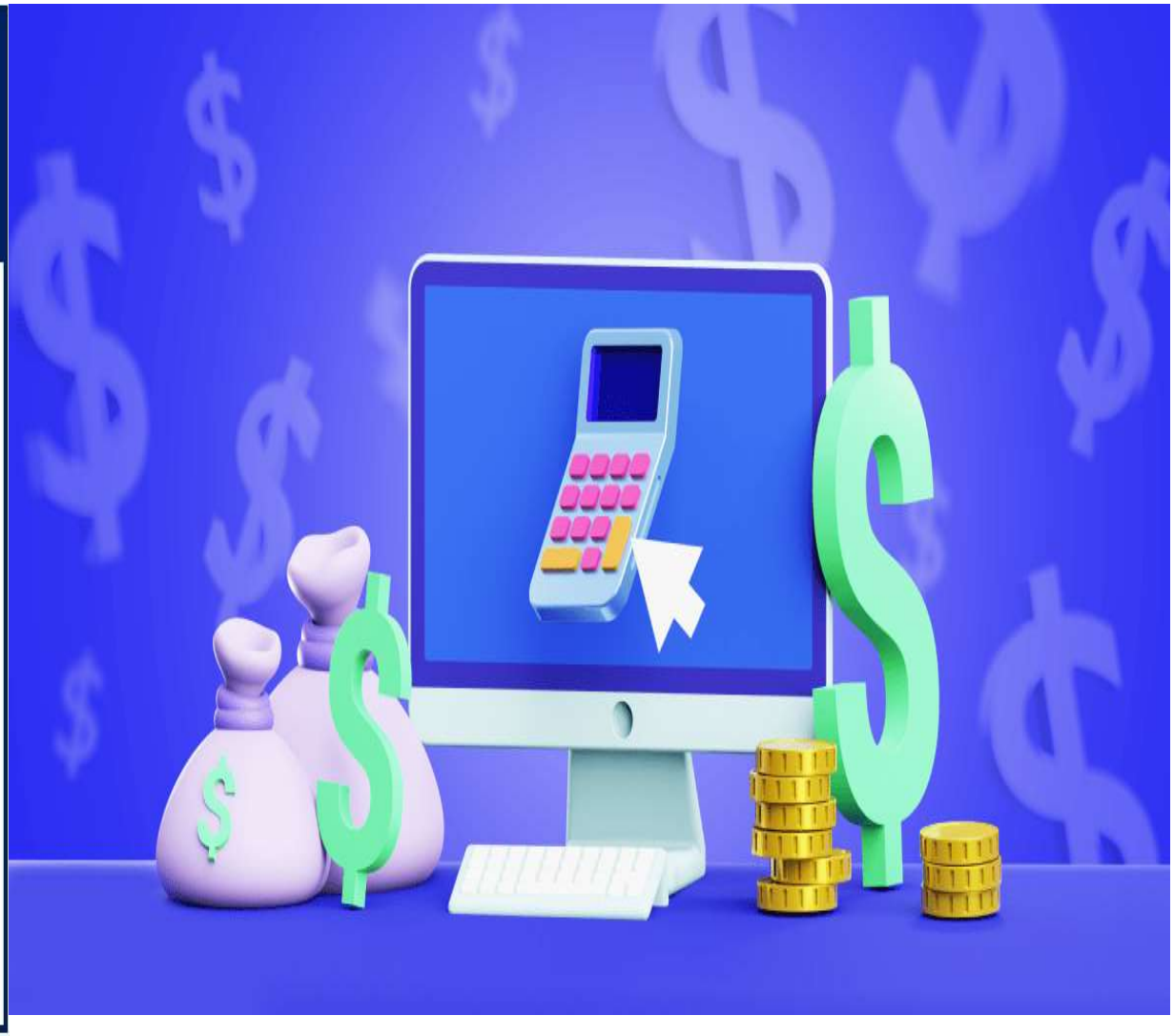
Chapter 7: Project Cost Management

Learning Objectives

- Develop a justification for project cost management and its importance in achieving project success
- Explain basic project cost management principles, concepts, and terms
- Describe the process of planning cost management
- Discuss different types of cost estimates and methods for preparing them
- Using an example of an information technology (IT) project, list and describe the processes of determining a budget and preparing a cost estimate
- Justify the use of earned value management and project portfolio management to assist in cost control
- Describe how project management software can assist in project cost management
- Discuss considerations for agile/adaptive environments

What is Cost?

- Cost is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange
  - Usually measured in monetary units like dollars that must be paid to acquire goods and services



What is Project Cost Management?

