Project Management: Lecture 5

Part I: Project Schedule Management

What is Project Schedule Management

- **Project schedule management** is the processes required to manage the timely completion of the project.
- Managers often cite the need to deliver projects on time as one of their biggest challenges and the main cause of conflict.
- People often compare planned and actual project completion times without taking into account the approved changes in the project.
- Time is the variable that has the least amount of flexibility. Time passes no matter what happens on a project.

Project Schedule Management Processes

- **Planning schedule management:** determining the policies, procedures, and documentation that will be used for planning, executing, and controlling the project schedule.

- **Defining activities:** involves identifying the specific activities that the project team members and stakeholders must perform to produce the project (activity or task element normally defined in WBS)

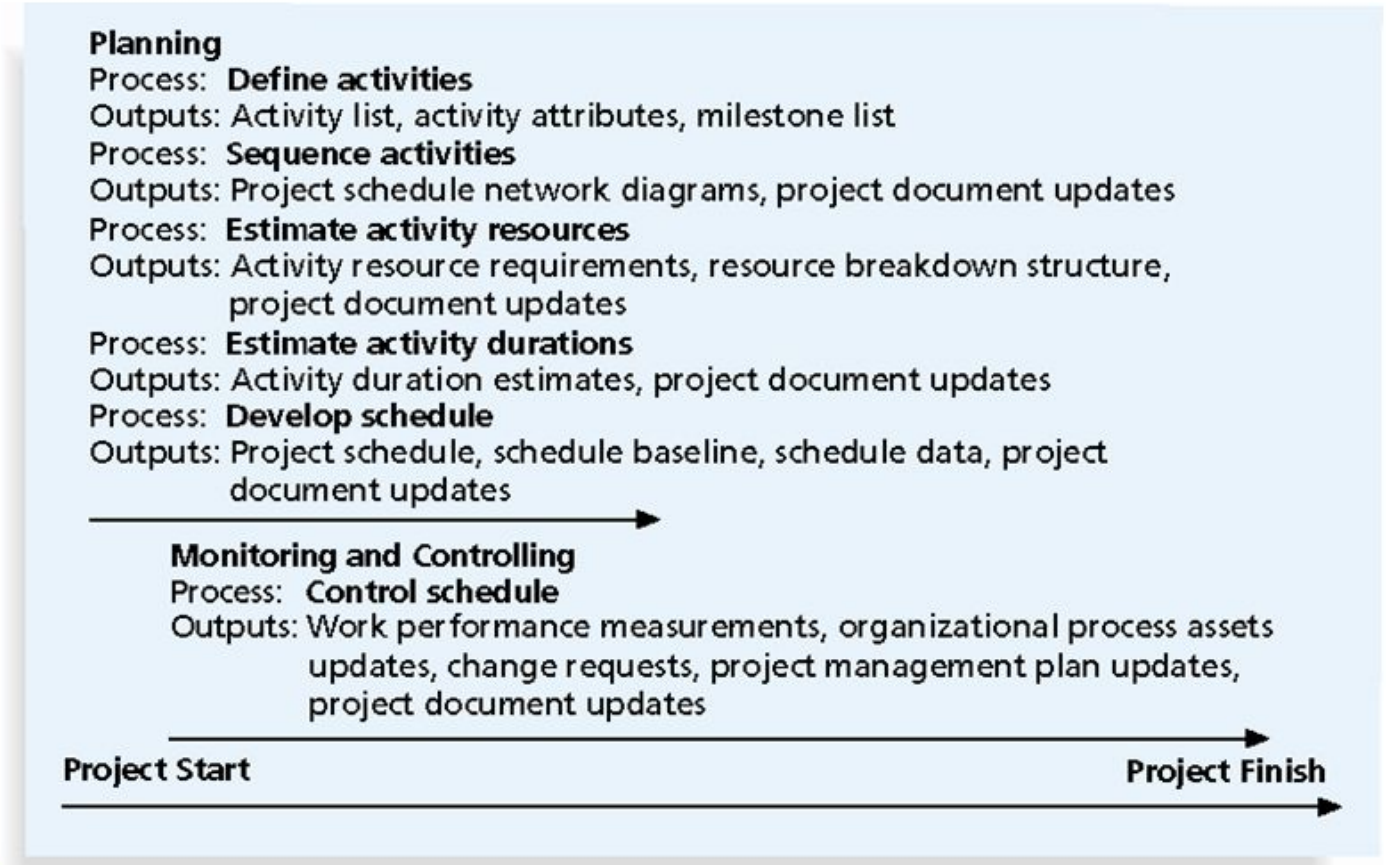
- **Sequencing activities:** identifying and documenting the relationships between project activities.

