Session 7

Project Cost Management

Learning Objectives

- Discuss the three project cost management planning processes
- Create a cost management plan, cost estimate, basis of estimates, cost baseline, and project funding requirements
- Review Agile Estimation Techniques
- Introduction to Earned Value Management

Project Cost Management

- Project cost management includes the processes required to ensure that a project team completes a project within an approved budget
- The planning tasks are: planning cost management, estimating costs, and determining the budget
- The main documents produced include:
  - a cost management plan,
  - a cost estimate, and
  - a cost performance baseline (Budget)

Possible Contents of a Cost Management Plan

- Units of measure, such as staff hours or days or a lump sum amount, currency to be used, inflation assumptions, etc.
- Level of accuracy, such as +/-10%
- Organizational procedures
- Control thresholds for monitoring cost performance, such as a percentage deviation from the baseline plan
- Rules of performance measurement, especially if Earned Value Management is used
- Reporting formats and frequency for cost reports
- Additional details about cost activities, such as strategic funding choices, procedures to account for currency fluctuations, and procedures for recording costs

Estimating Costs

- Project teams normally prepare cost estimates at various stages of a project, and these estimates should be fine-tuned as time progresses
- It is also important to provide supporting details for the estimates, including ground rules and assumptions (sometimes called the basis of estimates)
- A large percentage of total project costs are often labor costs, so it is important to do a good job estimating labor hours and costs

Cost Estimating Techniques

- **Analogous estimates**, also called **top-down estimates**, use the actual cost of a previous, similar project as the basis for estimating the cost of the current project. This technique requires a good deal of expert judgment and is generally less costly than others are, but it can also be less accurate

- **Bottom-up estimates** involve estimating individual activities and summing them to get a project total. This approach can increase the accuracy of the cost estimate, but it can also be time intensive and, therefore, expensive to develop

