

# COST MANAGEMENT

1

## LECTURE 5

# LEARNING OBJECTIVES

- Explain basic network security project cost management in terms of principles, concepts, processes, techniques and terms.
- Discuss different types of cost estimates and methods for preparing them.
- Understand the processes involved in cost budgeting, preparing a cost estimation and cost baseline for a network security project.
- Understand the benefits of earned value management and project portfolio management to assist in cost control.
- Describe how project management software tool assist in network security project cost management for data security and sustainability.

# 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 like Ringgit.
- **Project cost management** includes the processes required to ensure that the project is completed within an approved budget.

# The Basics of Project Cost Management

Why?  
Important to All.

Cost Management

What?  
Process of Managing Project Costs



Tips! How To Improve?



With ✓



Without ✗

- Sets the Baseline for Project Costs.
- Governs the Actions to Keep Budget on Track.

- Company might lose money  
→ Costs exceed profit.
- Customers invoiced incorrectly.

Prevent Going Over-Budget.

Project Budget	Labor		Materials						\$ Budget	\$ Actual	Balance UNDER/ OVER
	HR	\$/HR	UNITS	\$/UNITS	Travel	Equip/space	Fixed misc.				
Project									600	1590	(990)
Task	8	\$30	100	\$5			\$50		200	790	(590)
Task	8	\$15			\$30		\$100		300	250	50
Task			50	\$11					100	550	(450)
SubTask											
SubTOTAL											

Costs Easier to Collect:

- Labor
- Consulting Fees
- Raw Materials
- Software Licenses
- Travel

Costs May Change or Share:

- Telephone Charges
- Office Space
- Office Equipment
- General Administration
- Company Insurance

- Plan for Inflation
- Account for Natural Disasters or Potential Events
- Include Unexpected Costs
  - Legal
  - Penalties
  - Labor Costs
- Track Real-Time
- Respond Promptly
- Size Accordingly
  - Scale
  - Small vs Large

# PROJECT COST MANAGEMENT PROCESSES

- **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.



# PROJECT COST MANAGEMENT MAP

## Planning

Process: **Estimate costs**

Outputs: Activity cost estimates, basis of estimates, project document updates

Process: **Determine budget**

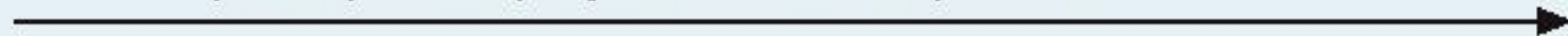
Outputs: Cost performance baseline, project funding requirements, product document updates



## Monitoring and Controlling

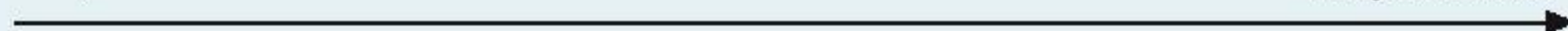
Process: **Control costs**

Outputs: Work performance measurements, budget forecasts, organizational process assets updates, change requests, project management plan updates, project document updates



Project Start

Project Finish



# BASIC PRINCIPLES OF COST MANAGEMENT

- Most members of an executive board better understand and are more interested in financial terms than IT terms, so the security project managers must speak their language too.
  - **Profits** are revenues minus expenditures
  - **Profit margin** is the ratio of revenues to profits
  - **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

# BASIC PRINCIPLES OF COST MANAGEMENT

- **Tangible costs or benefits** are those costs or benefits that an organization can easily measure in money.
- **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 and cannot be recovered; 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 money (in Ringgit) 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**)

# BASIC PRINCIPLES OF COST MANAGEMENT

## COST **BASLINE**

A starting point of the project, which used for comparison between project progress and project actual plan

- Cost Baseline is the authorized time-phased spending plan for the project on which the project cost performance is to be measured. As the Cost Baseline is baselined and managed under configuration management, changes to the Cost Baseline must undergo proper change management processes.
- The Cost Baseline includes all the project activities/resources costs and the money set aside to respond to risks identified (i.e. known unknowns) over time and it is usually represented as an S-curve
- $\text{Cost Baseline} = \text{Project Cost Estimates} + \text{Contingency Reserves}$

# BASIC PRINCIPLES OF COST MANAGEMENT

## COST BUDGET

- Cost Budget is the allowable deviations requested based on customer expectations
- The Cost Budget is the estimate of total amount of money required for carrying out the Project, including money set aside for identified and unidentified risks (i.e. unknown unknowns)
- The Cost Budget can be thought of as the Cost Baseline over time plus the Management Reserves
- $\text{Cost Budget} = \text{Project Cost Estimates} + \text{Contingency Reserves} + \text{Management Reserves}$

# EXAMPLE . . .

- Known unknowns – a company should reserve for labour turnover, recruitment of new staff and training for new staff.
- Unknown unknowns – a manager get sick for weeks, a supplier goes out of business due to COVID-19 pandemic.

