SEN319 Software Project Management (Fall 2023)

Project Cost Management

Asst.Prof.Dr. Hasan ÇİFCİ

Agenda

- PM Knowledge Areas
- Project Constraints
- Principles of Cost Management
- Project Cost Management Processes
- Plan Cost Management
- Estimate Costs
- Determine Budget
- Control Costs

PM Knowledge Areas

Integration	• Coordinate activities across all project management areas and process groups
Scope	• Ensure the project work includes all elements required to complete the work
Schedule	• Ensure the project work is completed in a timely way
Cost	• Plan, estimate, manage and control project finances
Quality	• Ensure the project delivers a quality output that is fit for purpose
Resource	• Secure, manage and monitor use of resources throughout the project
Communications	• Ensure communications on the project are planned and carried out appropriately
Risk	• Identify, assess and manage risk
Procurement	• Carry out purchasing and contracting as required
Stakeholder	• Identify and engage stakeholders throughout the project

Project Constraints

Main Constraints:

- Scope
- Time
- Cost

Additional Constraints:

- Quality
- Resources
- Risk

Principles of Cost Management

- **IT project managers need to be able to present and discuss project information both in financial terms and technical terms.**
- **In addition to net present value (NPV) analysis, return on investment (ROI), and payback analysis, project managers must understand several other cost management principles, concepts, and terms.**

Principles of Cost Management

Profit

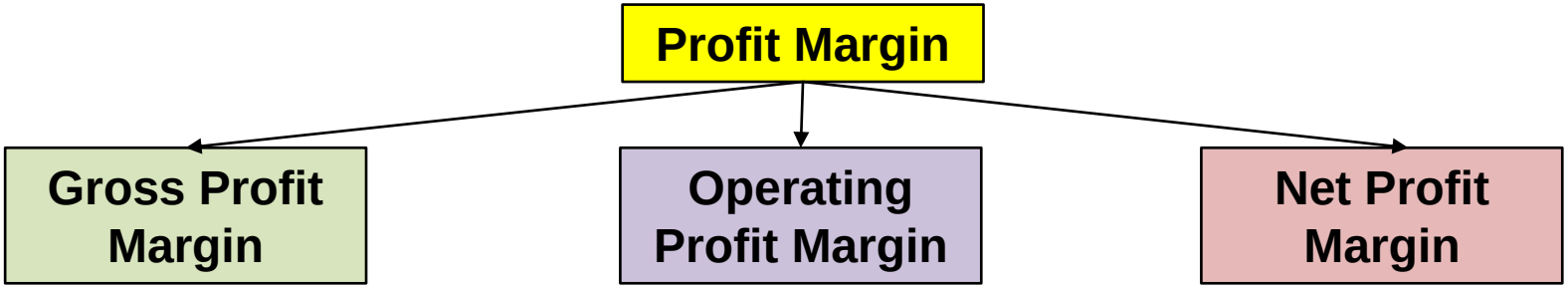
Profit: Revenues - Expenditures

Revenue is the total amount of income generated by the sale of goods or services related to the company's primary operations.

The action of spending funds.

Principles of Cost Management

Profit Margin



Gross Profit / Revenue x 100

Total revenue minus cost of goods sold (COGS)

Operating Profit / Revenue x 100

Revenue minus COGS and operating expenses

Net Income / Revenue x 100

Revenue minus all expenses, including interest and taxes

Example:

XYZ Company is in the online retail business and sells custom printed t-shirts. The revenue from selling shirts is $700K, the cost of goods sold (the direct cost of producing the shirts) is $200K, and all other operating expenses (such as selling, general, administrative (SG&A), interest and taxes) are $400K.

- Revenue : $700K
- COGS : $200K
- Gross profit : $500K
- Other expenses : $400K
- Net income : $100K
- Gross profit margin: 500/700x100 = 71,4%
- Net profit margin: 100/700x100 = 14,3%

Principles of Cost Management

Cash Flow Analysis

- **Cash flow refers to the net balance of cash moving into and out of a business at a specific point in time.**
- **Cash flow can be positive or negative.**
- **Cash flow analysis is a method for determining the estimated annual costs and benefits for a project and the resulting annual cash flow.**

Principles of Cost Management

Tangible vs Intangible Costs or Benefits

- **Tangible costs or benefits are easy to measure in dollars.**

- **If a company completed this study for $100,000, its tangible cost is $100,000.**
- **If a government agency estimated that it could have done the study for $150,000, the tangible benefits of the study would be $50,000 to the government.**

- **Intangible costs or benefits are difficult to measure in dollars.**

- **Intangible benefits for projects often include items like goodwill, prestige, customer satisfaction, enhanced user experience, and general statements of improved productivity that an organization cannot easily translate into dollar amounts.**

Principles of Cost Management

Direct vs Indirect Costs

- **Direct costs** can be directly related to creating the products and services of the project.
  - You can attribute direct costs to a particular project.
  - For example, direct costs include the salaries of people working full time on the project and the cost of hardware and software purchased specifically for the project.
  - Project managers should focus on direct costs because they can be controlled.
- **Indirect costs** are not directly related to the products or services of the project, but are indirectly related to performing work on the project.
  - For example, indirect costs would include the cost of electricity, paper towels, and other necessities in a large building that houses 1,000 employees who work on many projects.
  - Indirect costs are allocated to projects, and project managers have very little control over them.