- **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs

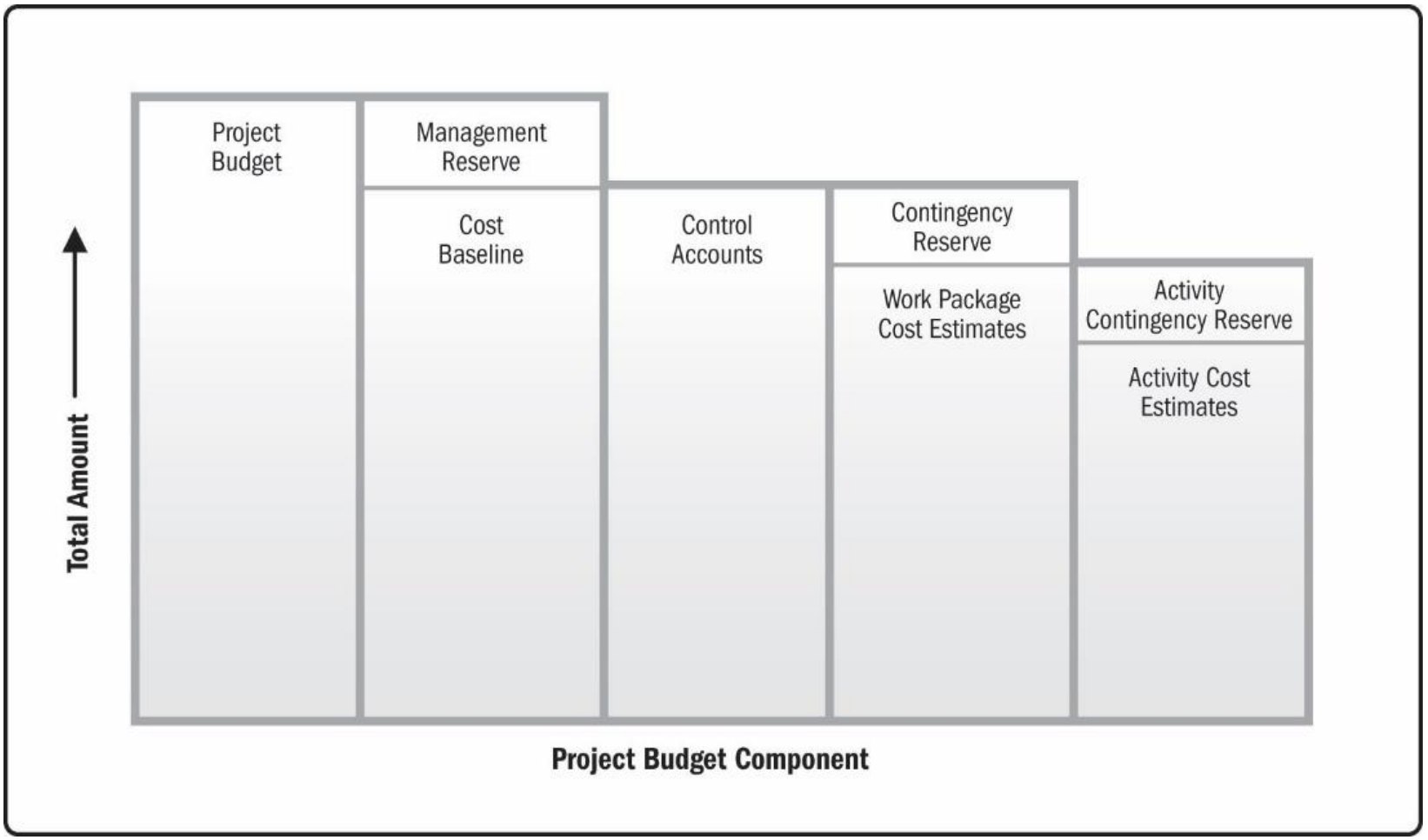
Sample Cost Estimate

WBS Categories	Internal Labor	$/hour	Internal $ Total	External Labor	$/hour	External $ Total	Total Labor	Non-labor $	Total Cost
1. Initiating	200	$ 65	$ 13,000			$ -	$ 13,000		$ 13,000
2. Planning	600	$ 60	$ 36,000			$ -	$ 36,000		$ 36,000
3. Executing			$ -			$ -	$ -		$ -
3.1 Course design and development			$ -			$ -	$ -		$ -
3.1.1 Supplier management training	600	$ 60	$ 36,000	600	$ 150	$ 90,000	$ 126,000	$ 100,000	$ 226,000
3.1.2 Negotiating skills training	300	$ 55	$ 16,500	300	$ 150	$ 45,000	$ 61,500	$ 50,000	$ 111,500
3.1.3 Project management training	400	$ 60	$ 24,000	400	$ 150	$ 60,000	$ 84,000	$ 50,000	$ 134,000
3.1.4 Software applications training	400	$ 60	$ 24,000	400	$ 150	$ 60,000	$ 84,000	$ 50,000	$ 134,000
3.2 Course administration	400	$ 55	$ 22,000	300	$ 250	$ 75,000	$ 97,000	$ 80,000	$ 177,000
3.3.Course evaluation	300	$ 55	$ 16,500			$ -	$ 16,500		$ 16,500
3.4 Stakeholder communications	300	$ 55	$ 16,500			$ -	$ 16,500		$ 16,500
4. Monitoring and Controlling	500	$ 55	$ 27,500			$ -	$ 27,500		$ 27,500
5. Closing	200	$ 55	$ 11,000			$ -	$ 11,000		$ 11,000
Subtotal									$ 903,000
Reserves			$ -			$ -	$ -		90,300.0
Total	4,200		243,000	2,000		330,000	573,000	330,000	**$ 993,300**

Cost Budgeting

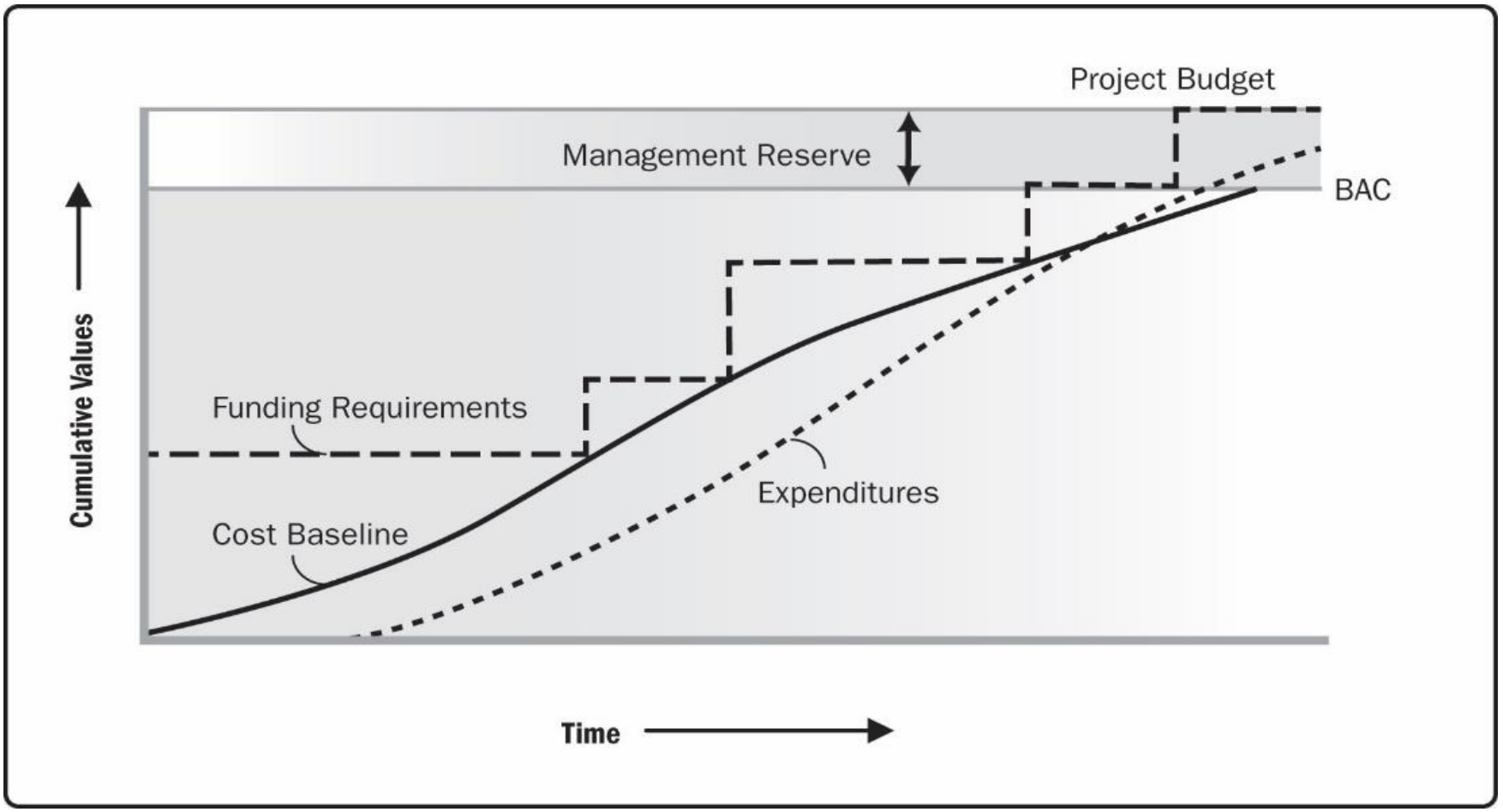
- Project cost budgeting involves allocating the project cost estimate to tasks over time
- The tasks are based on the work breakdown structure for the project
- The main goal of the cost budgeting process is to produce a **cost baseline**, or time-phased budget, that project managers use to measure and monitor cost performance

Project Budget Components



Source: Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Sixth Edition* (2017).