# 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.



# MAXIMUM DEPARTMENTAL HEADCOUNTS BY YEAR

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



# ESTIMATING COST

# ESTIMATING COSTS

- It is important for Project Manager to know :
  - **types** of estimating cost (ROM/Budgetary/Definitive),
  - **techniques** (top-down, bottom-up, parametric, cocomo, cocomo II and secomomo)
  - understand the **problem occurred** on network security services associated with the cost estimates.

# TYPES OF ESTIMATING COST

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

# COST ESTIMATION TOOLS AND TECHNIQUES

- Basic tools and techniques for cost estimation:
  - **Analogous or top-down estimates:** use the actual cost of a previous and 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.
  - **Constructive Cost Model (COCOMO):** uses Parametric Model to estimate the software development costs with the computerized form. **COCOMO II** allows Project Manager to estimate cost, effort and schedule to estimate the software project costs. (Example: use spreadsheet or Project Management Tool).
  - **Security Cost Model (SECOMO)** uses Parametric Model with the computer processing to estimate the implementation of network security project cost through measurement of network size, project cost, schedule, duration and parameters (scale factors and effort multipliers). (Example: use spreadsheet or Project Management Tool).



# TYPICAL PROBLEMS WITH NETWORK SECURITY COST ESTIMATION

- Estimations are done too quickly
- Lack of estimating experience
- Management control in procurement process
- Security services in network security devices are more expensive compared to network devices
- Red Tape

# ESTIMATING COST - EXAMPLE

- Before creating an estimate, Project Manager needs to know what it will be used for, gather as much information as possible, clarify the ground rules and assumptions for the estimation.
- If possible, estimate costs according to major WBS categories.
- Create a cost model to make it easy to make changes to and document the estimate.

# ESTIMATING COST - EXAMPLE

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

# ESTIMATING COST - EXAMPLE

Surveyor Pro Software Development Estimate Created October 5

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	$1920 * 75$
<b>Total labor estimate</b>			<b>\$594,000</b>	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	$7 * 10$
<b>Total function points</b>			<b>175</b>	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 (160 hours/month)			4,684.65	$29.28 * 160$
Cost/labor hour (\$120/hour)			\$120	Assumed value from budget expert
<b>Total function point estimate</b>			<b>\$562,158</b>	$4684.65 * 120$

\*\*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).



# DETERMINING BUDGET



# DETERMINING THE BUDGET

- Cost budgeting involves allocating the project cost estimate to individual work items over time.
- The WBS is a required input to the cost budgeting process since 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.

# DETERMINING BUDGET BASELINE - EXAMPLE

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**

# CONTROLLING COSTS

- 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
- Technique for measuring project performance with progress is using EVM.

# EARNED VALUE MANAGEMENT (EVM)

- **EVM** is a project performance measurement technique that integrates scope, time, cost and talent 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 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 this term and 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% 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

- Suppose you are managing a software development project. The project is expected to be completed in 8 months at a cost of \$10,000 per month. After 2 months, you realize that the project is 30 percent completed at a cost of \$40,000. You need to determine whether the project is on-time and on-budget after 2 months.
- Step 1: Calculate the Planned Value (PV) and Earned Value (EV)
- **From the scenario,**
- Budget at Completion (BAC) =  $\$10,000 * 8 = \$80,000$
- Actual Cost (AC) = \$40,000
- Planned Completion (CP) =  $2/8 = 25\%$
- Actual Completion (AC) = 30%
- Therefore,
- Planned Value = Planned Completion (PC) (%) \* BAC =  $25\% * \$80,000 = \$20,000$
- Earned Value = Actual Completion (AC) (%) \* BAC =  $30\% * \$80,000 = \$24,000$
- Step 2: Compute the Cost Performance Index (CPI) and Schedule Performance Index (SPI)
- **Cost Performance Index (CPI)** =  $EV / AC = \$24,000 / \$40,000 = 0.6$
- **Schedule Performance Index (SPI)** =  $EV / PV = \$24,000 / \$20,000 = 1.2$
- **Interpretation:** Since Cost Performance Index (CPI) is less than one, this means the project is over budget. For every dollar spent we are getting 60 percents' worth of performance. Since Schedule Performance Index (SPI) is more than one, the project is ahead of schedule. However, this has come at a cost of going over budget. If work is continued at this rate, the project will be delivered ahead of schedule and over budget. Therefore, corrective action should be taken.