Principles of Cost Management

Reserves

- **Reserves are dollar amounts included in a cost estimate to mitigate cost risk by allowing for future situations that are difficult to predict.**

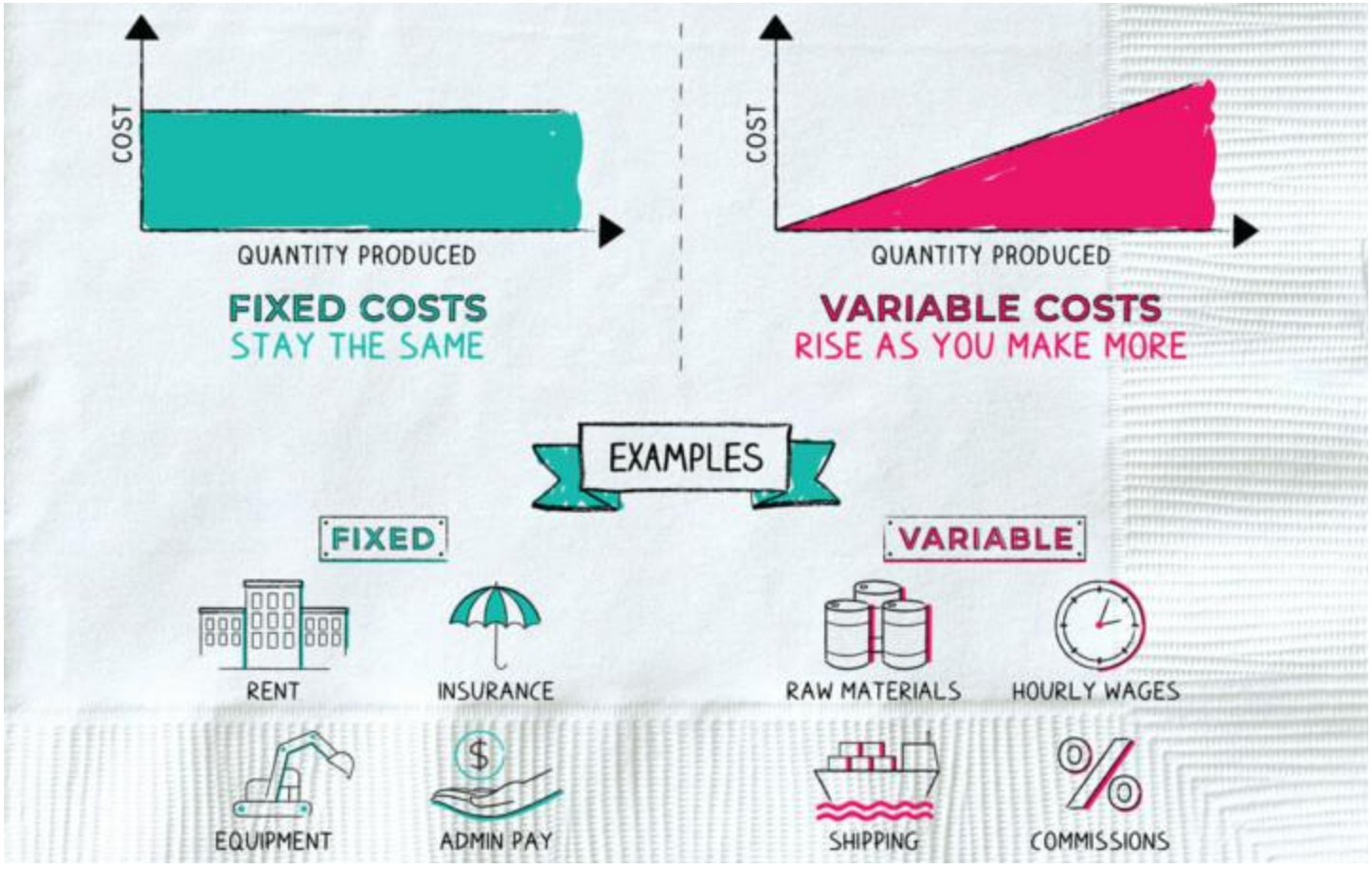
- **Contingency reserves allow for future situations that may be partially planned for (sometimes called known unknowns) and are included in the project cost baseline.**
  - **For example, if an organization knows it has a 20 percent rate of turnover for IT personnel, it should include contingency reserves to pay for recruiting and training costs of IT personnel.**

- **Management reserves allow for future situations that are unpredictable (sometimes called unknown unknowns).**
  - **For example, if a project manager gets sick for two weeks or an important supplier goes out of business, management reserve could be set aside to cover the resulting costs.**
  - **Management reserves are not included in a cost baseline.**

