Project Management

THE MANAGERIAL PROCESS

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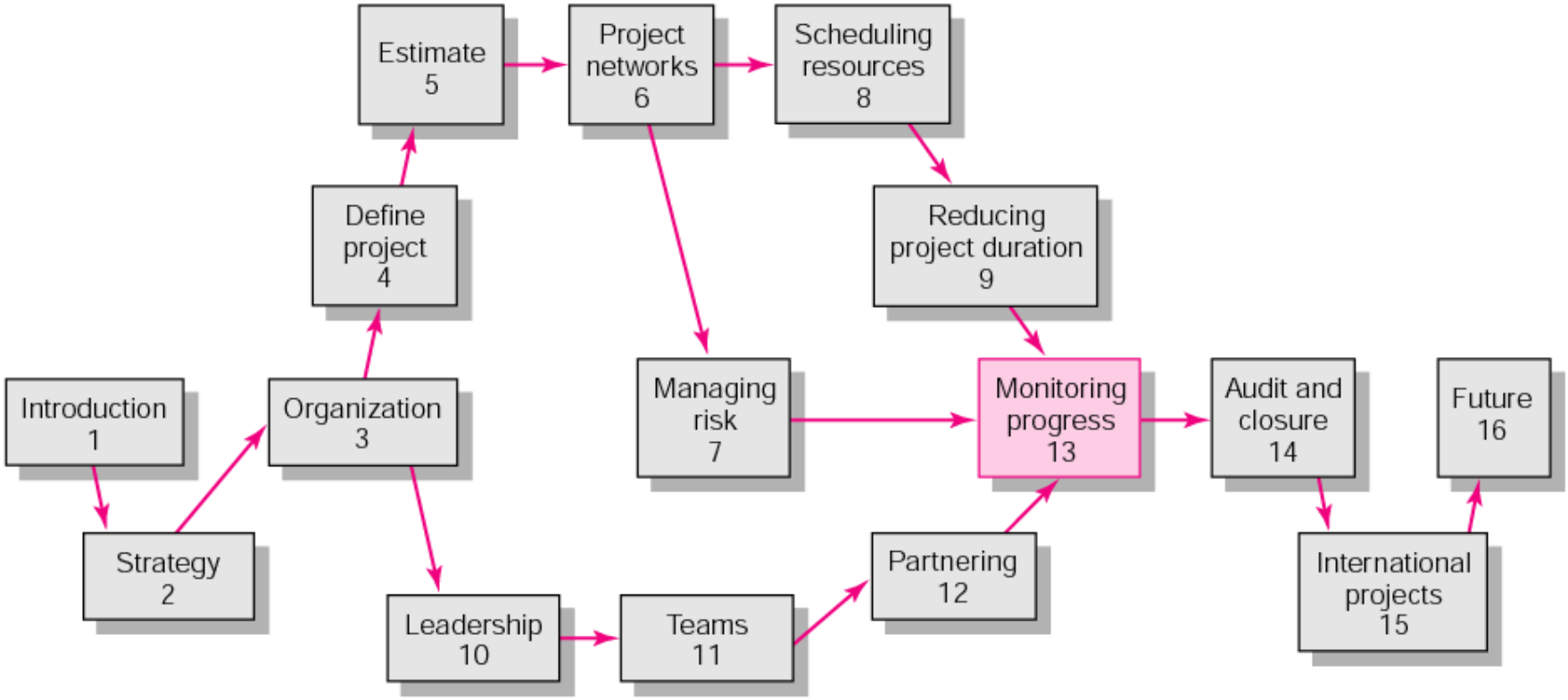
Third Edition

Chapter 13

Progress and Performance Measurement and Evaluation

PowerPoint Presentation by Charlie Cook



Project Monitoring System for Control

- Information System Structure
  - What data are collected?
    - Current status of project (schedule and cost)
    - Remaining cost to compete project
    - Date that project will be complete
    - Potential problems to be addressed now
    - Out-of-control activities requiring intervention
    - Cost and/or schedule overruns and the reasons for them
    - Forecast of overruns at time of project completion

Project Monitoring System… (cont'd)

- Information System Structure (cont'd)
  - Collecting data and analysis
    - Who will collect project data?
    - How will data be collected?
    - When will the data be collected?
    - Who will compile and analyze the data?
  - Reports and reporting
    - Who will receive the reports?
    - How will the reports be transmitted?
    - When will the reports be distributed?

Project Progress Report Format

- Progress since last report
- Current status of project
  - Schedule
  - Cost
  - Scope
- Cumulative trends
- Problems and issues since last report
  - Actions and resolution of earlier problems
  - New variances and problems identified
- Corrective action planned

The Project Control Process

- Control
  - The process of comparing actual performance against plan to identify deviations, evaluate courses of action, and take appropriate corrective action.
- Project Control Steps
  1. Setting a baseline plan.
  2. Measuring progress and performance.
  3. Comparing plan against actual.
  4. Taking actions

Monitoring Time Performance

- Tools used to catch negative variances from plan and communicate project schedule status:
  - –Tracking and baseline Gantt charts
    - Show expected, actual, and trend data for event duration performance.
  - –Control charts
    - Plot the difference in scheduled time on the critical path with the actual point on the critical path.