# 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)	-10,000
Schedule Variance (SV)	-5,000
Cost Performance Index (CPI)	33%
Schedule Performance Index (SPI)	50%

# EVM Example

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%



$$CV = EV - AC = 5000 - 15000 = -10000$$

$$SV = EV - PV = 5000 - 10000 = -5000$$

$$CPI = EV/AC = 5000/15000 = 33\%$$

$$SPI = EV / PV = 5000/10000 = 50\%$$

# Cost Variance (CV)

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PERFORMAN  
CE BASED

EV

of the work I actually performed,  
how much did I budget for it to cost?

AC

of the work I actually performed,  
how much did it actually cost?

**COST VARIANCE** is the difference between budgeted cost and actual cost

**formula:**  $CV \$ = EV - AC$

**example:**  $CV = EV - AC = \$1,000 - \$2,400$   
 $CV = -\$1,400$  (negative = cost overrun)

# EARNED VALUE FORMULAS


TERM	FORMULA
Earned Value	$EV = PV \text{ to date} \times RP$
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



# The Formula

<b>AC</b> <b>ACWP</b>	Actual Cost (or ACWP actual cost of work performed)	
<b>EV</b> <b>BCWP</b>	Earned Value (or BCWP budgeted cost of work performed)	
<b>PV</b> <b>BCWS</b>	Planned Value (or BCWS budgeted cost of work scheduled)	
<b>BAC</b>	Budget at completion ( BAC = PV at the completion time)	
<b>CV</b>	$CV = EV - AC$	Cost Variance
<b>CPI</b>	$CPI = \frac{EV}{AC}$	Cost Performance Index (greater than 1 is good, in budget)
<b>SV</b>	$SV = EV - PV$	Schedule Variance
<b>SPI</b>	$SPI = \frac{EV}{PV}$	Schedule performance index (greater than 1 is good, ahead of schedule)
<b>EAC</b>	$EAC = AC + \frac{(BAC - EV)}{CPI}$ $EAC = \frac{BAC}{CPI}$	Estimate at completion
<b>ETC</b>	$ETC = EAC - AC$	Estimate to complete
<b>TCPI</b>	$TCPI_{BAC} = \frac{(BAC - EV)}{(BAC - AC)}$ $TCPI_{EAC} = \frac{(BAC - EV)}{(EAC - AC)}$	To Complete Performance Index  (less than 1 is good, more efficient than planned)