Principles of Cost Management

Variable vs Fixed Costs

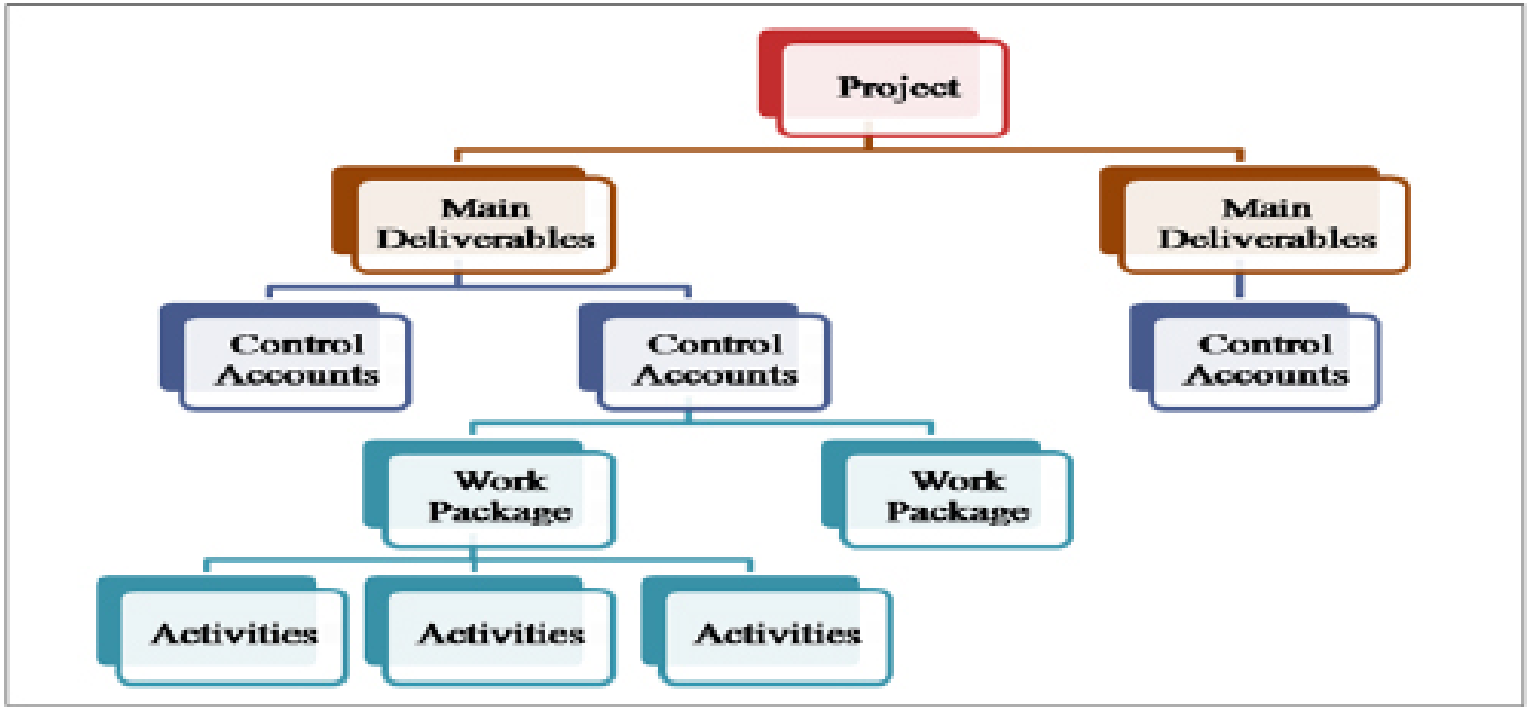
- **Fixed Costs**: Expenses that do not vary based on the usage of resources.
- **Variable Costs**: Expenses that vary based on the usage of resources.



Principles of Cost Management

Control Account

- **Control Account is a management control point where scope, budget, and schedule are integrated and compared to the earned value for performance measurement.**
- **A control account has two or more work packages, though each work package is associated with a single control account.**



Project Cost Management Processes

Project Cost Management				
Initiating	Planning	Executing	Monitoring & Controlling	Closing
	1. Plan Cost Management 2. Estimate Costs 3. Determine Budget		4. Control Cost	

Project Cost Management Processes

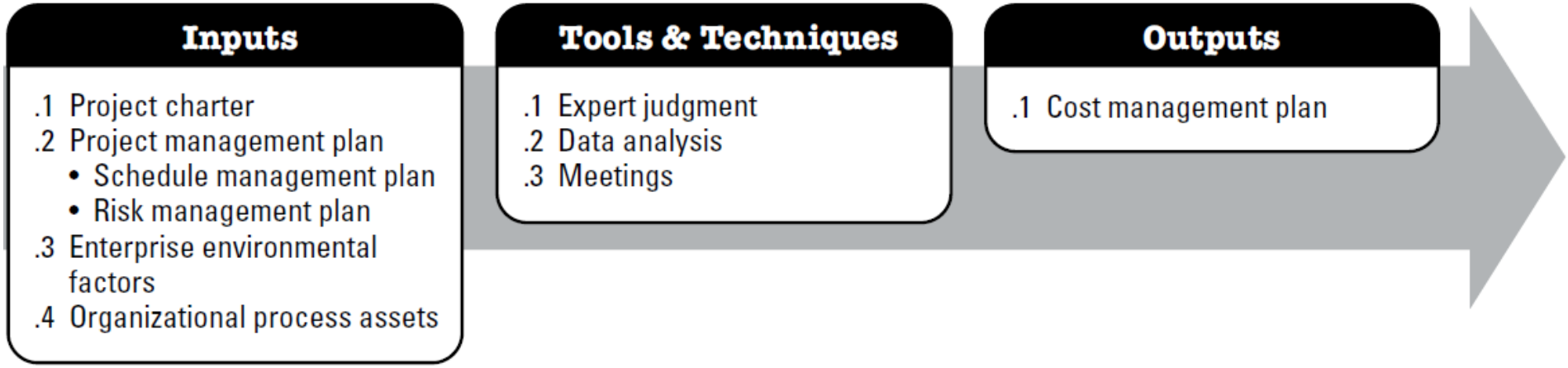
- **Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.**
- **The Project Cost Management processes are:**

1. **Plan Cost Management: The process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.**
2. **Estimate Costs: The process of developing an approximation of the monetary resources needed to complete project work.**
3. **Determine Budget: The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.**
4. **Control Costs: The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.**

Plan Cost Management

- **Plan Cost Management is the process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled.**
- **The key benefit of this process is that it provides guidance and direction on how the project costs will be managed throughout the project.**
- **This process is performed once or at predefined points in the project.**

Plan Cost Management



Plan Cost Management

Output: Cost Management Plan - Contents

- **Level of accuracy**: Activity cost estimates normally have rounding guidelines, such as rounding to the nearest $100. There may also be guidelines for the amount of contingency funds to include, such as 10 or 20 percent.
- **Units of measure**: Each unit used in cost measurements, such as labor hours or days, should be defined.
- **Organizational procedures links**: Many organizations refer to the work breakdown structure (WBS) component used for project cost accounting as the **Control Account (CA)**.
- **Control thresholds**: Amount of variation allowed before action needs to be taken, such as 10 percent of the baseline cost.
- **Rules of performance measurement**: Define measurement rules, such as how often actual costs will be tracked and to what level of detail.
- **Reporting formats**: Format and frequency of cost reports.
- **Process descriptions**: How to perform all of the cost management processes.