Baseline and Tracking Gantt Charts

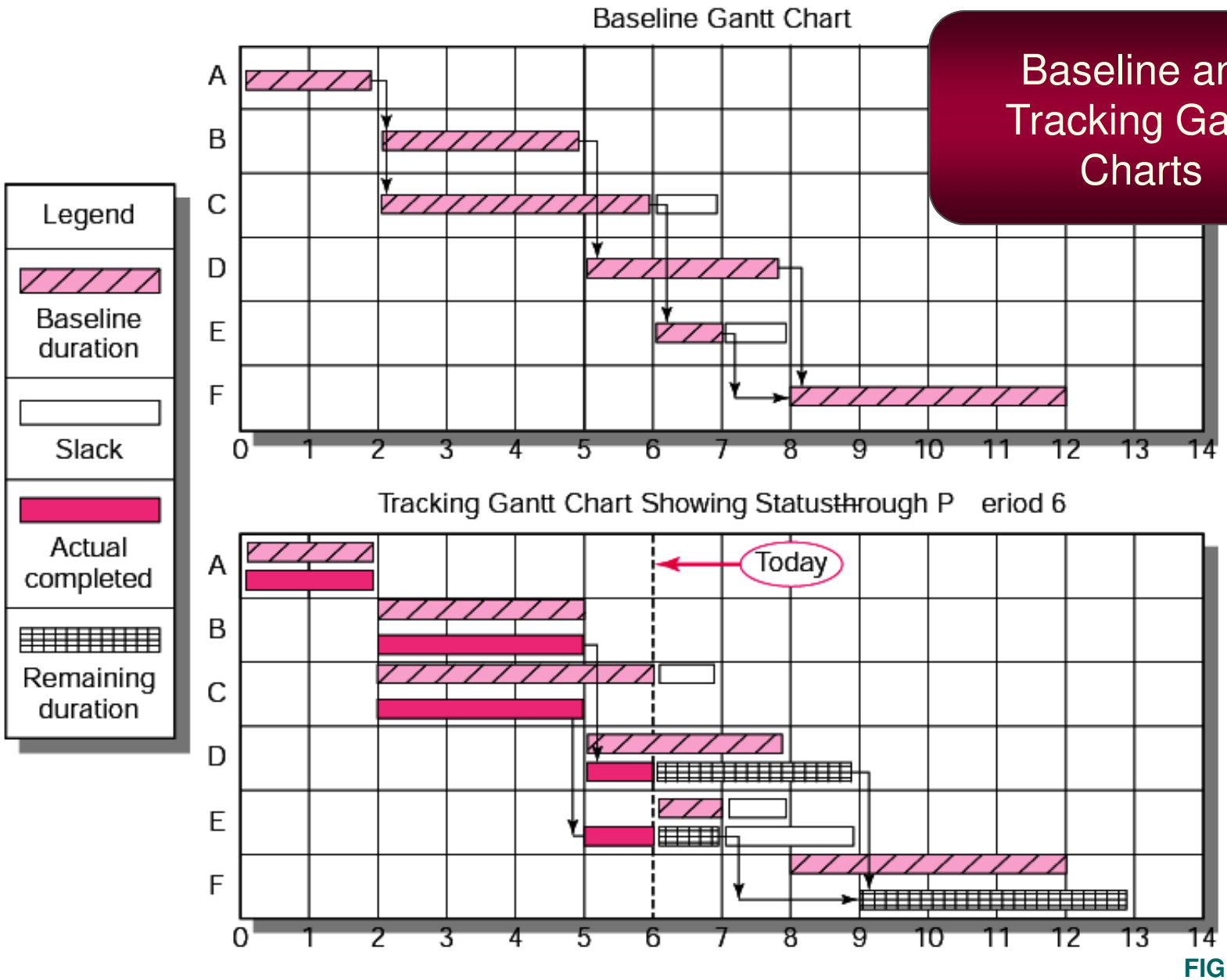


FIGURE 13.1

Project Schedule Control Chart

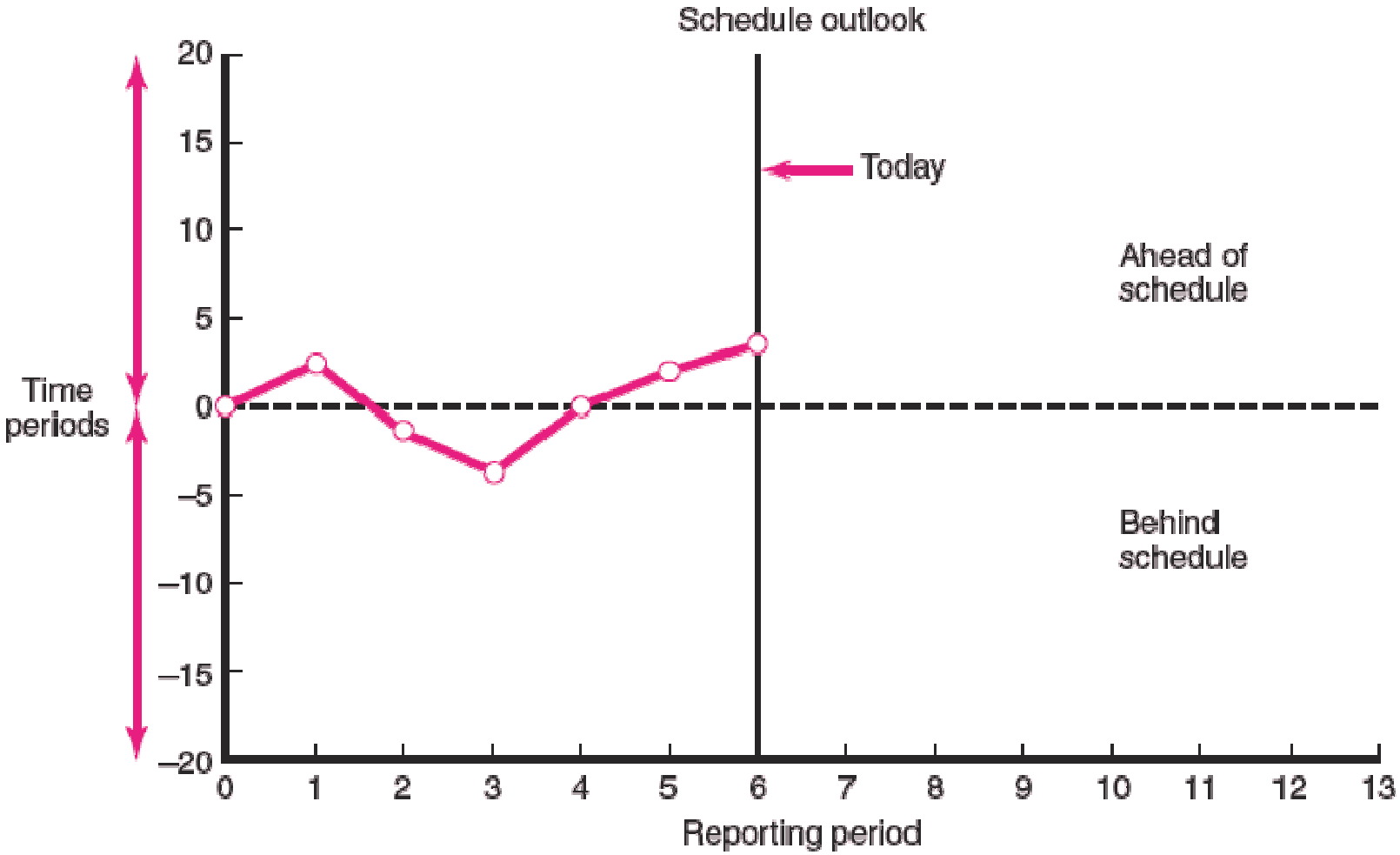


FIGURE 13.2

Disparity Among Monitoring Systems

- Time-Phase Baseline Plan
  - –Corrects the failure of most monitoring systems to connect a project's actual performance to its schedule and forecast budget.
    - Systems that measure only cost variances do not identify resource and project cost problems associated with falling behind or progressing ahead of schedule.
- Earned Value Cost/Schedule System
  - –An integrated project management system based on the earned value concept that uses a time-phased budget baseline to compare actual and planned schedule and costs.

Glossary of Terms

- EV
  - The percent complete times its original budget. The percent of the original budget that has been earned by actual work completed. The older acronym for this value was BCWP—budgeted cost of the work performed.
- PV (Planned Value)
  - The time-phased baseline of the value of the work scheduled. An approved cost estimate of the resources scheduled in a time-phased cumulative baseline (BCWS—budgeted cost of the work scheduled).
- AC
  - The actual cost of the work completed. The sum of the costs incurred in accomplishing work. (ACWP—actual cost of the work performed).

TABLE 13.1

Glossary of Terms

- CV
  - Cost variance is the difference between the earned value and the actual costs for the work completed to date where CV=EV-AC.
- SV
  - Schedule variance (SV) is the difference between the earned value and the baseline line to date where SV=EV-PV.
- BAC
  - Budgeted cost at completion. The total budgeted cost of the baseline or project cost accounts.
- EAC
  - Estimated costs at completion. Includes costs to-date plus revised estimated costs for the work remaining.

TABLE 13.1

Glossary of Terms

- ETC
  - Estimate to complete.
- VAC
  - Cost variance at completion (BAC-EAC_e), where EAC_e is derived by estimators in the field.
  - Or, alternatively, cost variance at completion (BAC-EAC_f), where EAC_f is derived from a formula using actual and earned value costs.
  - VAC indicates expected actual over-or underrun cost at completion.

TABLE 13.1

Developing an Integrated Cost/Schedule System

1. Define the work using a WBS.
   a. Scope
   b. Work packages
   c. Deliverables
   d. Organization units
   e. Resources
   f. Budgets
2. Develop work and resource schedules.
   a. Schedule resource to activities
   b. Time-phase work packages into a network
3. Develop a time-phased budget using work packages included in an activity.

Developing an Integrated Cost/Schedule System

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   f. Budgets
2. Develop work and resource schedules.
   a. Schedule resources to activities
   b. Time-phase work packages into a network
3. Develop a time-phased budget using work packages included in an activity. Accumulate budgets (PV).
4. At the work package level, collect the actual costs for the work performed (AC).
5. Multiply percent complete times original budget (EV).`
6. Compute the schedule variance (EV-PV) and the cost variance (EV-AC).