Cost Baseline, Expenditures, and Funding



Source: Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Sixth Edition* (2017).

Sample Cost Baseline

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total Cost
WBS Categories													
1. Initiating	13,000												$ 13,000
2. Planning	6,000	16,000	8,000	1,000	1,000	1,000	1,000	1,000	1,000				$ 36,000
3. Executing			-			-	-						$ -
3.1 Course design and development			-			-	-						$ -
3.1.1 Supplier management training			5,000	73,667	73,667	73,667							$226,000
3.1.2 Negotiating skills training			5,000	35,500	35,500	35,500							$111,500
3.1.3 Project management training			5,000	43,000	43,000	43,000							$134,000
3.1.4 Software applications training			5,000	43,000	43,000	43,000							$134,000
3.2 Course administration						17,000	53,333	53,333	53,333				$177,000
3.3.Course evaluation							3,000	3,000	3,000	7,500			$ 16,500
3.4 Stakeholder communications		1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	$ 16,500
4. Monitoring and Controlling	1,000	2,000	2,000	2,000	3,000	3,500	3,000	3,000	2,000	3,000	2,000	1,000	$ 27,500
5. Closing											8,000	3,000	$ 11,000
Subtotal													$903,000
Reserves*			-			-	-					90,300	$ 90,300
Total	20,000	19,500	31,500	199,667	200,667	218,167	61,833	61,833	60,833	12,000	11,500	95,800	993,300

