project stakeholders of authorized changes to the project that will affect costs.
- Many organizations around the globe have problems with cost control.

Media Snapshot

- **Australia**: Problems with the installation of an ERP system at Crane Group Ltd. led to an estimated cost overrun of $11.5 million.
- **India**: As many as 274 projects currently under implementation in the Central sector are suffering serious cost and time overruns.
- **Pakistan**: Pakistan has sustained a cost overrun of Rs 1.798 billion (over $30 million U.S. dollars) in the execution of the 66.5 megawatt Jagran Hydropower Project in the Neelum Valley.
- **United States**: Northern California lawmakers were outraged over Governor Arnold Schwarzenegger's announcement that commuters should have to pay construction costs on Bay Area bridges. *Maybe it takes the Terminator to help control costs!*

Earned Value Management (EVM)

- **EVM** is a project performance measurement technique that integrates scope, time, and cost data.
- Given a **baseline** (original plan plus approved changes), you can determine how well the project is meeting its goals.
- You must enter actual information periodically to use EVM.
- More and more organizations around the world are using EVM to help control project costs.

Earned Value Management Terms

- The **planned value (PV)**, formerly called the budgeted cost of work scheduled (BCWS), also called the budget, is that portion of the approved total cost estimate planned to be spent on an activity during a given period.
- **Actual cost (AC)**, formerly called actual cost of work performed (ACWP), is the total of direct and indirect costs incurred in accomplishing work on an activity during a given period.
- The **earned value (EV)**, formerly called the budgeted cost of work performed (BCWP), is an estimate of the value of the physical work actually completed.
- EV is based on the original planned costs for the project or activity and the rate at which the team is completing work on the project or activity to date.

Rate of Performance

- **Rate of performance (RP)** is the ratio of actual work completed to the percentage of work planned to have been completed at any given time during the life of the project or activity.
- Brenda Taylor, Senior Project Manager in South Africa, suggests using this approach for estimating earned value.
- For example, suppose the server installation was halfway completed by the end of week 1. The rate of performance would be 50 percent (50/100) 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 completed.

Table 7-4. Earned Value Calculations for One Activity After Week One

Activity	Week 1
Earned Value (EV)	5,000
Planned Value (PV)	10,000
Actual Cost (AC)	15,000
Cost Variance (CV)	–7,500
Schedule Variance (SV)	–2,500
Cost Performance Index (CPI)	50%
Schedule Performance Index (SPI)	75%

Table 7-5. Earned Value Formulas

TERM	FORMULA
Earned Value	EV = PV to date × RP
Cost Variance	CV = EV – AC
Schedule Variance	SV = EV – PV
Cost Performance Index	CPI = EV/AC
Schedule Performance Index	SPI = EV/PV
Estimate at Completion (EAC)*	EAC = BAC/CPI
Estimated Time to Complete	Original Time Estimate/SPI