Project Management System Overview

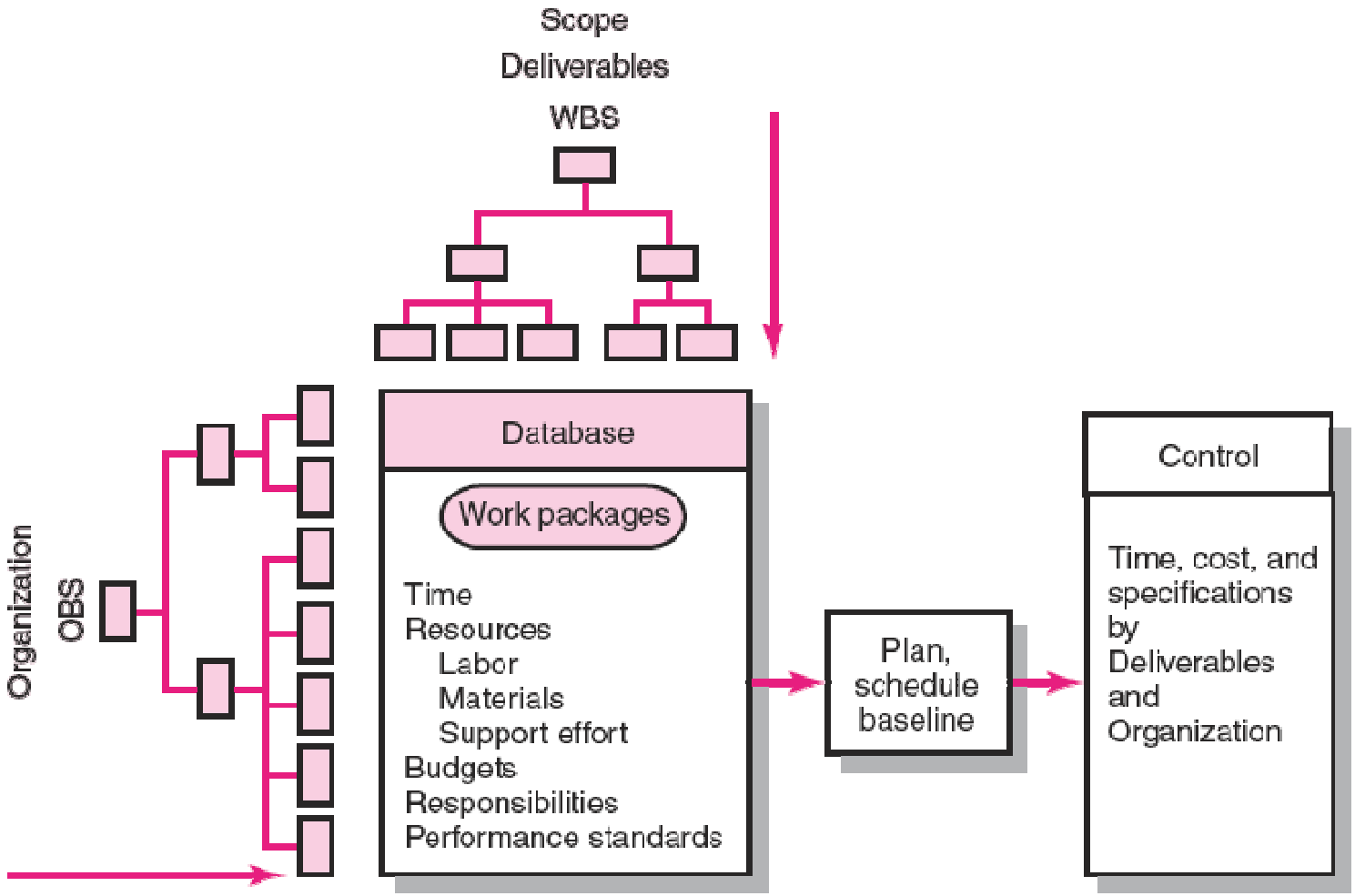


FIGURE 13.3

Development of Project Baselines

- Purposes of a Baseline (PV)
  - An anchor point for measuring performance
    - A planned cost and expected schedule against which actual cost and schedule are measured.
    - A basis for cash flows and awarding progress payments.
    - A summation of time-phased budgets (cost accounts as summed work packages) along a project timeline.
- What Costs Are Included in Baselines?
  - Labor
  - Equipment
  - Materials
  - Project direct overhead costs (DOC)

Baseline Data Relationships

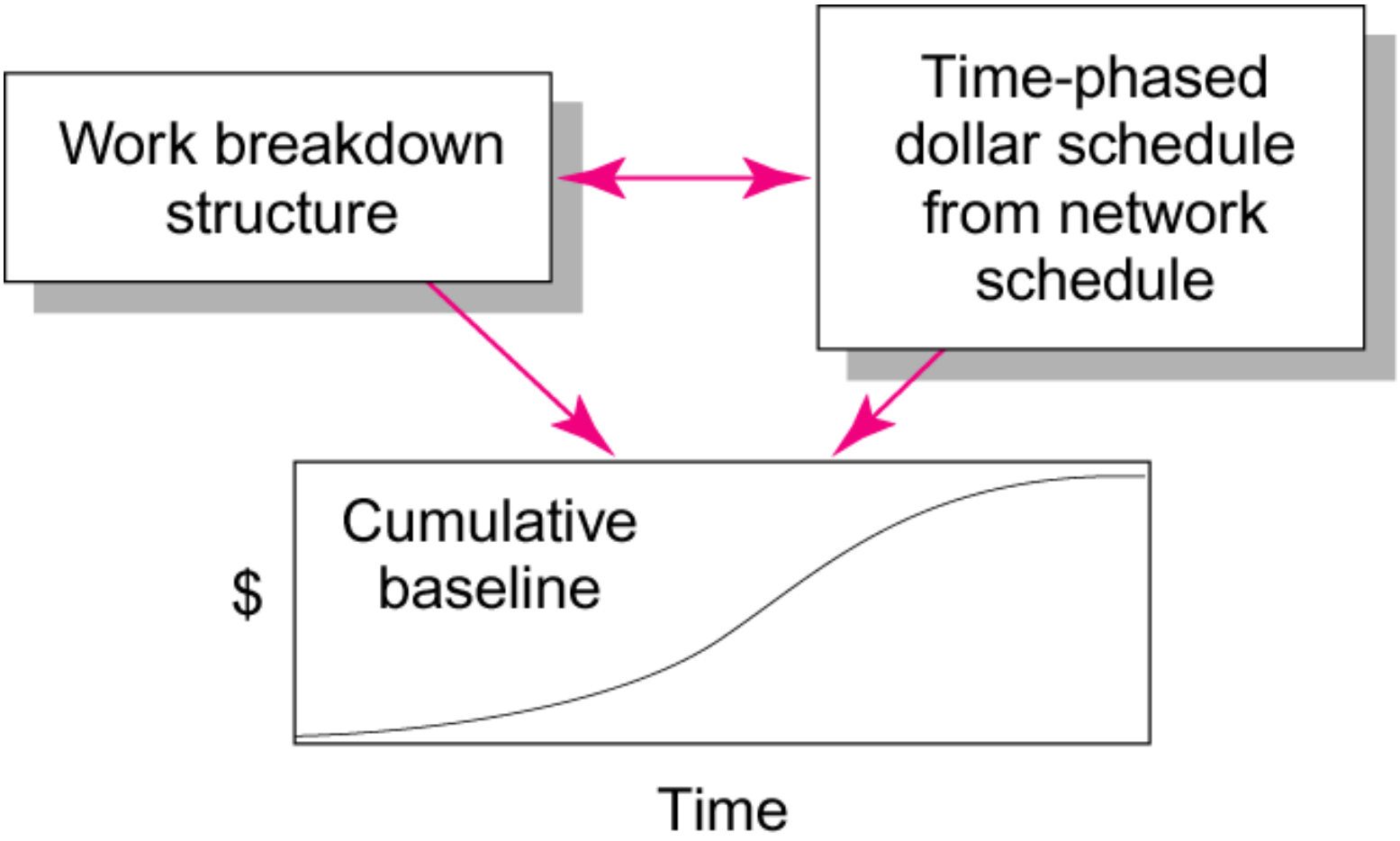


FIGURE 13.4

Development of Project Baselines (cont'd)

- Rules for Placing Costs in Baselines
  - –Costs are placed exactly as they are expected to be "earned" in order to track them to their point of origin.
  - –*Percent Complete Rule*
    - Costs are periodically assigned to a baseline as units of work are completed over the duration of a work package.

Methods of Variance Analysis

- Comparing Earned Value
  - –With the expected schedule value.
  - –With the actual costs.
- Assessing Status of a Project
  - –Required data elements
    - Data Budgeted cost of the work scheduled (PV)
    - Budgeted cost of the work completed (EV)
    - Actual cost of the work completed (AC)
  - –Calculate schedule and cost variances
    - A positive variance indicates a desirable condition, while a negative variance suggests problems or changes that have taken place.

Methods of Variance Analysis

- Cost Variance (CV)
  - Indicates if the work accomplished using labor and materials costs more or less than was planned at any point in the project.
- Schedule Variance (SV)
  - Presents an overall assessment in dollar terms of the progress of all work packages in the project scheduled to date.