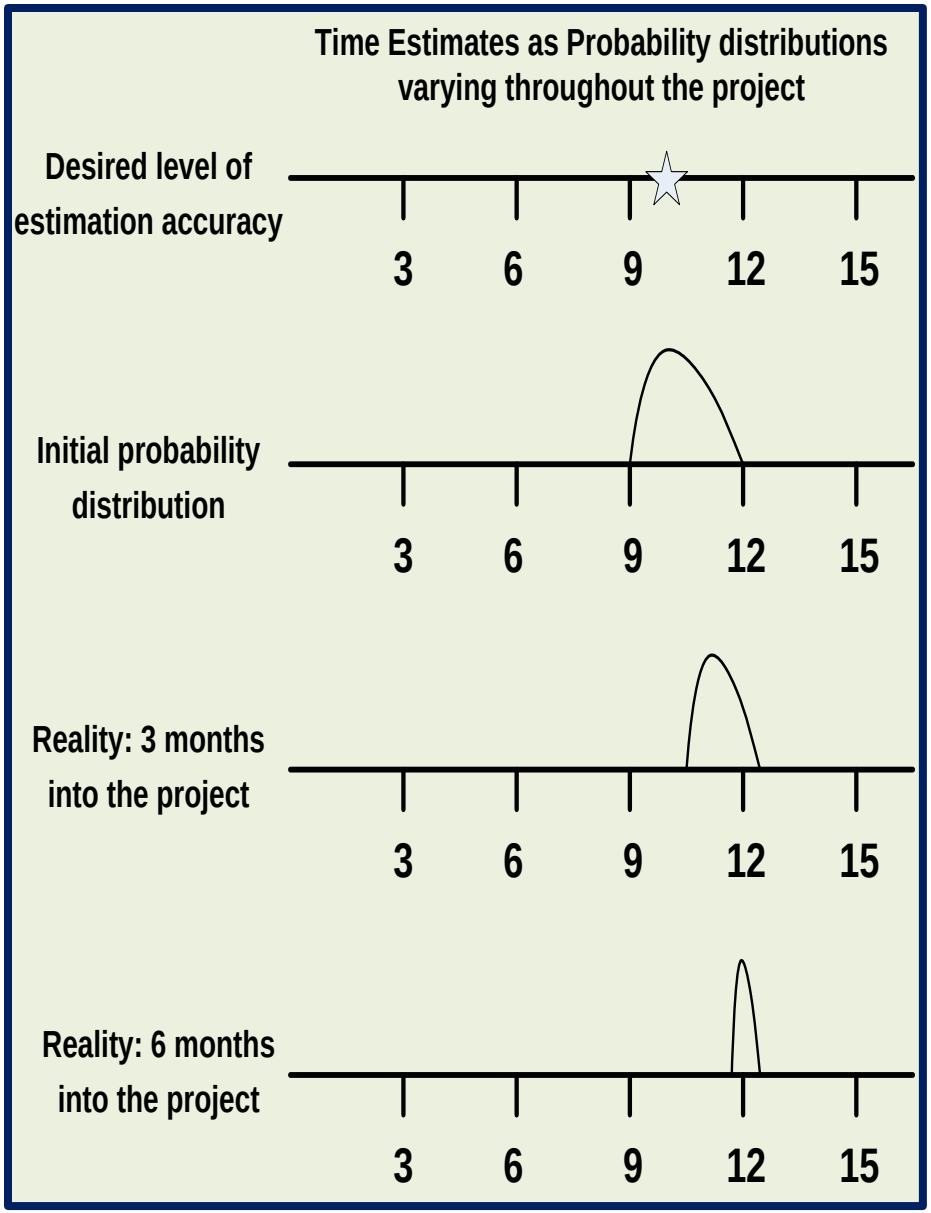
*Reserves are all entered in month 12

TIME & COST ESTIMATING TECHNIQUES FOR AGILE

Formulating an Initial Schedule

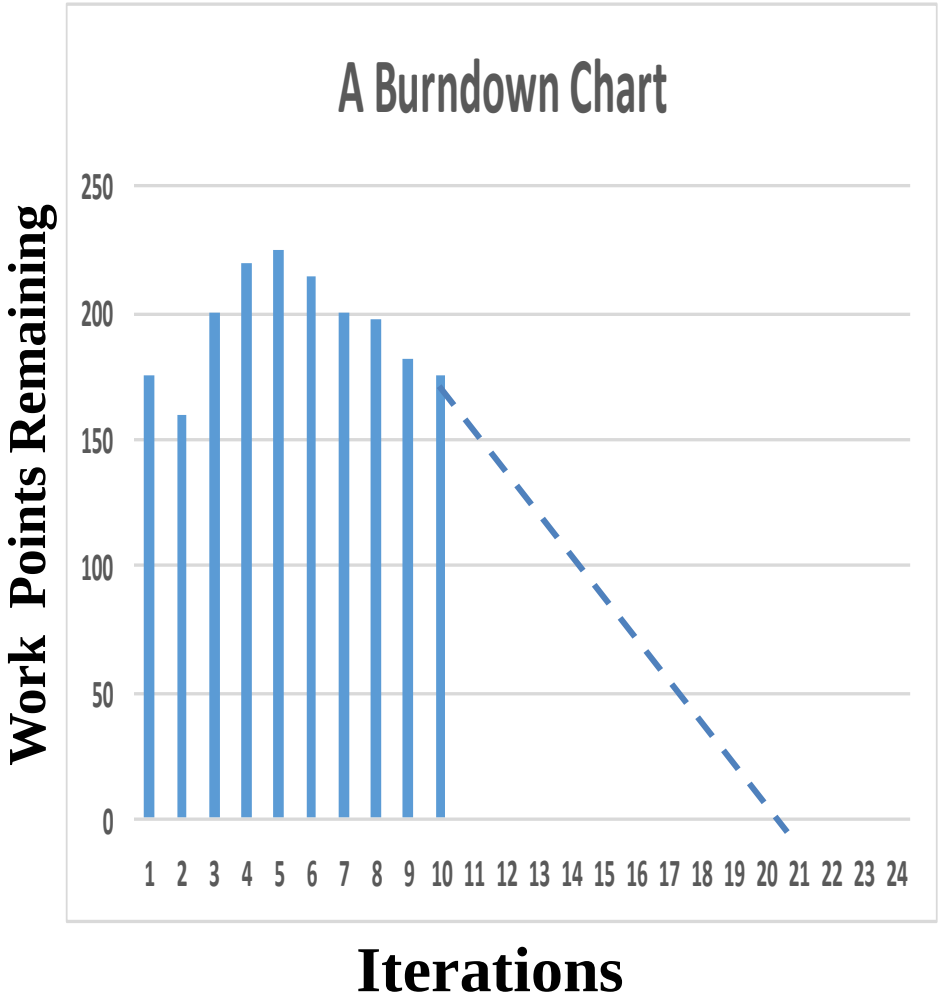
- Important scheduling considerations:
  - ✓ Team members' skills and collaboration ability
  - ✓ Milestone reviews such as: stakeholder consensus, validating the architecture, identifying when the solution is ready for release, confirming stakeholder satisfaction, etc.
  - ✓ Dependence with other teams such as dB admin group, operations group, enterprise architects, etc.
  - ✓ Desired or legislated release dates
  - ✓ When - what day of the week - to start iterations?

- Agile teams are always pressured to provide an estimate to complete the work
- At the beginning of the project, the range of the schedule estimate should be wide, due the uncertainty of the information, the required scope and the initial technical strategy
- As the team's understanding of both stakeholders' needs, and the solution to address those needs evolve, the range of schedule and cost estimates can be tightened



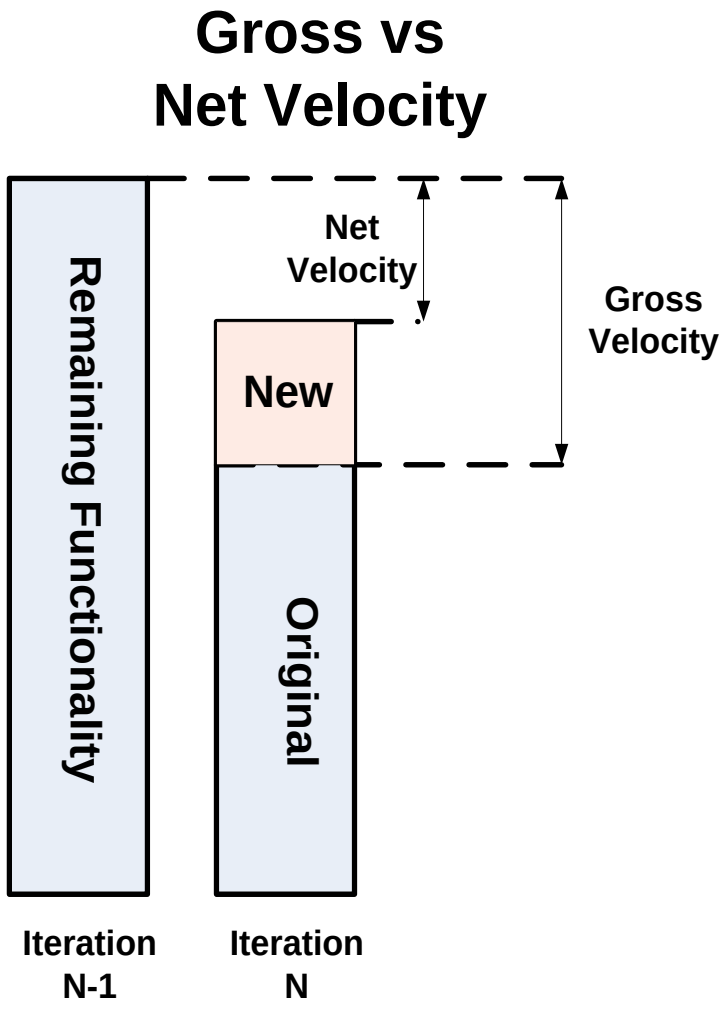
Using Burndown Charts to Improve Estimates