Estimate Costs

- **Estimate Costs is the process of developing an approximation of the cost of resources needed to complete project work.**
- **The key benefit of this process is that it determines the monetary resources required for the project.**
- **This process is performed periodically throughout the project as needed.**

Estimate Costs

Inputs	Tools & Techniques	Outputs
.1 Project management plan • Cost management plan • Quality management plan • Scope baseline .2 Project documents • Lessons learned register • Project schedule • Resources requirements • Risk register .3 Enterprise environmental factors .4 Organizational process assets	.1 Expert judgment .2 Analogous estimating .3 Parametric estimating .4 Bottom-up estimating .5 Three-point estimating .6 Data analysis • Alternatives analysis • Reserve analysis • Cost of quality .7 Project management information system .8 Decision making • Voting	.1 Cost estimates .2 Basis of estimates .3 Project documents updates • Assumption log • Lessons learned register • Risk register

Estimate Costs

Types of Cost Estimates

1. Rough Order of Magnitude (ROM) Estimate
2. Budgetary Estimate
3. Definitive Estimate

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	Provides details for purchases, estimates actual costs	-5% to +10%

Estimate Costs

Types of Cost Estimates: ROM Estimate

- Rough Order of Magnitude (ROM) estimate provides an estimate of what a project will cost. A ROM estimate can also be referred to as a ballpark estimate, a guesstimate, a swag, or a broad gauge.
- This type of estimate is done very early in a project or even before a project is officially started.
- Project managers and top management use this estimate to help make project selection decisions.
- A ROM estimate's accuracy is typically -50% to +100%, meaning the project's actual costs could be 50% below the ROM estimate or 100% above.
  - For example, the actual cost for a project with a ROM estimate of $100,000 could range from $50,000 to $200,000.
- For IT project estimates, this accuracy range is often much wider.
- Many IT professionals automatically double estimates for software development because of the history of cost overruns on IT projects.

Estimate Costs

Types of Cost Estimates: Budgetary Estimate

- **A Budgetary Estimate is used to allocate money into an organization's budget.**
- **Many organizations develop budgets at least two years into the future.**
- **Budgetary estimates are made one to two years prior to project completion. The accuracy of budgetary estimates is typically -10% to +25%, meaning the actual costs could be 10% less or 25% more than the budgetary estimate.**
  - **For example, the actual cost for a project with a budgetary estimate of $100,000 could range from $90,000 to $125,000.**

Estimate Costs

Types of Cost Estimates: Definitive Estimate

- A Definitive Estimate provides an accurate estimate of project costs.
- Definitive estimates are used for making many purchasing decisions for which accurate estimates are required and for estimating final project costs.
  - For example, if a project involves purchasing 1,000 personal computers from an outside supplier in the next three months, a definitive estimate would be required to aid in evaluating supplier proposals and allocating the funds to pay the chosen supplier.
- Definitive estimates are made one year or less prior to project completion.
- A definitive estimate should be the most accurate of the three types of estimates.
- The accuracy of this type of estimate is normally -5% to +10%, meaning the actual costs could be 5% less or 10% more than the definitive estimate.
  - For example, the actual cost for a project with a definitive estimate of $100,000 could range from $95,000 to $110,000.

Estimate Costs

Tools and Techniques

1. Expert Judgment
2. Analogous Estimating
3. Parametric Estimating
4. Three-Point Estimates
5. Bottom-Up Estimating

Estimate Costs

Tools and Techniques: Analogous Estimates

- **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 other techniques, but it is also less accurate.**
- **Analogous estimates are most reliable when the previous projects are similar in fact, not just in appearance.**
- **In addition, the groups preparing cost estimates must have the needed expertise to determine whether certain parts of the project will be more or less expensive than analogous projects.**
- **For example, estimators often try to find a similar project and then customize or modify it for known differences. However, if the project to be estimated involves a new programming language or working with a new type of hardware or network, the analogous estimate technique could easily result in too low an estimate.**

Estimate Costs

Tools and Techniques: Parametric Estimating

- **Parametric Estimating uses project characteristics (parameters) in a mathematical model to estimate project costs.**
  - **For example, a parametric model might provide an estimate of $50 per line of code for a software development project based on the programming language the project is using, the level of expertise of the programmers, the size and complexity of the data involved, and so on.**
- **Parametric models are most reliable when the historical information used to create the model is accurate, the parameters are readily quantifiable, and the model is flexible in terms of the project's size.**
- **In practice, many people find that using a combination or hybrid approach with analogous, bottom-up, three-point, and parametric estimating provides the best cost estimates.**