Cost/Schedule Graph

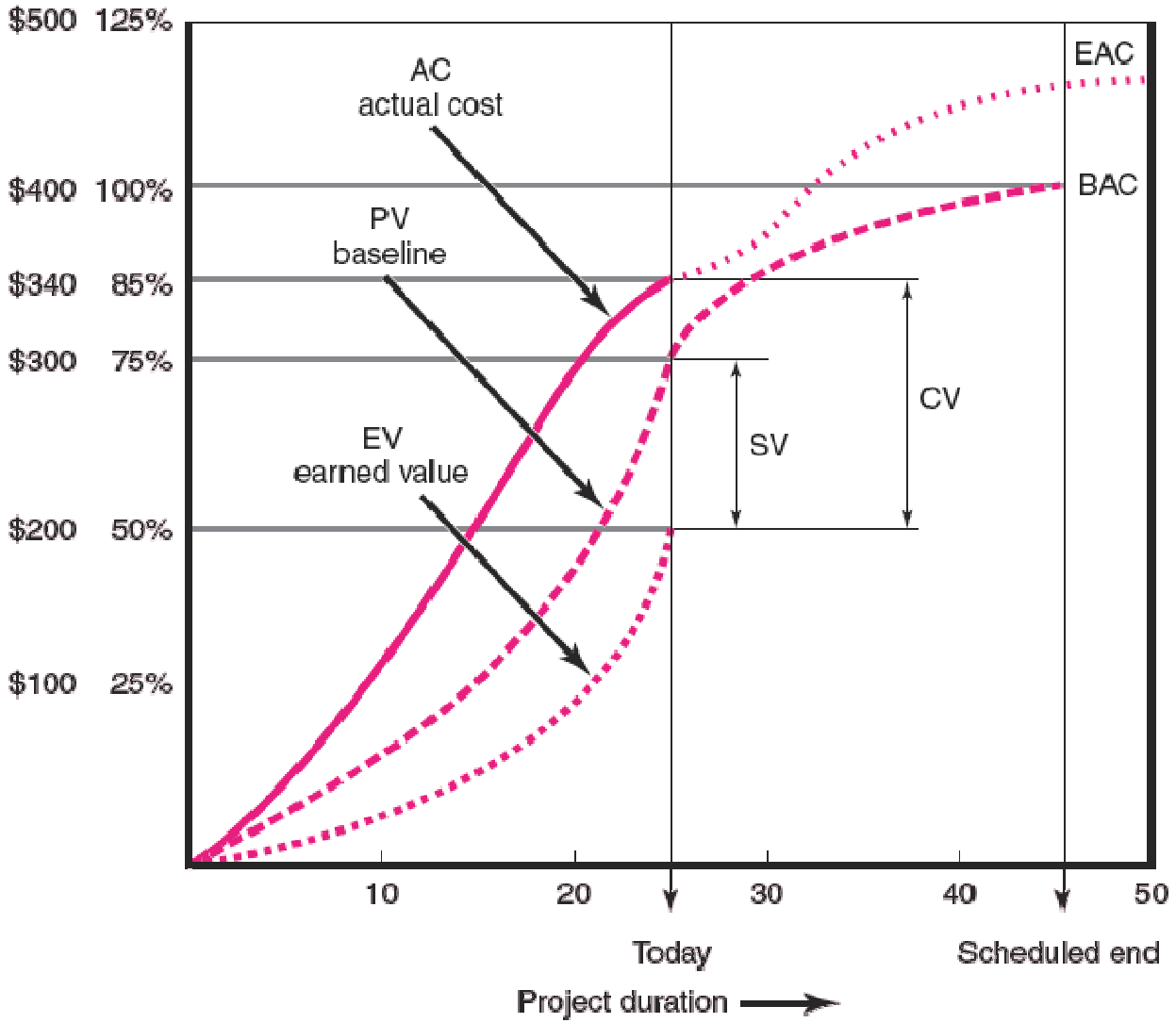


FIGURE 13.5

Earned Value Review Exercise

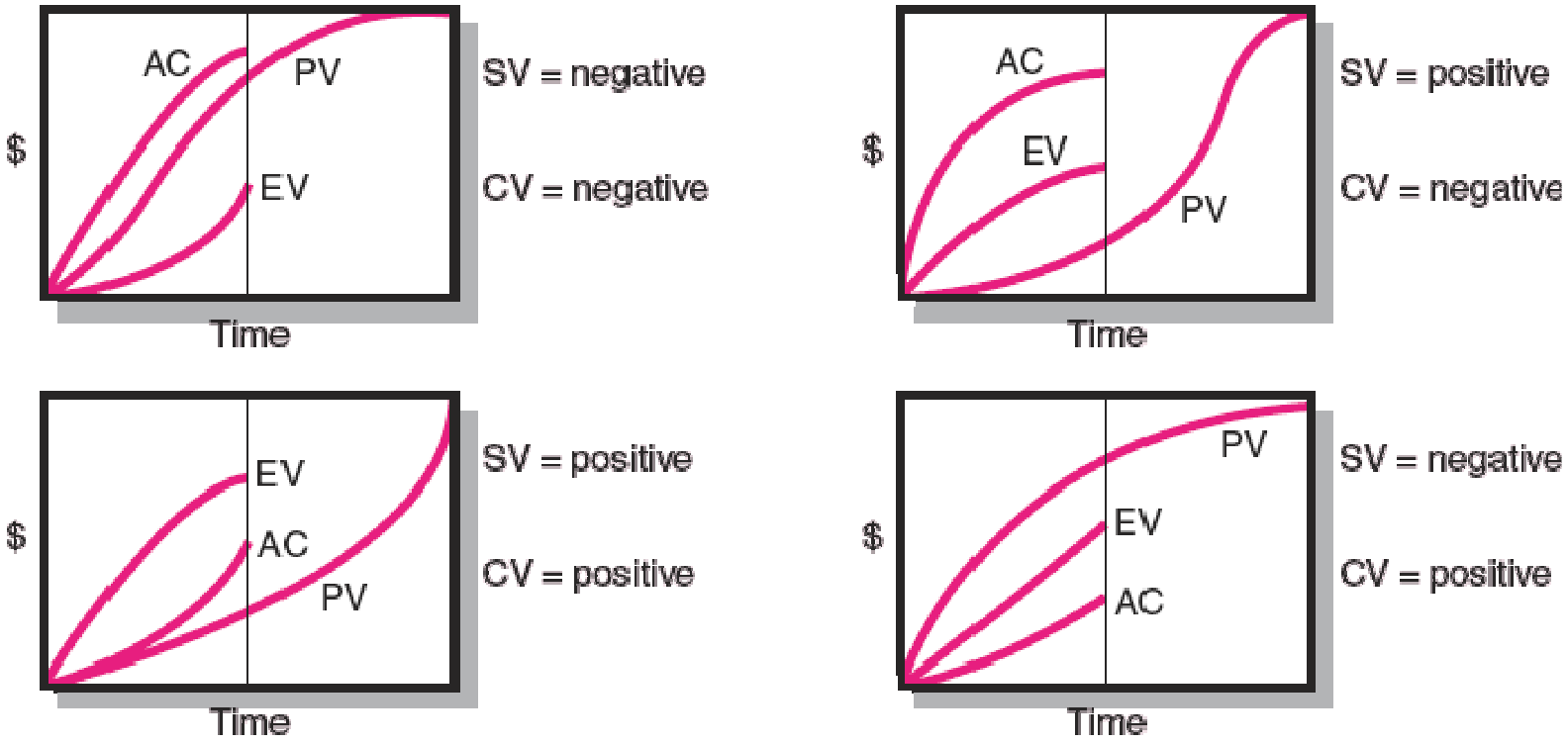


FIGURE 13.6

Developing A Status Report: A Hypothetical Example

- **Assumptions**
  - **Each cost account has only one work package, and each cost account will be represented as an activity on the network.**
  - **The project network early start times will serve as the basis for assigning the baseline values.**
  - **Baseline value will be assigned linearly, unless stated differently.**
  - **From the moment work on an activity begins, some actual costs will be incurred each period until the activity is completed.**