- Example:
  - ✓ During iteration 10, the team had completed 16 points of work and 176 points of work are remaining.
  - ✓ At the end of iteration 10, it appears that it would take another 11 iterations to complete the remaining work (e.g. 176 ÷ 16 = 11) for an estimated 21 iterations for the total schedule.

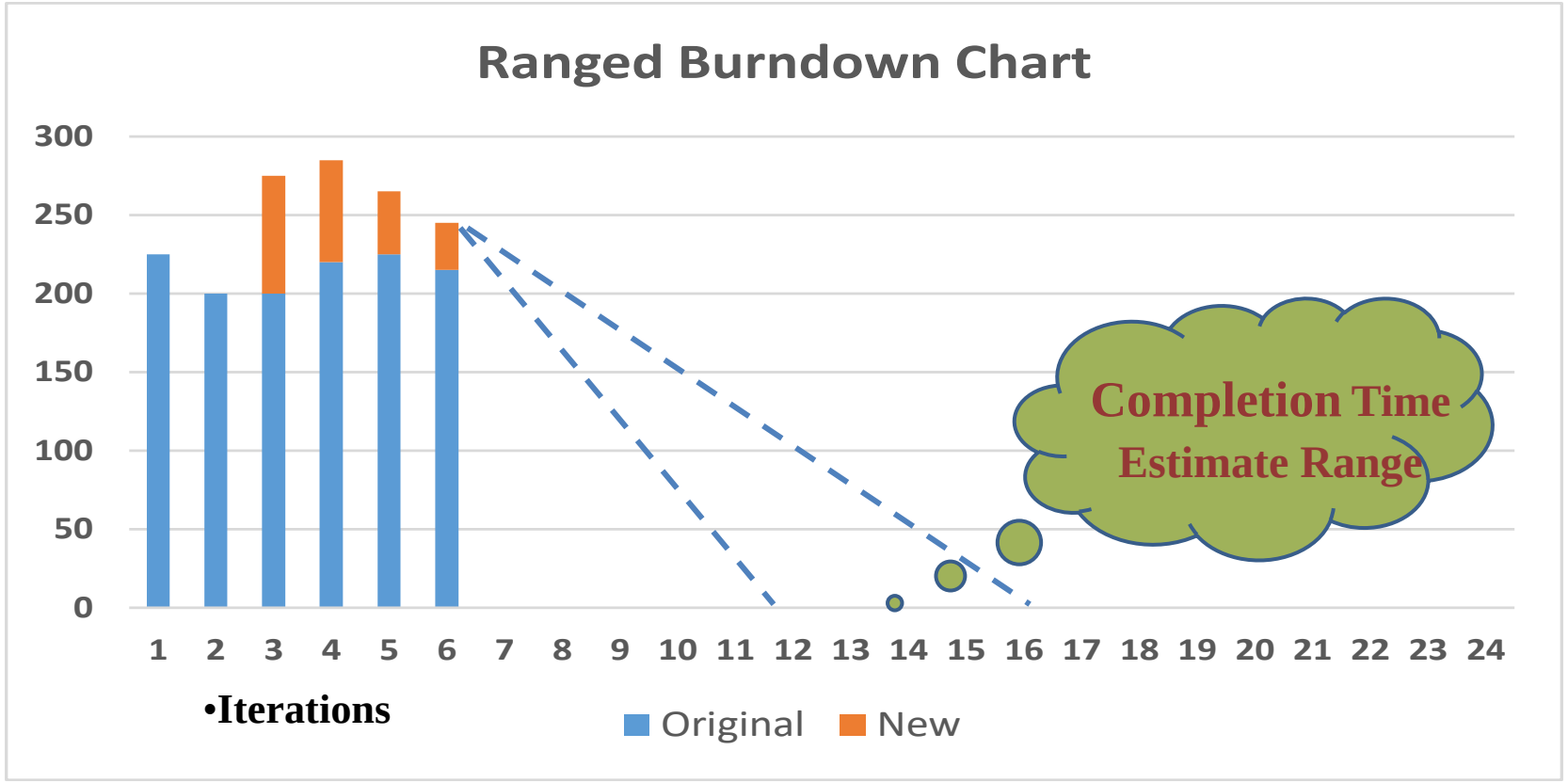


Using Ranged Burndown for Ranged Schedule Estimate

- Definitions of velocity:
  - ✓ ***Gross Velocity***: The amount of work completed in an iteration
  - ✓ ***Net Velocity***: The change in the amount of work still to do, which is the amount of work completed in the iteration less the added amount of new functionality in that iteration.
- *Example:*
  - ✓ if the team completes 20 points in an iteration, but 5 extra points were added, the Gross Velocity = 20 and the Net Velocity= 15
  - ✓ if there's 230 points in the stack, then the Gross Velocity implies 12 iterations left; the Net Velocity implies 16 iterations left, providing a ranged estimate.