- Project cost management includes the processes required to ensure that the project is completed within an approved budget
  - 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

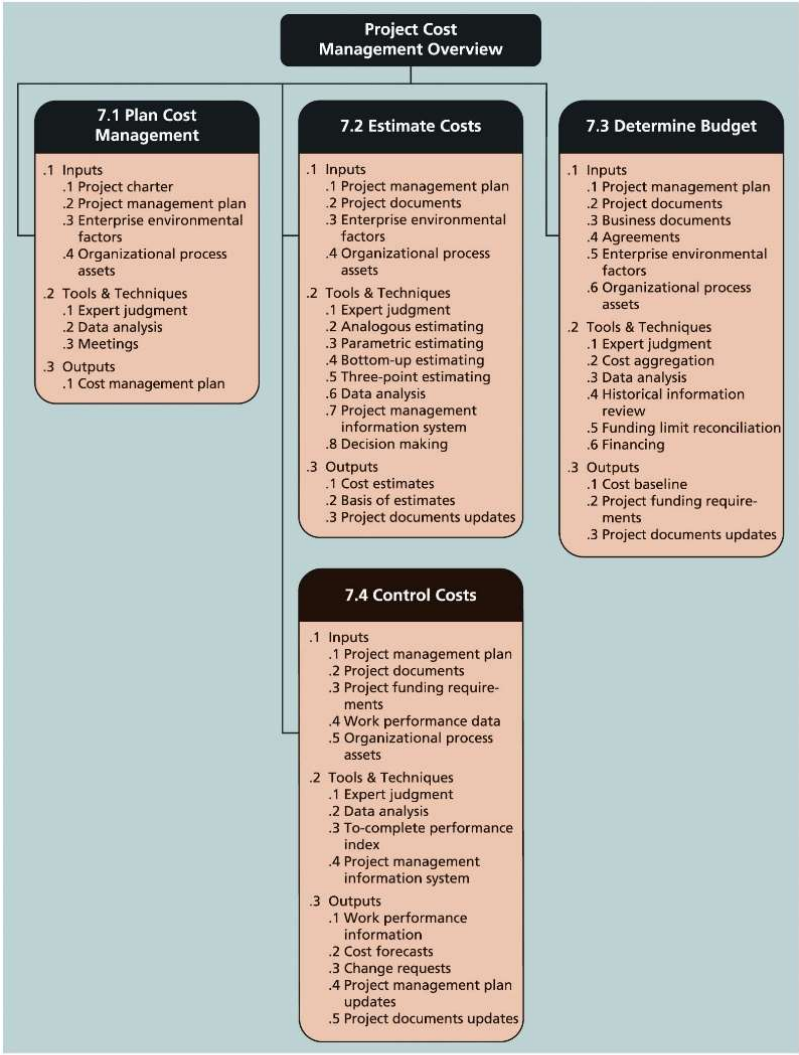


FIGURE 7-1 Project cost management overview

Basic Principles of Cost Management

Most members of an executive board better understand and are more interested in financial terms than IT terms; they need to be able to present and discuss project information in both

- Profits: revenues minus expenditures
- Profit margin: ratio of profits to revenues
- Life cycle costing: considers total cost of ownership, or development plus support costs, for a project
- Cash flow analysis: determines estimated annual costs and benefits for a project and resulting annual cash flow

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
- 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 (2 of 2)

- Additional concepts
  - 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)

Advice for Young Professionals

- If you have never done so, take a class or do self-study in accounting, financial statements, or financial management
  - There are many online resources and short books available on the topics of finance for the non-financial manager, how to use financial statements, or similar content
  - Financial specialists are often willing to help less-experienced people better understand the key terminology of the financial field

Planning Cost Management

The first step in project cost management is planning how the costs will be managed throughout the life of the project

- The project team uses expert judgment, analytical techniques, and meetings to develop the cost management plan

Cost management plan includes:

- Level of accuracy
- Units of measure
- Organizational procedure links
- Control thresholds
- Rules of performance measurement
- Reporting formats
- Process descriptions

Estimating Costs (1 of 2)

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints
  - Types of cost estimates
  - Tools and techniques for estimating costs
  - Typical problems associated with IT cost estimates

Type of Estimate	When Done	Why Done	Typical Range
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	Puts dollars in the budget plans	-5% to +10%

are estimates of the effort and cost involved in completing a project. The ROM estimation process occurs early in the project life cycle and serves as a guide in the selection of strategies and planning options.