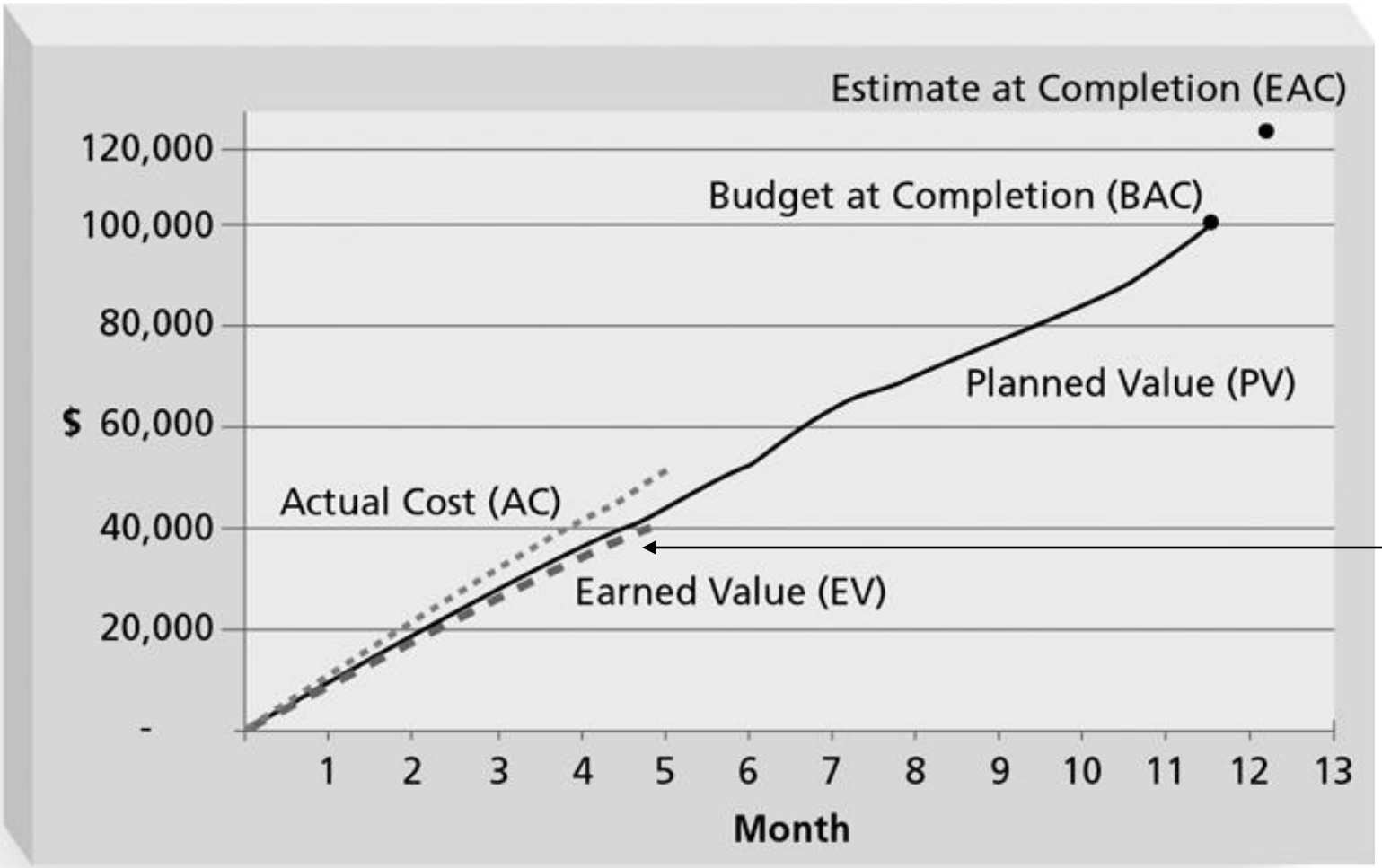
Rules of Thumb for Earned Value Numbers

- Negative numbers for cost and schedule variance indicate problems in those areas.
- A CPI or SPI that is less than 100 percent indicates problems.
- Problems mean the project is costing more than planned (over budget) or taking longer than planned (behind schedule).