Ranged Schedule Estimate at Iteration 6



Earned Value

- Suppose you just signed a contract with a consulting firm called Dewey, Cheatem, and Howe for developing an IS application.
- Project Budget, Schedule, Tasks
  - $40,000
  - 4 months
  - 20 Tasks (evenly divided over 4 months)
    - $2,000 per task
    - 5 tasks per month

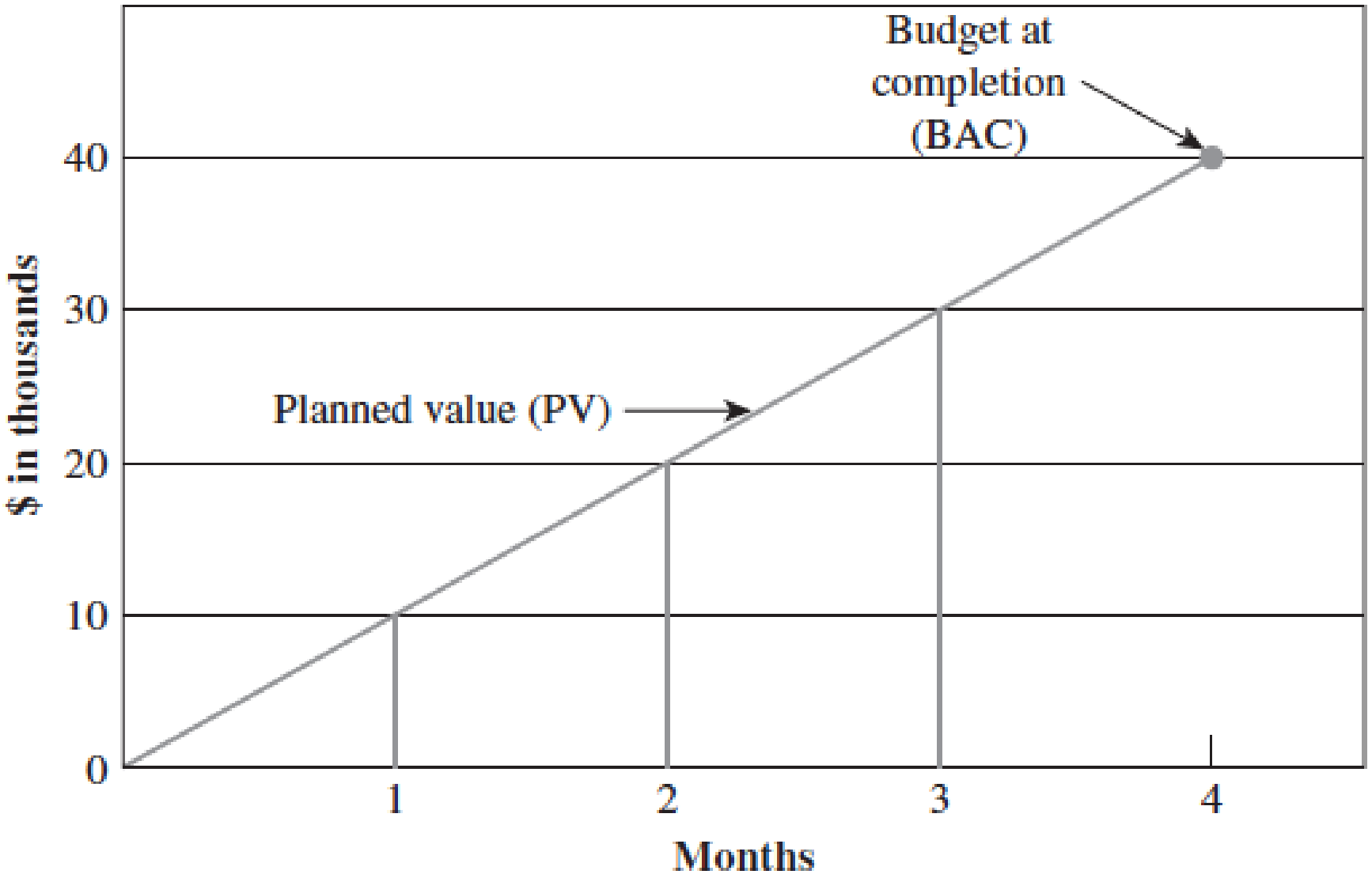
The Planned Project Schedule And Budget

Task	Month 1	Month 2	Month 3	Month 4
1	$2,000			
2	$2,000			
3	$2,000			
4	$2,000			
5	$2,000			
6		$2,000		
7		$2,000		
8		$2,000		
9		$2,000		
10		$2,000		
11			$2,000	
12			$2,000	
13			$2,000	
14			$2,000	
15			$2,000	
16				$2,000
17				$2,000
18				$2,000
19				$2,000
20				$2,000
Total	**$10,000**	**$10,000**	**$10,000**	**$10,000**

Earned Value Concepts

- **Planned Value (PV)**
  - The planned or budgeted cost of work scheduled for an activity or component of the WBS
    - In our case, our planned value for each task is $2,000
    - The planned value for each month is $10,000
- **Budgeted At Completion (BAC)**
  - The total budget for our project
    - In our case, $40,000 is our BAC since this is what we expect to pay for the completed project
    - The BAC is the total cumulative planned value

Planned Budget



At the end of Month 1, we received the following invoice…

Invoice

Dewey, Cheatem, and Howe

Amount Due: $8,000.00

Payment Due: Immediately

Page 1 of 2

This Looks Like Good News!

- We expected to pay $10,000 but we're only being billed for $8,000
  - Are we really ahead of our budgeted or planned value by $2,000?
- It depends on what work was accomplished for the $8,000 that is due

Therefore, we need to look at the rest of the invoice to be sure

It appears that only three of the five tasks scheduled to be completed in Month 1 were completed as planned. In fact, two of the tasks cost more to complete than originally estimated.