Estimating Costs (2 of 2)

- The number and type of cost estimates vary by application area
  - The Association for the Advancement of Cost Engineering International identifies five types of cost estimates for construction projects
    - Order of magnitude, conceptual, preliminary, definitive, and control
  - Estimates are usually done at various stages of a project
    - Should become more accurate as time progresses
  - It is important to provide supporting details for estimates and updates to project documents
  - A large percentage of total project costs are often labor costs

Department	Year 1	Year 2	Year 3	Year 4	Year 5	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

Cost Estimation Tools and Techniques

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
Three-point estimates	• Involve estimating the most likely, optimistic, and pessimistic costs for items
Parametric estimating	• Uses project characteristics (parameters) in a mathematical model to estimate project costs

Typical Problems with IT Cost Estimates

- Reasons for inaccuracies
  - Estimates are done too quickly
  - People lack estimating experience
  - Human beings are biased toward underestimation
  - Management desires accuracy

How to Develop a Cost Estimate and Basis of Estimates (1 of 2)

- Before creating an estimate gather as much information as possible about the project, ask how the organization plans to use the cost estimate, and clarify the ground rules and assumptions

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	1,920	$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	1,920	$75	$144,000		
Subtotal			$1,267,700		
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 project cost estimate

How to Develop a Cost Estimate and Basis of Estimates (2 of 2)

Surveyor Pro Software Development Estimate Created October 5

1. Labor Estimate	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	**Calculations**
Contractor labor estimate	3,000	$150	$450,000	3,000 * 150
Project team member estimate	1,920	$75	$144,000	1,920 * 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×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

FIGURE 7-3 Surveyor pro software development estimate

Determining the Budget

- Budgeting involves allocating the project cost estimate to individual work items over time
  - Material resources or work items are based on the activities in the WBS for the project
- Important goal is to produce a cost baseline
  - Time-phased budget that project managers use to measure and monitor cost performance

Surveyor Pro Project Cost Baseline Created October 10*

	Months												
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

*See the lecture slides for this chapter on the Instructor website for a larger view of this and other figures in this chapter. Numbers are rounded, so some totals appear to be off.

FIGURE 7-4 Surveyor Pro project cost baseline

Controlling Costs

Activities involved in controlling project costs

- 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

Several tools and techniques assist in project cost control

- Expert judgment, data analysis, project management information systems, and the to-complete performance index

Earned Value Management (EVM) (1 of 3)

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 scope, time, and cost goals

Earned value management involves calculating three values for each activity or summary activity from a project's WBS

Planned value
Actual cost
Earned value

Activity	Week 1
Earned value (EV)	5,000
Planned value (PV)	10,000
Actual cost (AC)	15,000
Cost variance (CV)	-10,000
Schedule variance (SV)	-5,000
Cost performance index (CPI)	33%
Schedule performance index (SPI)	50%

Earned value calculations for one activity after week 1

Earned Value Management (EVM) (2 of 3)

Term	Formula
Earned value (EV)	EV = PV of all completed work
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 to Complete (ETC)	ETC = EAC - AC

Earned value formulas

Important concepts

- Cost variance (CV) is the earned value minus the actual cost
- Schedule variance (SV) is the earned value minus the planned value
- Cost performance index (CPI) is the ratio of earned value to actual cost
- Schedule performance index (SPI) is the ratio of earned value to planned value
- Estimate at completion (EAC) is an estimated cost of completing a project based on performance to date
- To-complete performance index (TCPI) is a measure of the cost performance that must be achieved with the remaining resources to meet a specific goal

Earned Value Management (EVM) (3 of 3)