Estimate Costs

Tools and Techniques: Bottom-up Estimates

- **Bottom-up Estimates involve estimating the costs of individual work items or activities and summing them to get a project total.**
- **This approach is sometimes referred to as Activity-based Costing.**
- **The size of the individual work items and the experience of the estimators drive the accuracy of the estimates.**
- **If a detailed WBS is available for a project, the project manager could require each person who is responsible for a work package to develop a cost estimate for that work package, or at least an estimate of the amount of resources required.**
- **The drawback with bottom-up estimates is that they are usually time-intensive and therefore expensive to develop.**

Estimate Costs

Outputs: Basis of Cost Estimates

- **The amount and type of additional details supporting the cost estimate vary by application area.**
- **Regardless of the level of detail, the supporting documentation should provide a clear and complete understanding of how the cost estimate was derived.**
- **Supporting detail for cost estimates may include:**
  - **Documentation of the basis of the estimate (i.e., how it was developed),**
  - **Documentation of all assumptions made,**
  - **Documentation of any known constraints,**
  - **Documentation of identified risks included when estimating costs,**
  - **Indication of the range of possible estimates (e.g., US$10,000 (±10%) to indicate that the item is expected to cost between a range of values), and**
  - **Indication of the confidence level of the final estimate.**

Estimate Costs

Outputs: Cost Estimates

- **Cost estimates include quantitative assessments of the probable costs required to complete project work, as well as contingency amounts to account for identified risks, and management reserve to cover unplanned work.**
- **Cost estimates can be presented in summary form or in detail.**
- **Costs are estimated for all resources that are applied to the cost estimate.**
  - **This includes but is not limited to direct labor, materials, equipment, services, facilities, information technology, and special categories such as cost of financing (including interest charges), an inflation allowance, exchange rates, or a cost contingency reserve. Indirect costs, if they are included in the project estimate, can be included at the activity level or at higher levels.**

Estimate Costs

Outputs: Cost Estimates (Sample Project)

Sample Project: A web-based software development project.

1. Project management
2. Hardware
   - 2.1 Handheld devices
   - 2.2 Servers
3. Software
   - 3.1 Licensed software
   - 3.2 Software development
4. Testing
5. Training and support
6. Reserves

Estimate Costs

Outputs: Cost Estimates (Sample Project)

	# 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	

Determine Budget

- **Determine Budget is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.**
- **Determining the budget involves allocating the project cost estimate to individual material resources or work items over time. These material resources or work items are based on the activities in the WBS for the project.**
- **The key benefit of this process is that it determines the cost baseline against which project performance can be monitored and controlled.**
- **This process is performed once or at predefined points in the project.**

Determine Budget

Inputs	Tools & Techniques	Outputs
.1 Project management plan • Cost management plan • Resource management plan • Scope baseline .2 Project documents • Basis of estimates • Cost estimates • Project schedule • Risk register .3 Business documents • Business case • Benefits management plan .4 Agreements .5 Enterprise environmental factors .6 Organizational process assets	.1 Expert judgment .2 Cost aggregation .3 Data analysis • Reserve analysis .4 Historical information review .5 Funding limit reconciliation .6 Financing	.1 Cost baseline .2 Project funding requirements .3 Project documents updates • Cost estimates • Project schedule • Risk register