Maybe things are not as good as we thought!

Invoice

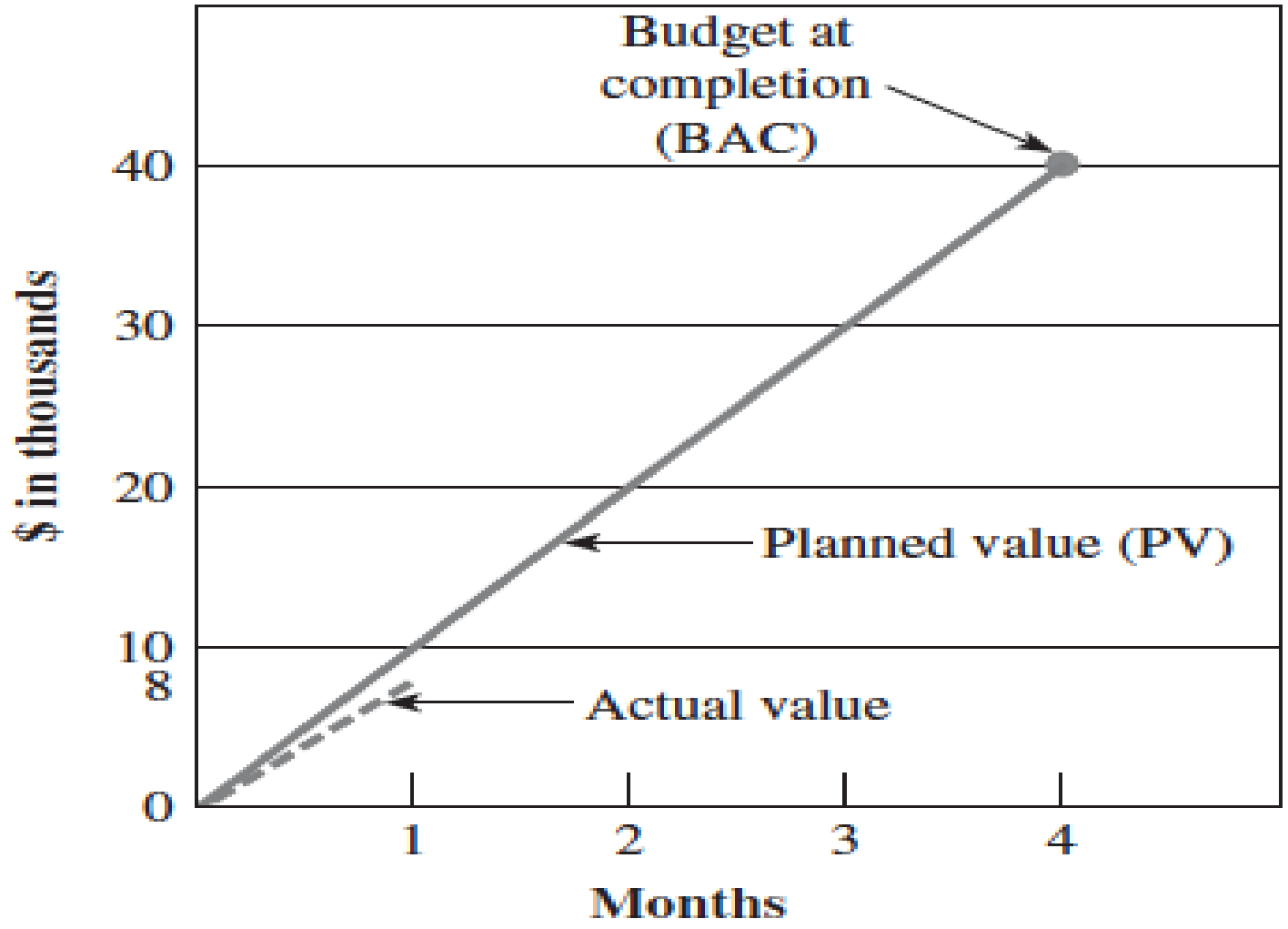
Dewey, Cheatem, and Howe

Work Completed for Month 1

Task 1: $2,000
Task 2: $3,000
Task 3: $3,000

Page 2 of 2

Planned Value versus Actual Cost



Some More Earned Value Concepts

- **Actual Cost (AC)**
  - The actual cost incurred for completing an activity or component of the WBS
    - For example, the actual cost for completing task 2 is $3,000
    - Or, we have to write a check for $8,000 for the three tasks that were completed in Month 1
- **Earned Value (EV)**
  - A performance measurement that tells us how much of the budget we really should have spent for the work that was completed
  - We need to pay our consultants $8,000 in actual costs even though we should be paying them only $6,000
  - This $6,000 is called the **earned value**

Planned, Actual, & Earned Values for Month 1

Task	Planned Value	Actual Cost	Earned Value
1	$2,000	$2,000	$2,000
2	$2,000	$3,000	$2,000
3	$2,000	$3,000	$2,000
4	$2,000		
5	$2,000		
Cumulative	$10,000	$8,000	$6,000
	↑ What we *planned* to pay	↑ What we *have* to pay	↑ What we *should* to pay

Cost Metrics

- **Cost Variance (CV) -** the difference between a task's or WBS component's estimated cost and its actual cost:

$$\mathbf{CV = EV - AC}$$

  - Negative Value = over budget
  - Positive Value = under budget
  - Value = 0 means project is right on budget

- **Cost Performance Index (CPI) -** percentage of work completed per dollar spent

$$\mathbf{CPI = EV \div AC}$$

  - ratio > 1 = ahead of budget
  - ratio < 1 = behind budget (cost overrun)
  - Ratio = 1 means project is right on budget

Cost Metrics

Cost Variance (CV) = EV – AC

= $6,000 - $8,000

= ($2,000)

Negative value tells us the project is over budget

Cost Metrics

Cost Performance Index (CPI) = EV / AC

= $6,000 / $8,000

= .75

ratio < 1 = the project is over budget

For every $1 spent, only $0.75 of the work we budgeted was really completed.