Work Breakdown Structure and Cost Accounts

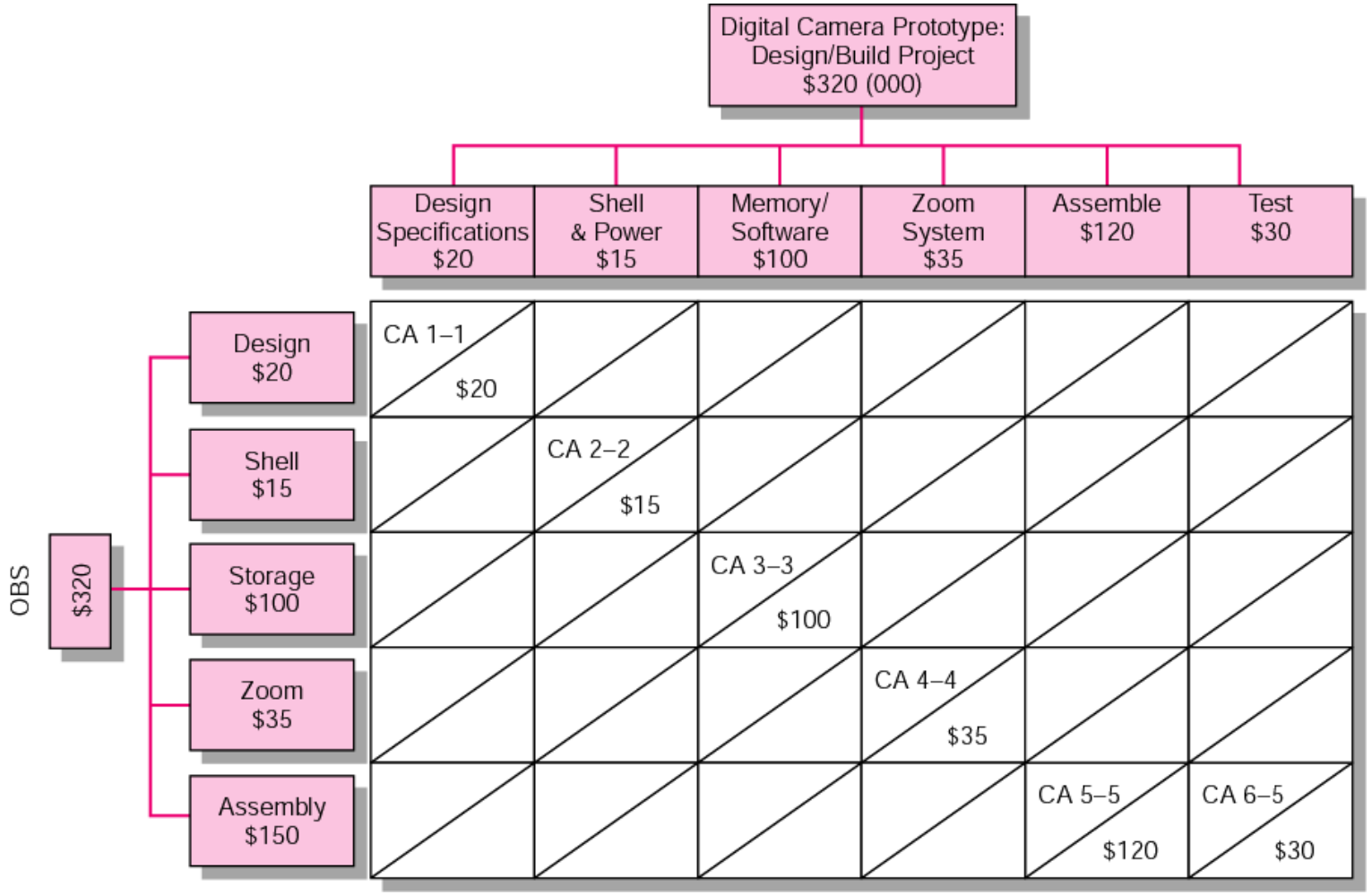


FIGURE 13.7

Digital Camera Prototype Project Baseline Gantt Chart

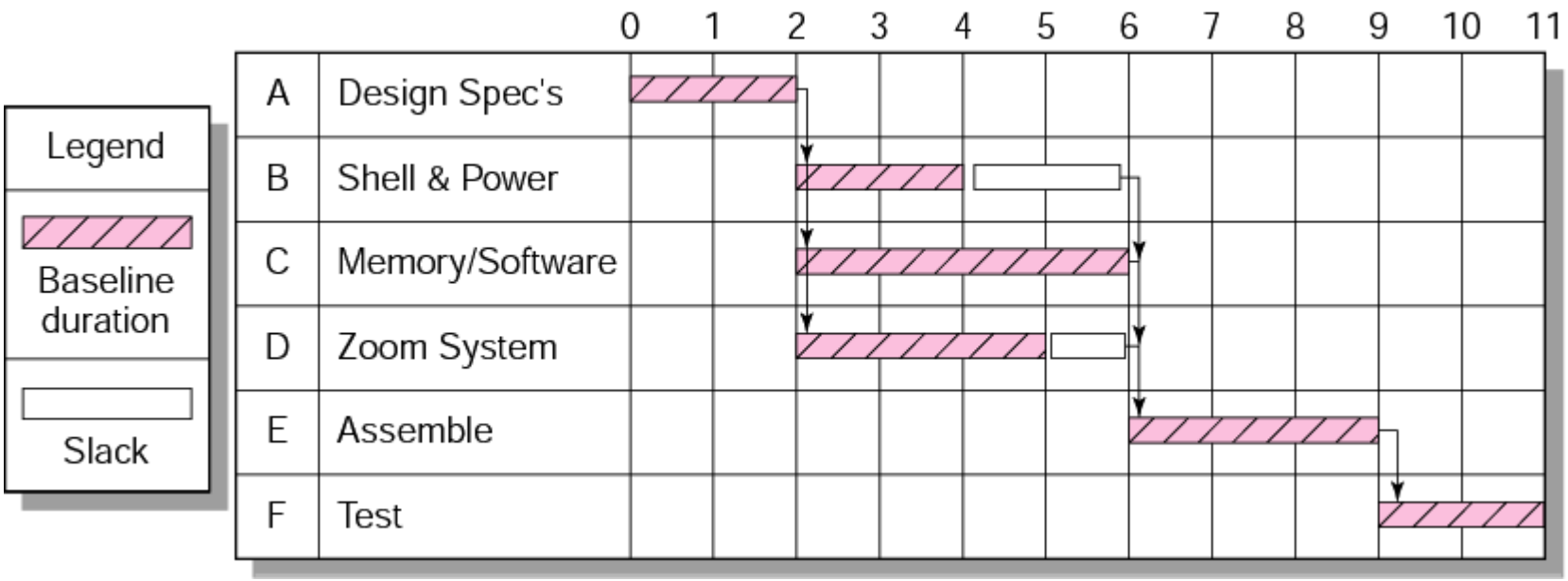


FIGURE 13.8

Digital Camera Prototype Project Baseline

Schedule information						Baseline budget needs										
ACT/ WP	DUR	ES	LF	TF	Total PV	Time period 0	1	2	3	4	5	6	7	8	9	10	11
A	2	0	2	0	20	10	10										
B	2	2	6	2	15			5	10								
C	4	2	6	0	100			20	30	30	20						
D	3	2	6	1	35			15	10	10							
E	3	6	9	0	120							30	40	50			
F	2	9	11	0	30										10	20	
Total PV by period						10	10	40	50	40	20	30	40	50	10	20	
Cumulative PV by period						10	20	60	110	150	170	200	240	290	300	320	

FIGURE 13.9

Digital Camera Prototype Status Reports: Periods 1–3

Cost Variance	CV = EV − AC
Schedule Variance	SV = EV − PV

Status Report: Ending Period 1

Task	%Complete	EV	AC	PV	CV	SV
A	50%	10	10	10	0	0
Cumulative Totals		**10**	**10**	**10**	**0**	**0**

Status Report: Ending Period 2

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
Cumulative Totals		**20**	**30**	**20**	**−10**	**0**

Status Report: Ending Period 3

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
B	33%	5	10	5	−5	0
C	20%	20	30	20	−10	0
D	60%	21	20	15	+1	+6
Cumulative Totals		**66**	**90**	**60**	**−24**	**+6**

TABLE 13.2

Digital Camera Prototype Status Reports: Periods 4–6

Status Report: Ending Period 4

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
B	Finished	15	20	15	−5	0
C	50%	50	70	50	−20	0
D	80%	28	30	25	−2	+3
Cumulative Totals		113	150	110	−37	+3

Status Report: Ending Period 5

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
B	Finished	15	20	15	−5	0
C	60%	60	100	80	−40	−20
D	80%	28	50	35	−22	−7
Cumulative Totals		123	200	150	−77	−27

Status Report: Ending Period 6

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
B	Finished	15	20	15	−5	0
C	80%	80	110	100	−30	−20
D	Finished	35	60	35	−25	0
Cumulative Totals		150	220	170	−70	−20

TABLE 13.2 (cont'd)