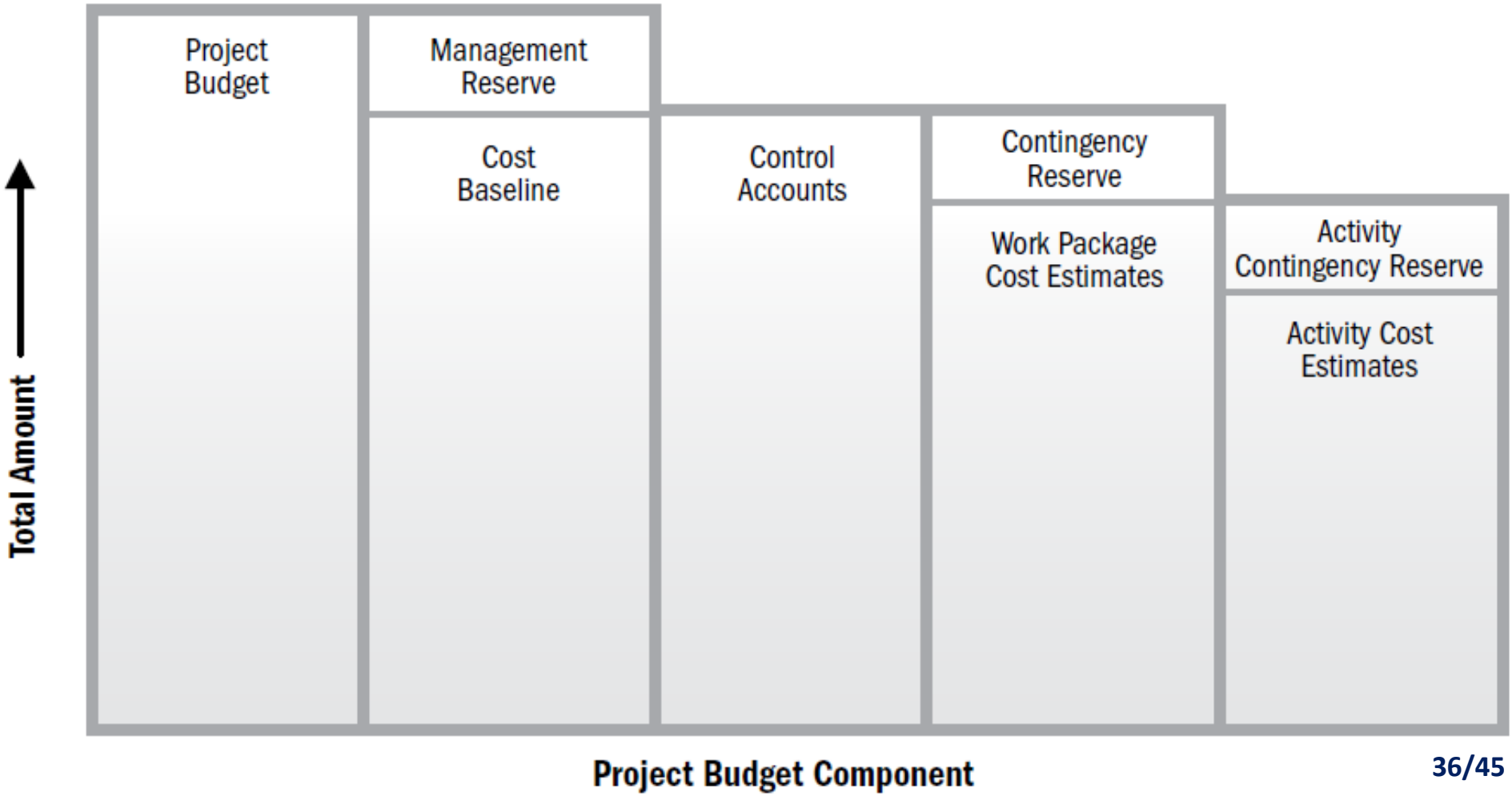
Determine Budget

Outputs: Cost Baseline

- **The Cost Baseline is the approved version of the time-phased project budget, excluding any management reserves, which can only be changed through formal change control procedures.**
- **It is used as a basis for comparison to actual results.**
- **The cost baseline is developed as a summation of the approved budgets for the different schedule activities.**