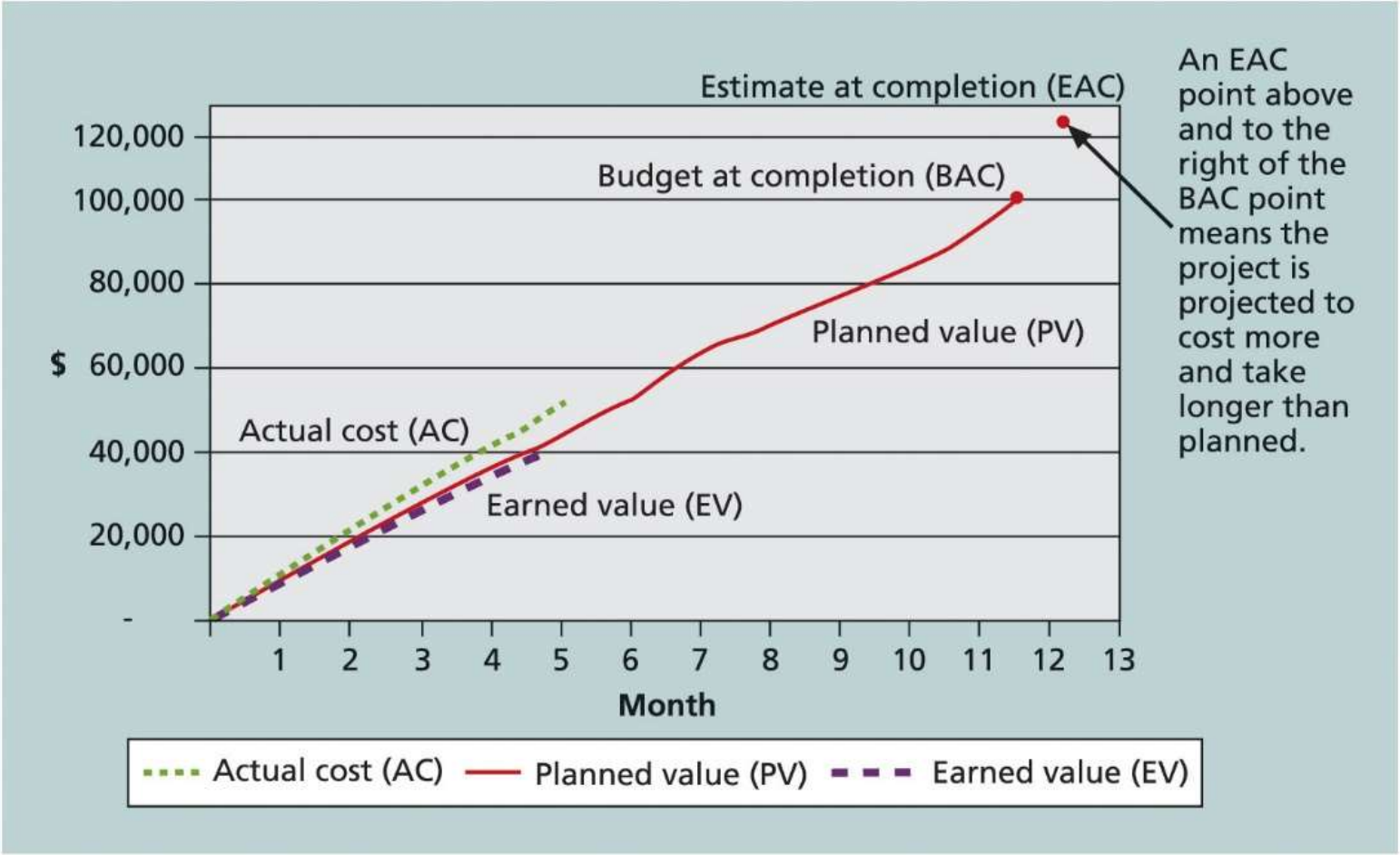


FIGURE 7-6 Earned value chart for project after five months

Project Portfolio Management

Many organizations collect and control an entire suite of projects or investments as one set of interrelated activities in a portfolio

Five levels for project portfolio management

Put all your projects in one database	Prioritize the projects in your database	Divide your projects into two or three budgets based on type of investment	Automate the repository	Apply modern portfolio theory, including risk-return tools that map project risk on a curve

Using Project Management Software to Assist in Project 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 can increase a project manager's effectiveness during each process of project cost management

- Many IT project managers use other tools to manage cost information because they do not know that they can use project management software, or they do not track costs based on a WBS, as most project management

Recent Studies on PPM Software

- 2017 Gartner report says the market continues to grow, with annual sales over $2.3 billion
- Forrester estimates ROIs of 250 percent from PPM tools
- Pfizer and Ford use PPM software to improve transparency of the many projects they manage
- software does

Considerations for Agile/Adaptive Environments

- AgileEVM is an adapted implementation of EVM
  - Uses the Scrum framework artifacts as inputs, uses traditional EVM calculations, and is expressed in traditional EVM metrics
  - Requires a minimal set of input parameters
    - Actual cost of a project, an estimated product backlog, a release plan that provides information on the number of iterations in the release and the assumed velocity
  - All estimates can be in hours, story-points, team days or any other consistent estimate of size
    - The critical factor is that it must be a numerical estimate of some kind

Chapter Summary

Project cost management is a traditionally weak area of IT projects

Project managers must understand several basic principles of cost management to be effective in managing project costs

Main processes

- Plan cost management
- Estimate costs
- Determine the budget
- Control costs

Several software products can assist with project cost management