Digital Camera Prototype Status Reports: Period 7

Status Report: Ending Period 7

Task	%Complete	EV	AC	PV	CV	SV
A	Finished	20	30	20	−10	0
B	Finished	15	20	15	−5	0
C	90%	90	120	100	−30	−10
D	Finished	35	60	35	−25	0
E	0%	0	0	30	0	−30
F	0%	0	0	0	0	0
Cumulative Totals		**160**	**230**	**200**	**−70**	**−40**

TABLE 13.2 (cont'd)

Digital Camera Prototype Summary Graph (000)

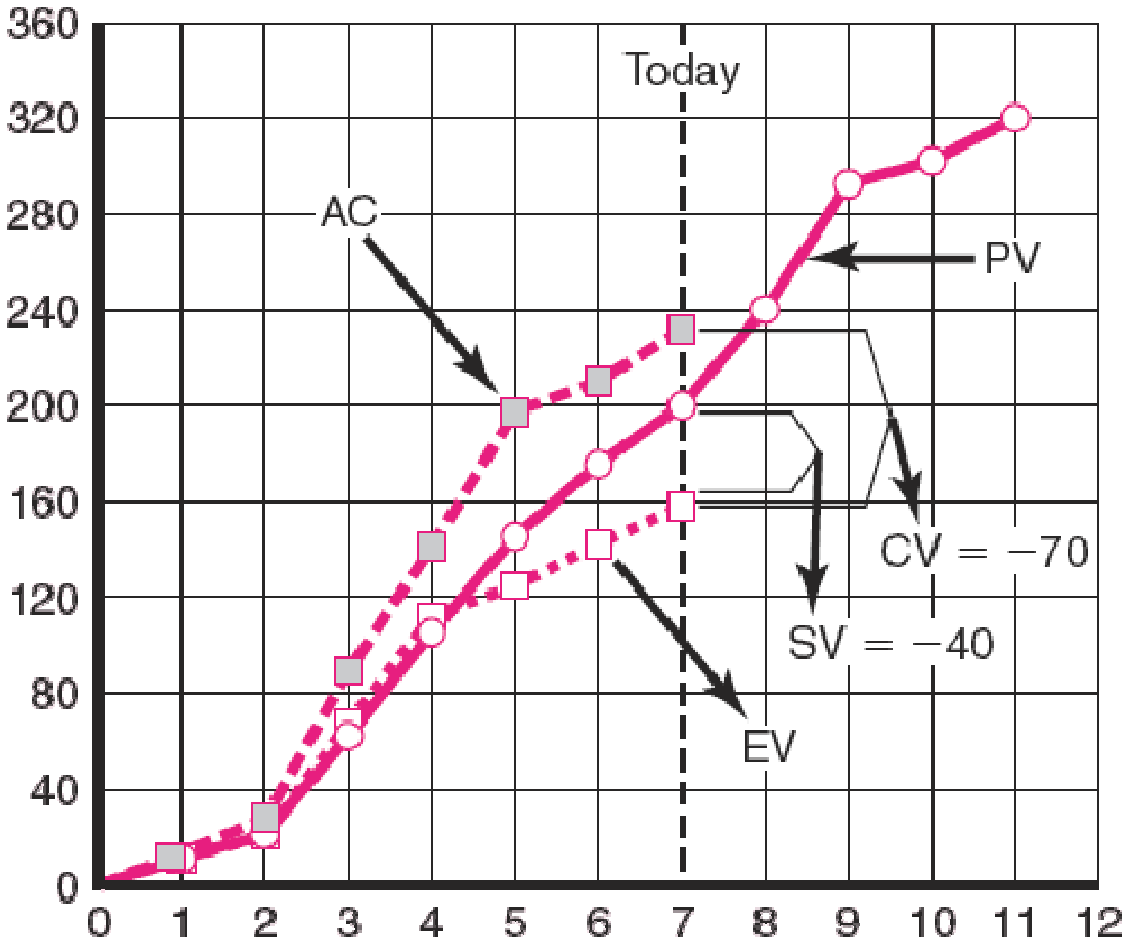


FIGURE 13.10

Digital Camera Project Tracking Gantt Chart Showing Status—Through Period 7

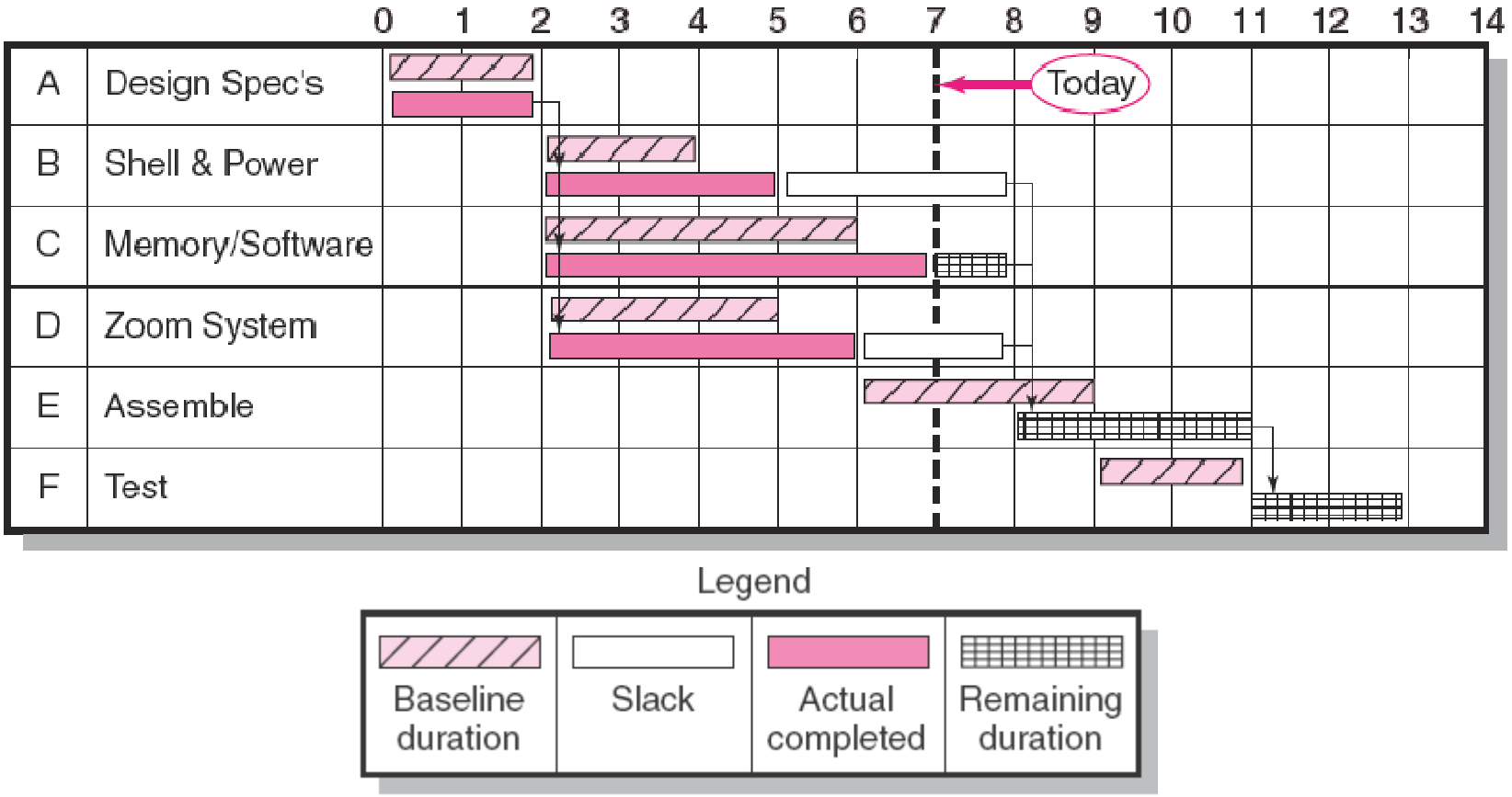


FIGURE 13.11

Digital Camera Project Rollup at End Period 7 (000)