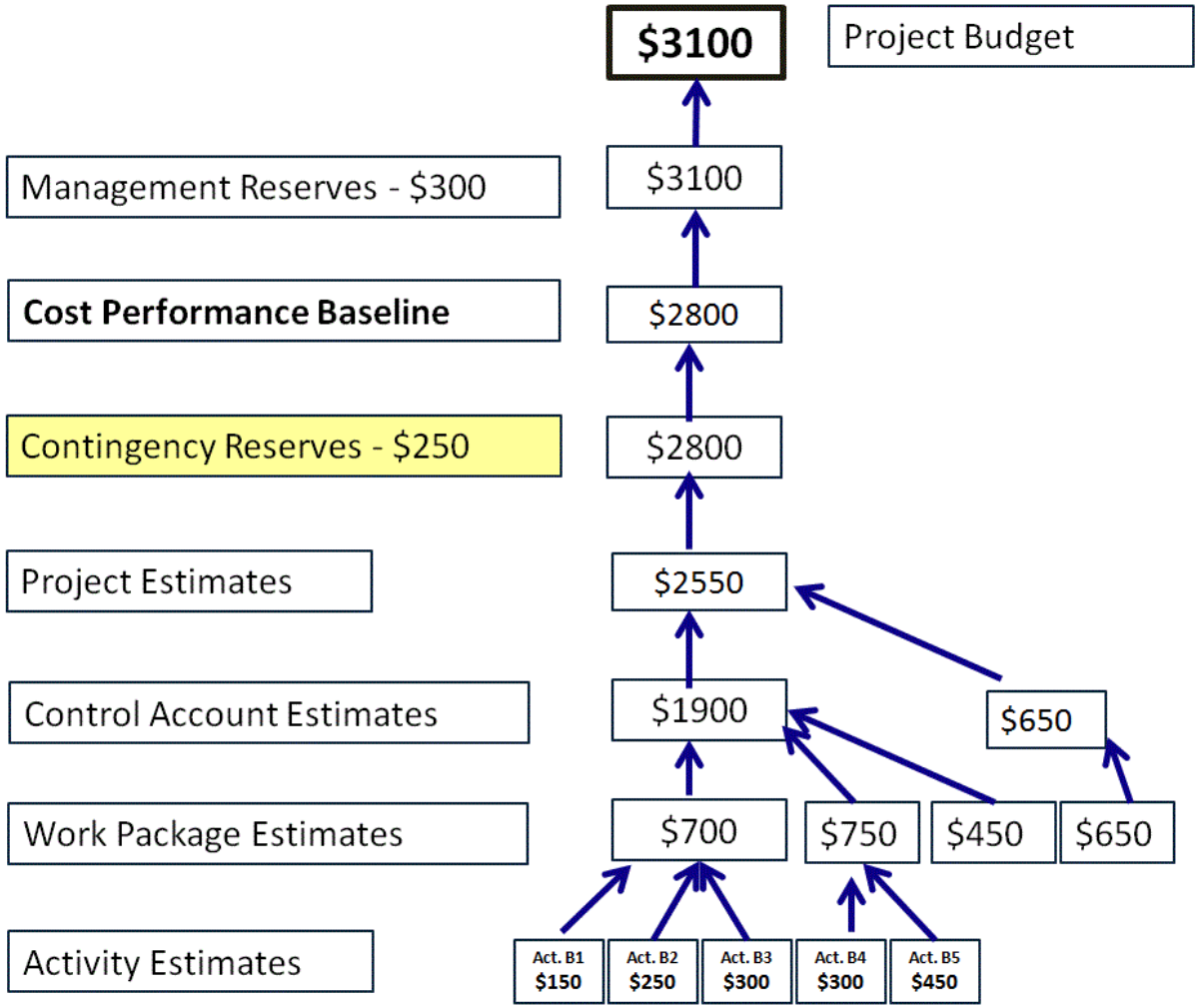
Determine Budget

Outputs: Cost Baseline



Determine Budget

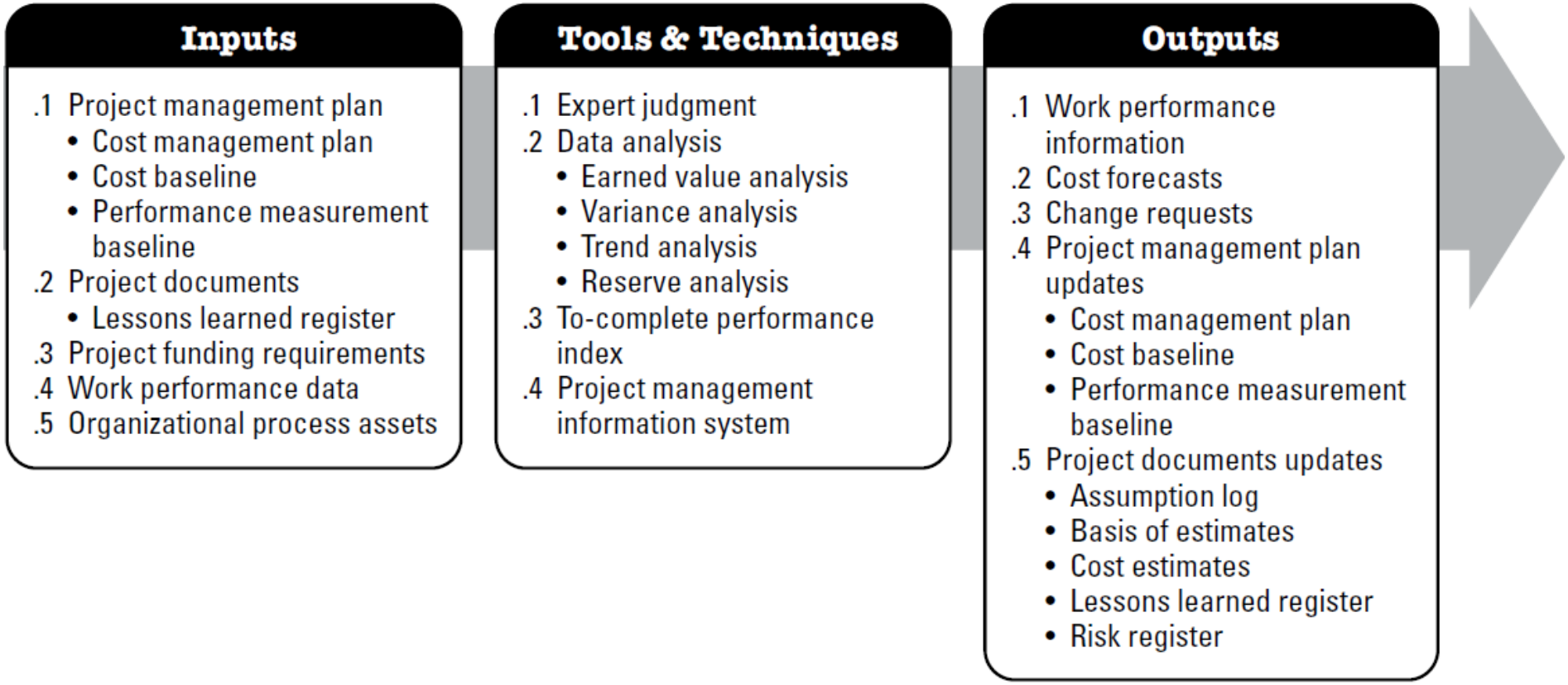
Outputs: Cost Baseline (Sample)



Control Costs

- **Control Costs is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.**
- **The key benefit of this process is that the cost baseline is maintained throughout the project.**
- **This process is performed throughout the project.**

Control Costs



Control Costs

Tools and Techniques: Earned Value Management (EVM)

- **Earned value management (EVM) is a project performance measurement technique that integrates scope, time, and cost data.**
- **Given a cost performance baseline, project managers and their teams can determine how well the project is meeting scope, time, and cost goals by entering actual information and then comparing it to the baseline.**
- **EVM involves calculating three values for each activity or summary activity from a project's WBS.**
  1. **Planned Value (PV) is the authorized budget assigned to scheduled work (Budgeted Cost of Work Scheduled).**
  2. **Actual Cost (AC) is the realized cost incurred for the work performed on an activity during a specific time period.**
  3. **Earned Value (EV) is the measure of work performed expressed in terms of the budget authorized for that work (Budgeted Cost of Work Performed).**

Control Costs

Tools and Techniques: Earned Value Management (EVM)

Term	Definition	Formula
Earned Value (EV)	Measure of work performed in terms of the budget authorized for that work	EV=PV of all completed work
Cost Variance (CV)	Earned Value - Actual Cost	CV=EV-AC
Schedule Variance (SV)	Earned Value - Planned Value	SV=EV-PV
Cost Performance Index (CPI)	Ratio of Earned Value to Actual Cost	CPI=EV/AC
Schedule Performance Index (SPI)	Ratio of Earned Value to Planned Value	SPI=EV/PV
Budget at Completion (BAC)	Original total budget for the project	-
Estimate at Completion (EAC)	Estimated cost of completing a project based on performance to date	EAC=BAC/CPI
Estimated to Complete (ETC)	Estimate at Completion - Actual Cost	ETC=EAC-AC

Control Costs

Tools and Techniques: EVM (Sample)

- You are the project manager for the construction of 20 km of sidewalk.
- According to your plan, the cost of construction will be $15,000 per km and will take 8 weeks to complete.
- 2 weeks into the project, you have spent $55,000 and completed 4 km of sidewalk and you want to report performance and determine how much time and cost remain.