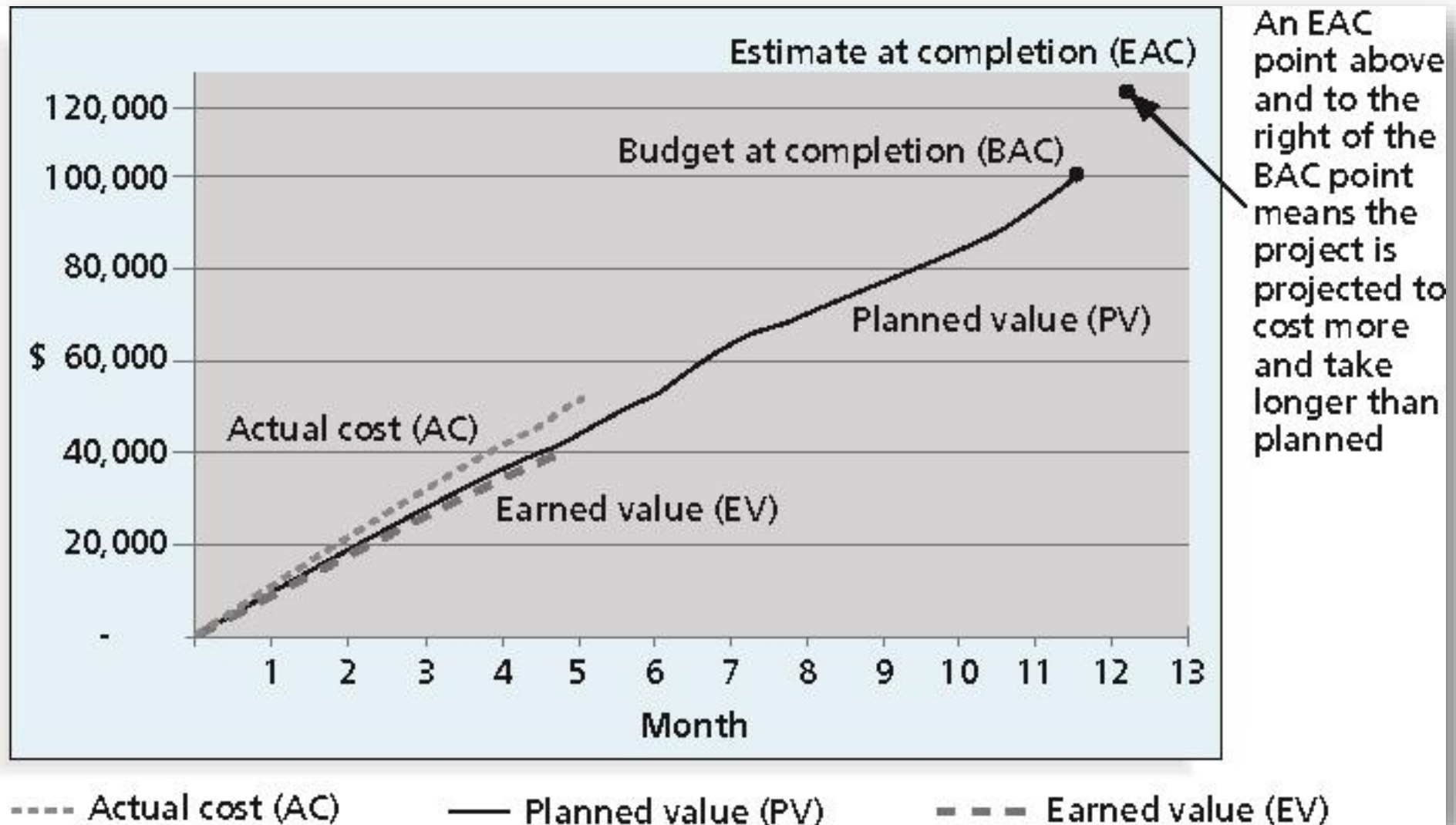
# The Formula and Interpretation

Abbreviation	Name	Equation	Interpretation of Result
<b>SV</b>	Schedule Variance	$SV = EV - PV$	Positive = Ahead of schedule Neutral = On schedule Negative = Behind Schedule
<b>SPI</b>	Schedule Performance Index	$SPI = EV/PV$	Greater than 1.0 = Ahead of schedule Exactly 1.0 = On schedule Less than 1.0 = Behind schedule.
<b>CV</b>	Cost variance	$CV = EV - AC$	Positive = Under planned cost Neutral = On planned cost Negative = Over Planned cost
<b>CPI</b>	Cost Performance Index	$CPI = EV/AC$	Greater than 1.0 = Under planned cost Exactly 1.0 = On planned cost Less than 1.0 = Over Planned cost
<b>VAC</b>	Variance at Completion	$VAC = BAC - EAC$	Positive = Under planned cost Neutral = On planned cost Negative = Over planned cost
<b>EAC</b>	Estimate at Completion	$EAC = BAC/CPI$ $EAC = AC + BAC - EV$  $EAC = AC + \text{Bottom-up ETC}$  $EAC = AC + [(BAC-EV)/(CPI \times SPI)]$	If the CPI is expected to be the same  If future work will be accomplished at the planned rate  If the initial plan is no longer valid, use:  If both the CPI and SPI influence the remaining work, use:
<b>ETC</b>	Estimate to Complete	$ETC = EAC - AC$ $ETC = \text{Reestimate}$	
<b>TCPI</b>	To Complete Performance Index	$TCPI = (BAC - EV) / (BAC - AC)$  $TCPI = (BAC - EV) / (EAC - AC)$  Work Remaining = $BAC - EV$ Funds Remaining = $BAC - AC$ Funds Remaining = $EAC - AC$	Greater than 1.0 = Harder to complete Exactly 1.0 = Same to complete Less than 1.0 = Easier to complete  

# RULES OF THUMB FOR EARNED VALUE NUMBERS

- Negative numbers for cost and schedule variance indicate problems in those areas.
- 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 to date; the **budget at completion** (BAC) is the original total budget for the project.