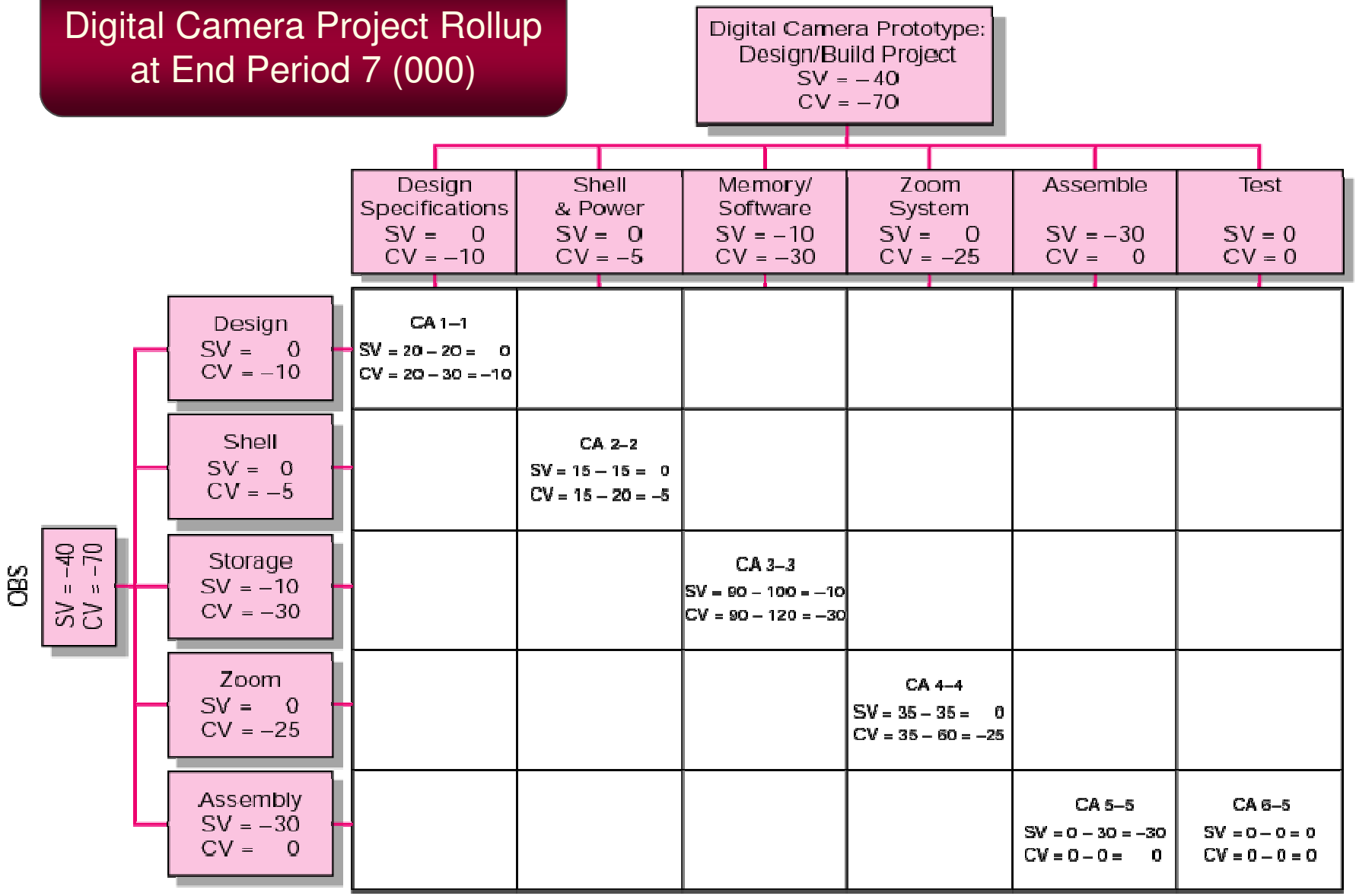


FIGURE 13.12

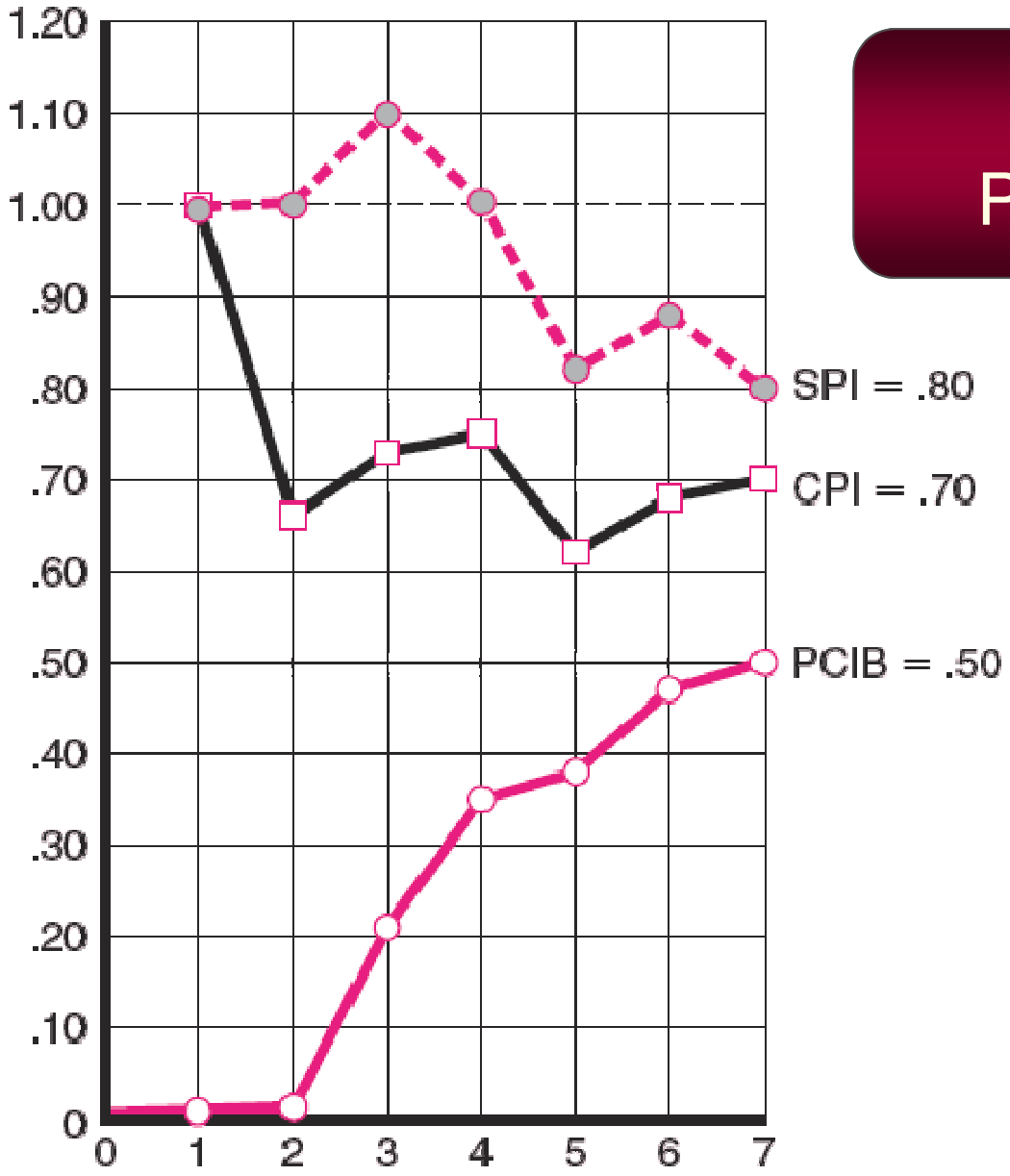
Indexes to Monitor Progress

- Performance Indexes
  - Cost Performance Index (CPI)
    - Measures the cost efficiency of work accomplished to date.
    - CPI = EV/AC
  - Scheduling Performance Index (SPI)
    - Measures scheduling efficiency
    - SPI = EV/PV
  - Percent Complete Indexes
    - Indicates how much of the work accomplished represents of the total budgeted (BAC) and actual (AC) dollars to date.
    - PCIB = EV/BAC
    - PCIC = AC/EAC

Interpretation of Indexes

Index	Cost (CPI)	Schedule (SPI)
>1.00	Under cost	Ahead of schedule
$=1.00$	On cost	On schedule
<1.00	Over cost	Behind schedule

TABLE 13.3



Indexes Periods 1–7

FIGURE 13.13

Project Cost/Schedule Systems Software

- Typical Computer-Generated Status Report
  - Schedule variance (EV-PV) by cost account and WBS and OBS
  - Cost variance (EV-AC) by cost account and WBS and OBS
  - Indexes—cost, schedule, total percent complete, and the to complete performance index
  - Cumulative actual total to date (AC)
  - Expected costs at completion
  - Paid and unpaid commitments

Additional Earned Value Rules

- Rules applied to short-duration activities and/or small-cost activities
  - –0/100 percent rule
    - Assumes 100 % of budget credit is earned at once and only when the work is completed.
  - –50/50 rule
    - Allows for 50% of the value of the work package budget to be earned when it is started and 50% to be earned when the package is completed.