Schedule Metrics

- Schedule Variance (SV) – the difference between the current progress of the project and its original or planned schedule

  SV = EV – PV

  - Negative Value = behind schedule
  - Positive Value = ahead of schedule
  - Value = 0 means project is right on schedule

- **Schedule Performance Index (SPI)** – a ratio of the work performed to the work scheduled.

  SPI = EV ÷ PV

  - ratio > 1 = ahead of schedule
  - ratio < 1 = behind schedule
  - Ratio = 1 means our project is right on schedule

Schedule Metrics

Schedule Variance (SV) = EV – PV
= $6,000 - $10,000
= ($4,000)

Negative value tells the project is behind schedule

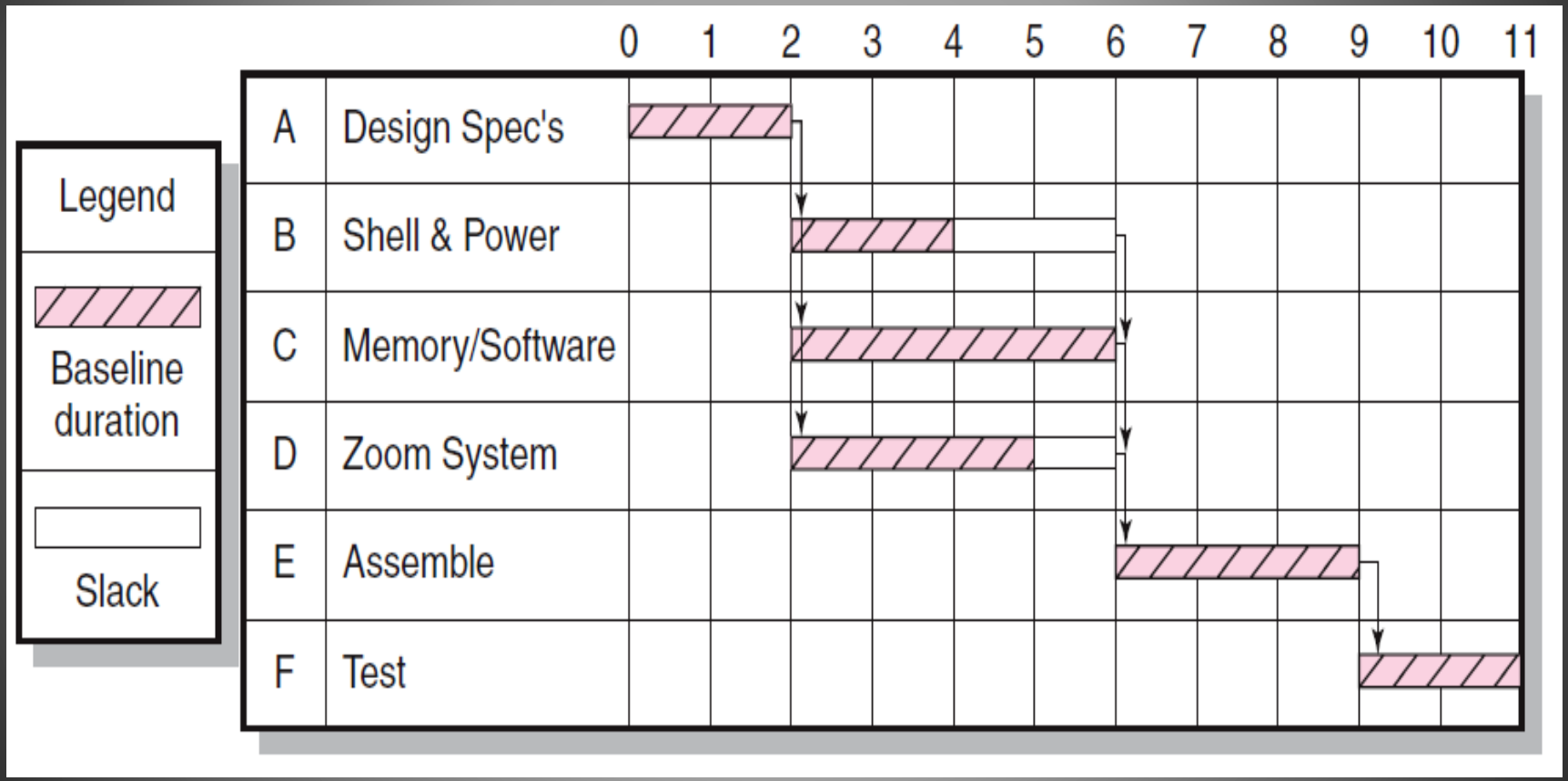
Schedule Metrics

Schedule Performance Index (SPI) = EV/PV
= $6,000 / $10,000
= .60

ratio < 1 tells us the project is behind schedule

For every $1.00 of work that was expected to be completed, only $0.60 was accomplished.

Digital Camera Prototype Project Baseline Gantt Chart



Digital Camera Prototype Project Baseline Budget ($000)

Schedule information						Baseline budget needs										
ACT/ WP	DUR	ES	LF	SL	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	

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**

Digital Camera Prototype Status Reports: Periods 4 & 5

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
Comulative 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**

Digital Camera Prototype Status Reports: Periods 6 & 7

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**

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**

Digital Camera Prototype Summary Graph ($000)