Figure 7-4. Earned Value Calculations for a One-Year Project After Five Months

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1														To Date	Planned	Actual
2	**Activity**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**PV**	**% Complete**	**% Complete**
3	Plan and staff project	4,000	4,000											8,000	100	100
4	Analyze requirements		6,000	6,000										12,000	100	100
5	Develop ERDs			4,000	4,000									8,000	100	100
6	Design database tables				6,000	4,000								10,000	100	100
7	Design forms, reports, and queries					8,000	4,000							8,000	75	50
8	Construct working prototype						10,000								-	
9	Test/evaluate prototype						2,000	6,000							-	
10	Incorporate user feedback							4,000	6,000	4,000					-	
11	Test system									4,000	4,000	2,000			-	
12	Document system											3,000	1,000		-	
13	Train users												4,000		-	
14	Monthly Planned Value (PV)	4,000	10,000	10,000	10,000	12,000	16,000	10,000	6,000	8,000	4,000	5,000	5,000			
15	Cumulative Planned Value (PV)	4,000	14,000	24,000	34,000	46,000	62,000	72,000	78,000	86,000	90,000	95,000	100,000			
16	Monthly Actual Cost (AC)	4,000	11,000	11,000	12,000	15,000										
17	Cumulative Actual Cost (AC)	4,000	15,000	26,000	38,000	53,000										
18	Monthly Earned Value (EV)	4,000	10,000	10,000	10,000	9,333										
19	Cumulative Earned Value (EV)	4,000	14,000	24,000	34,000	43,333										
20	Project EV as of May 31	43,333														
22	Project PV as of May 31	46,000														
21	Project AC as of May 31	$ 53,000														
23	**CV=EV-AC**	**$ (9,667)**														
24	**SV=EV-PV**	**$ (2,667)**														
25	**CPI=EV/AC**	**81.761%**														
26	**SPI=EV/PV**	**94.203%**														
27	**Estimate at Completion (EAC)**	**$ 122,308** (original plan of $100,000 divided by CPI)														
28	**Estimated time to complete**	**12.74** (original plan of 12 months divided by SPI)														

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



If the EV line is below the AC or PV line, there are problems in those areas.

Project Portfolio Management

- Many organizations collect and control an entire suite of projects or investments as one set of interrelated activities in a portfolio.
- Project portfolio management has five levels:
  1. Put all your projects in one database.
  2. Prioritize the projects in your database.
  3. Divide your projects into two or three budgets based on type of investment.
  4. Automate the repository.
  5. Apply modern portfolio theory, including risk-return tools that map project risk on a curve.

Benefits of Portfolio Management

- Schlumberger saved $3 million in one year by organizing 120 information technology projects into a portfolio.
- META Group research shows that:
  - Organizations that evaluate information technology projects by what their business impacts are and what their potential business values will be implement projects that result in 25 percent more improvement to the bottom line.
  - By 2005-2006, more than 50 percent of the CIOs for Global 2000 companies will adopt project portfolio management tools and techniques for IT projects, asset management, and budget planning and monitoring.
  - Business executives state that using project portfolio management allows managers to make decisions faster and with more confidence.

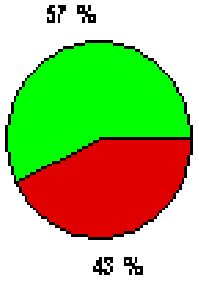
Using Software to Assist in Cost Management

- 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.

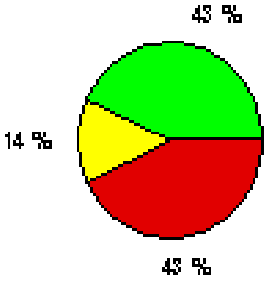
Figure 7-6. Sample Project Portfolio Management Screen Showing Project Health

PLANVIEW

Project Health (Effort Based)



Schedule Variance	Project Count
On Target	4
In Trouble	3



Cost Variance	Project Count
On Target	3
At Risk	1
In Trouble	3

Work Id	Project	% Complete	Schedule Variance	Cost Variance	Budget Variance	Risk Pct
0000051	Upgrade Sales Staff Laptop PC's	100.0 %	0.0	-74.0	-74.0	-
CAW-035	CRM Website	75.8 %	8.0	18.0	18.0	39.7 %
CW-2002	MyMystic.com Customer Website	97.0 %	-120.0	-343.0	-263.0	-
PARMS-0	PARMS Implementation	50.4 %	-440.0	-192.0	-8.0	3.9 %
POS-2002	PlanView and SAP Financial Integration	98.6 %	0.0	-221.0	-221.0	-
SSR-012	Strategic Systems Review	0.0 %	0.0	0.0	-72.0	15.9 %
TAU-2002	Tax Accounting Update 2002	24.9 %	-119.0	-15.0	33.0	0

Chapter Summary

- Project cost management is traditionally a weak area in IT projects, and project managers must work to improve their ability to deliver projects within approved budgets.
- Main processes include:
  - Cost estimating
  - Cost budgeting
  - Cost control