Forecasting Final Project Cost

- Methods used to revise estimates of future project costs:
  - EAC_e
    - Allows experts in the field to change original baseline durations and costs because new information tells them the original estimates are not accurate.
  - EAC_f
    - Uses actual costs-to-date plus an efficiency index to project final costs in large projects where the original budget is unreliable.

Forecasting Model: EAC_f

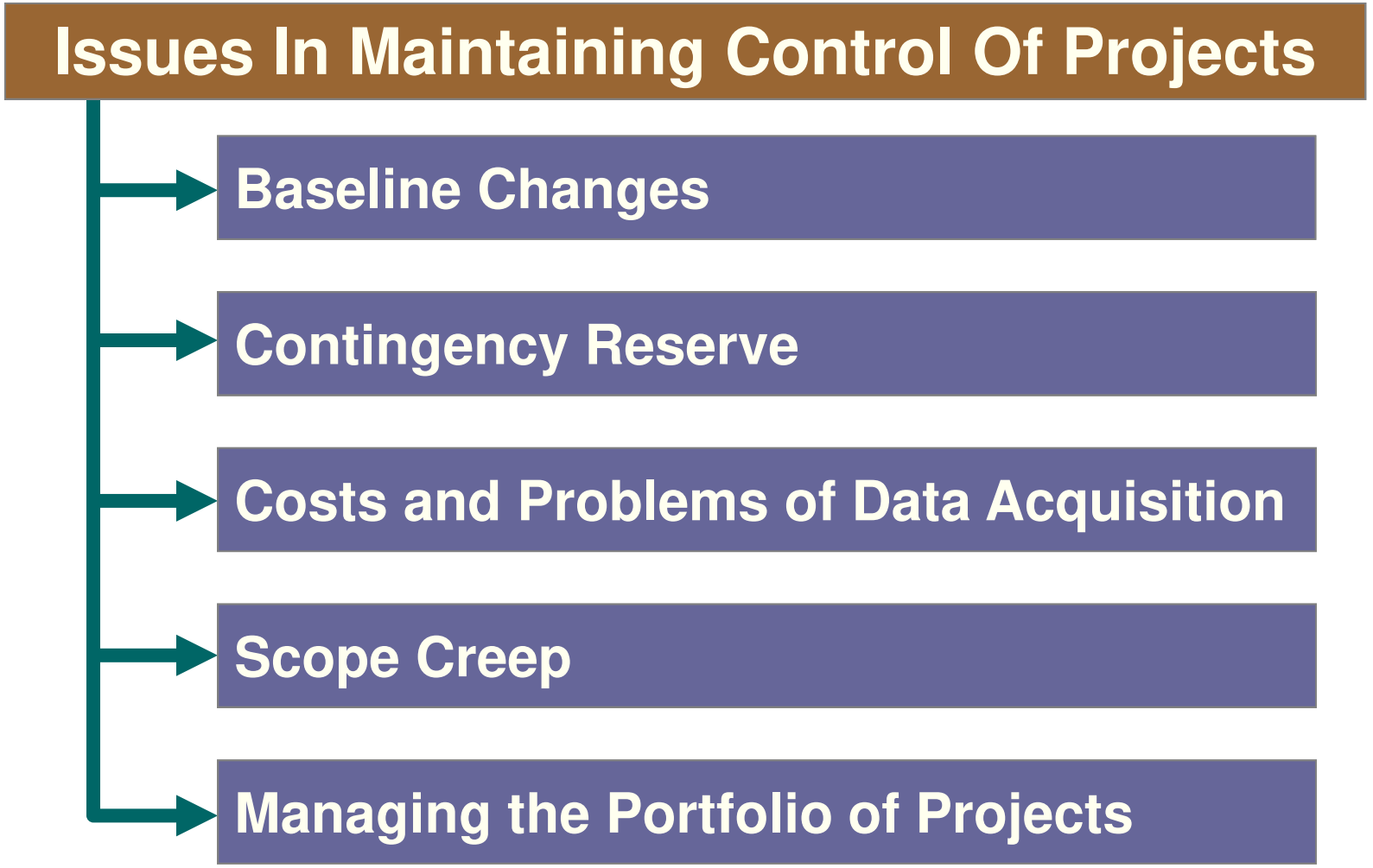
The equation for this forecasting model:

$$ETC = \frac{\text{Work remaining}}{CPI} = \frac{BAC - EV}{EV/AC}$$

$$EAC_f = ETC + AC$$

where
- ETC = estimated cost to complete.
- CPI = cumulative cost index to date.
- EV = cumulative budgeted cost of work completed to date.
- AC = cumulative actual cost of work completed to date.
- BAC = total budget of the baseline.
- EAC_f = estimated total cost at completion.

Other Control Issues



Scope Changes to a Baseline

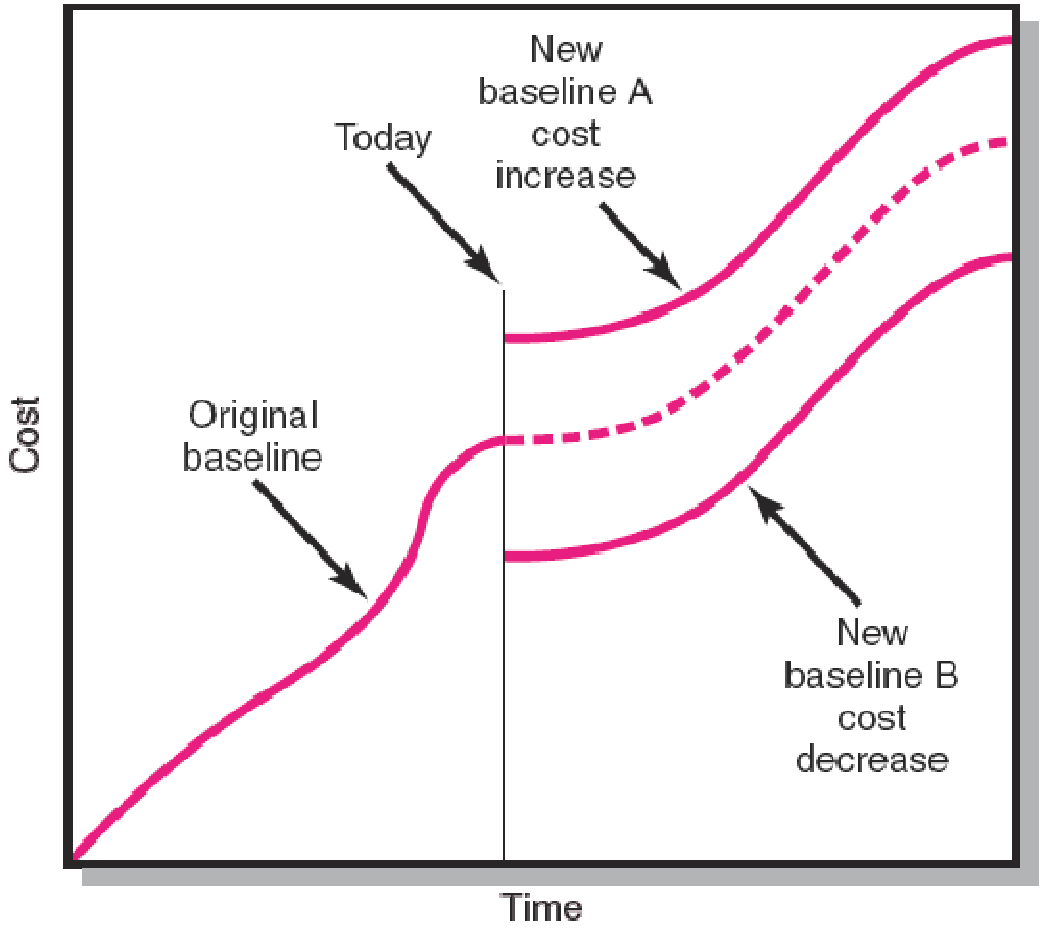


FIGURE 13.14

Key Terms

Baseline budget

Cost performance index (CPI)

Cost variance (CV)

Earned value

Schedule variance (SV)

Time phasing

Variance at completion (VAC)

Estimate at completion (EAC)