- Budget at Completion (BAC):……
- Planned Value (PV) (=Budgeted Cost of Work Scheduled (BCWS)):…….
- Earned Value (EV) (=Budgeted Cost of Work Performed (BCWP)):…….
- Actual Cost (AC):……

Control Costs

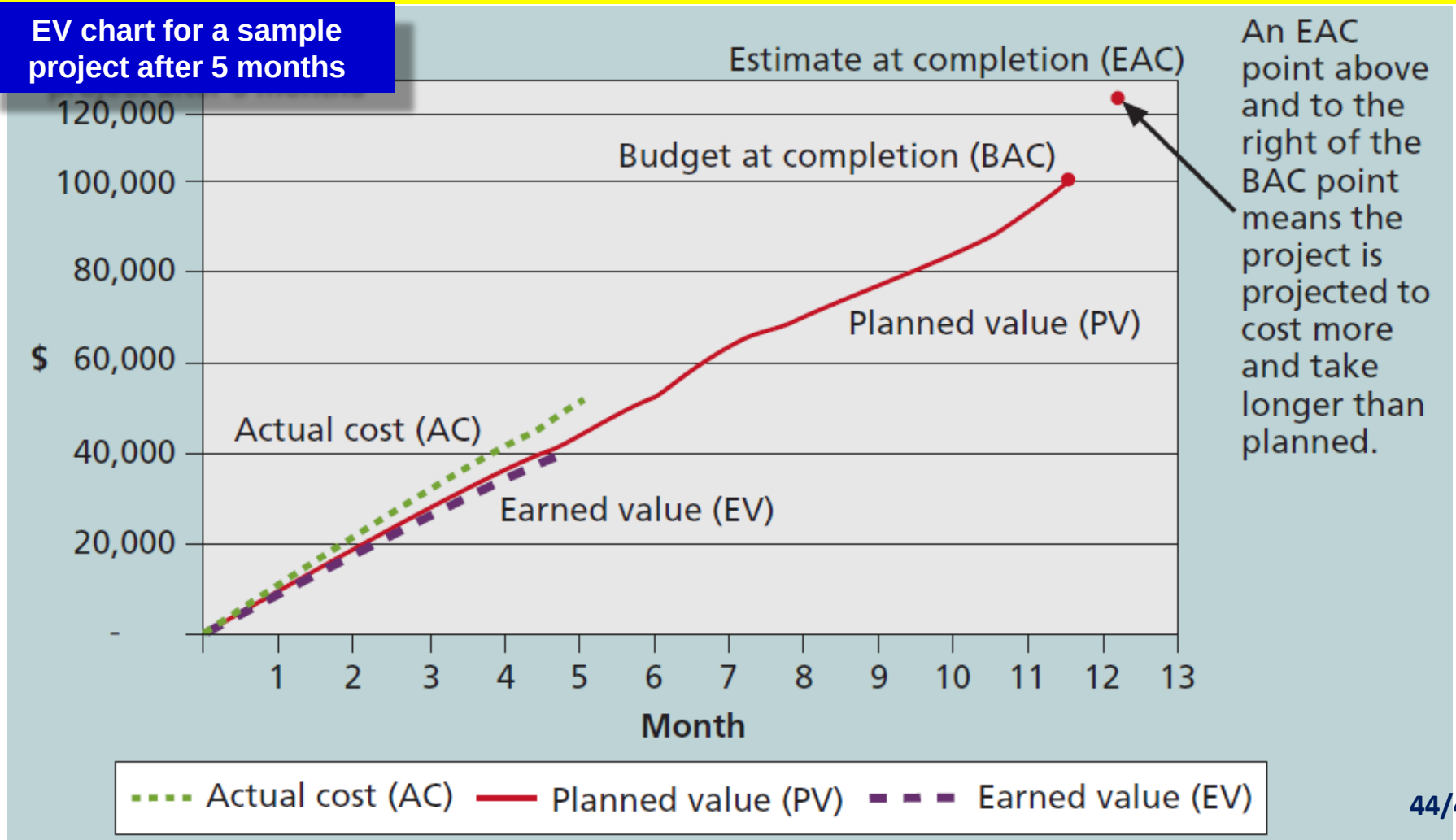
Tools and Techniques: EVM (Sample)

- **Cost Variance (CV):……**
- **Cost Performance Index (CPI):…….**
- **Schedule Variance (SV):……**
- **Schedule Performance Index (SPI):……**
- **Estimate at Completion (EAC):…….**
- **Estimate to Complete (ETC):……..**
- **Variance at Completion (VAC):…..**

Control Costs

Tools and Techniques: Earned Value Management (EVM)

EV chart for a sample project after 5 months



Thank you…

Hasan ÇİFCİ

Control Costs

Answers to Sample Question

- Budget at Completion (BAC): 20x15K = 300K
- Planned Value (PV): [(2/8x20]*15K = 5*15K = 75K
- Earned Value (EV): 4x15K = 60K
- Actual Cost (AC): 55K
- Cost Variance (CV): EV-AC=60K-55K = 5K (positive → within budget)
- Cost Performance Index (CPI): EV/AC=60K/55K = 1.09
- Schedule Variance (SV): EV-PV=60K-75K=-15K (negative → behind schedule)
- Schedule Performance Index (SPI): EV/PV=60/75 = 0.8
- Estimate at Completion (EAC): BAC/CPI = 300K/1.09 = 275K
- Estimate to Complete (ETC): BAC-AC = 275K-55K = 220K
- Variance at Completion (VAC): BAC-EAC=300K-275K = 25K