# EARNED VALUE CHART FOR PROJECT AFTER FIVE MONTHS



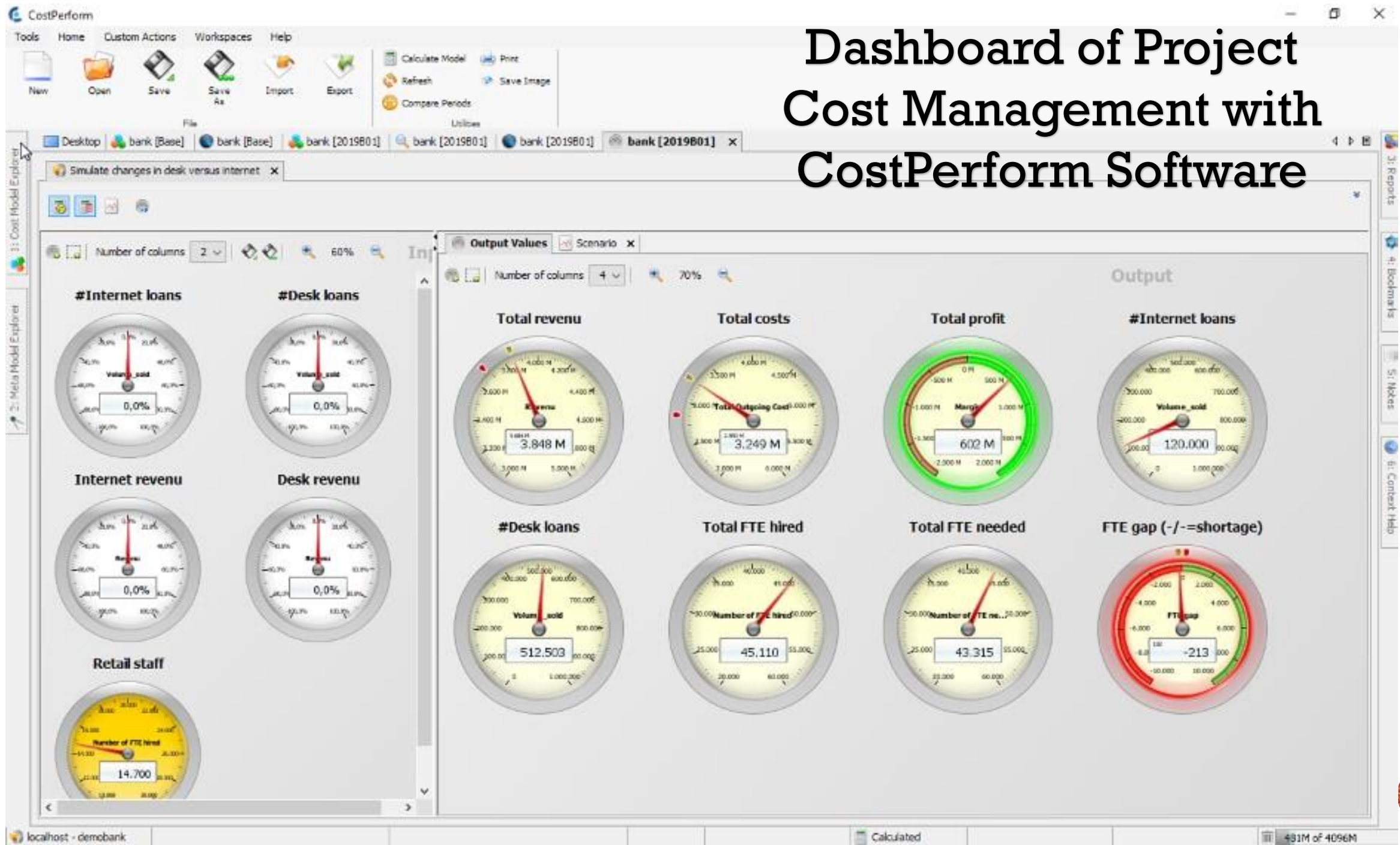
# PROJECT PORTFOLIO MANAGEMENT

- Many organizations collect and control projects or investments as one set of interrelated activities including formulas and justifications in a portfolio.
- Five levels for project portfolio management
  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

# 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 to reduce costs.









Dashboard  
of Project  
Cost  
Management  
with  
Project  
Manager.com

# CHAPTER SUMMARY

- Project cost management is an important aspect for Project Manager to focus on for project completion on scheduled.
- Main processes include:
  - Estimate costs
  - Determine the budget
  - Control costs



# THANK YOU