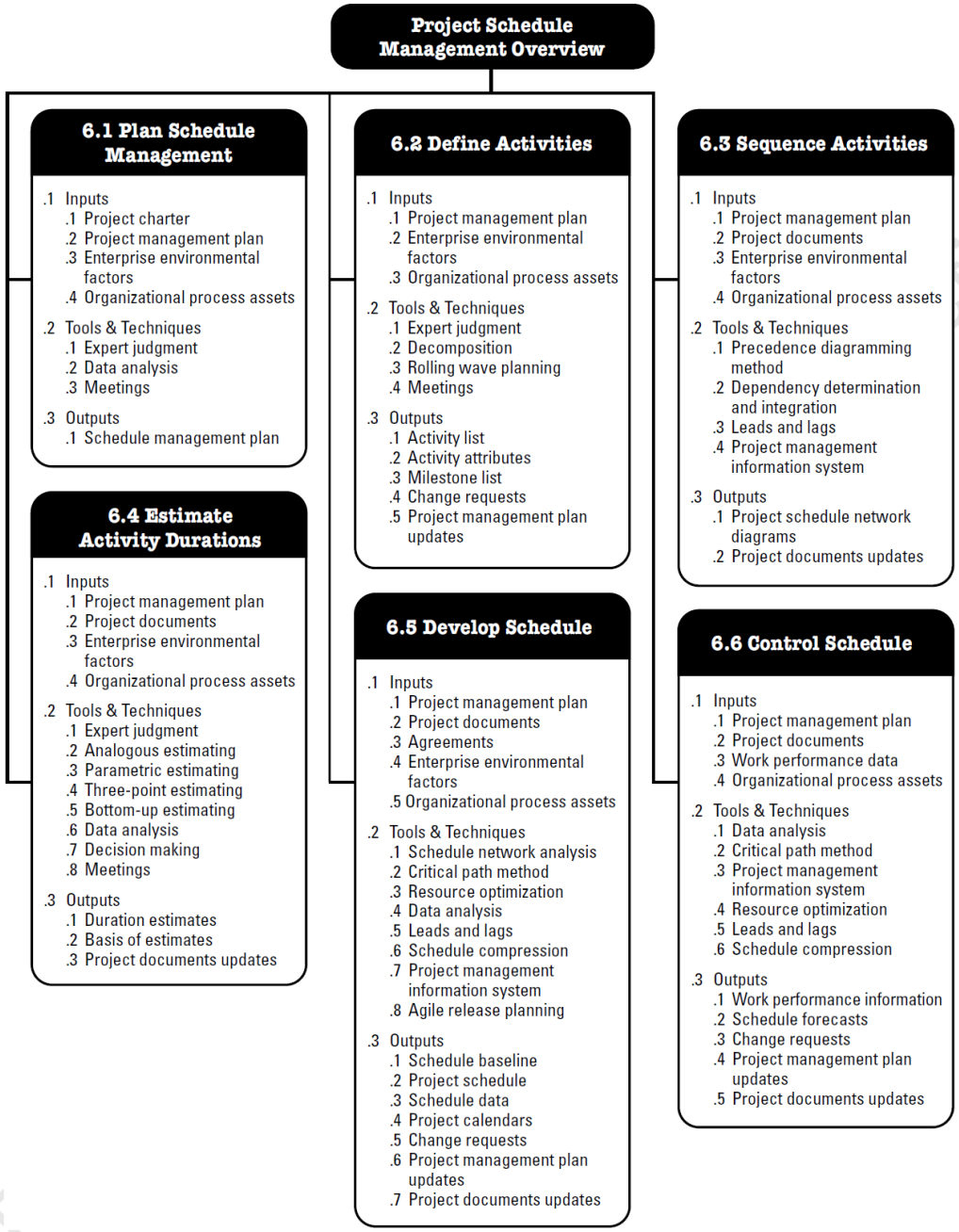
- **Estimating activity durations:** estimating the number of work periods that are needed to complete individual activities.

- **Developing the schedule:** analyzing activity sequences, resource requirements, and activity duration estimates to create the project schedule.

- **Controlling the schedule:** controlling and managing changes to the project schedule.

Project Schedule Management Summary





Project Schedule Management Overview

Source: PMBOK Guide- Sixth Edition, Project Management Institute, Inc(2017)

Step 1: Planning Schedule Management

- The first step in project schedule management is planning how the schedule will be managed throughout the life of the project.
- After reviewing the project management plan, project charter, enterprise environmental factors, and organizational process assets, the project team uses expert judgment, analytical techniques, and meetings to develop the schedule management plan.
- **The schedule management plan consist of the following contents**
    - Project schedule model development
    - Level of accuracy and units of measure
    - Control thresholds
    - Rules of performance measurement
    - Reporting formats
    - Process descriptions

Step 2: Defining Activities

- Defining activities involves **identifying the specific actions** that will produce the project deliverables in enough detail to determine resource and schedule estimates.
- The project team reviews the project management plan, enterprise environmental factors, and organizational process assets to begin defining activities.
- Outputs of this process include an ***activity list, activity attributes, a milestone list, change requests, and project management plan updates.***

- **An activity list** is a tabulation of activities to be included on a project schedule that includes:
    - *The activity name*
    - *An activity identifier or number*
    - *A brief description of the activity*
- **Activity attributes** provide more information such as predecessors, successors, logical relationships, leads and lags, resource requirements, constraints, imposed dates, and assumptions related to the activity

Step 2: Defining Activities

- ***A milestone*** is a significant event that normally has no duration
  - Not every deliverable or output created for a project is a milestone.
- It often takes several activities and a lot of work to complete a milestone.
- They're useful tools for setting schedule goals and monitoring progress.
- Examples include obtaining customer sign-off on key documents or completion of specific products such as software modules or the installation of new hardware.

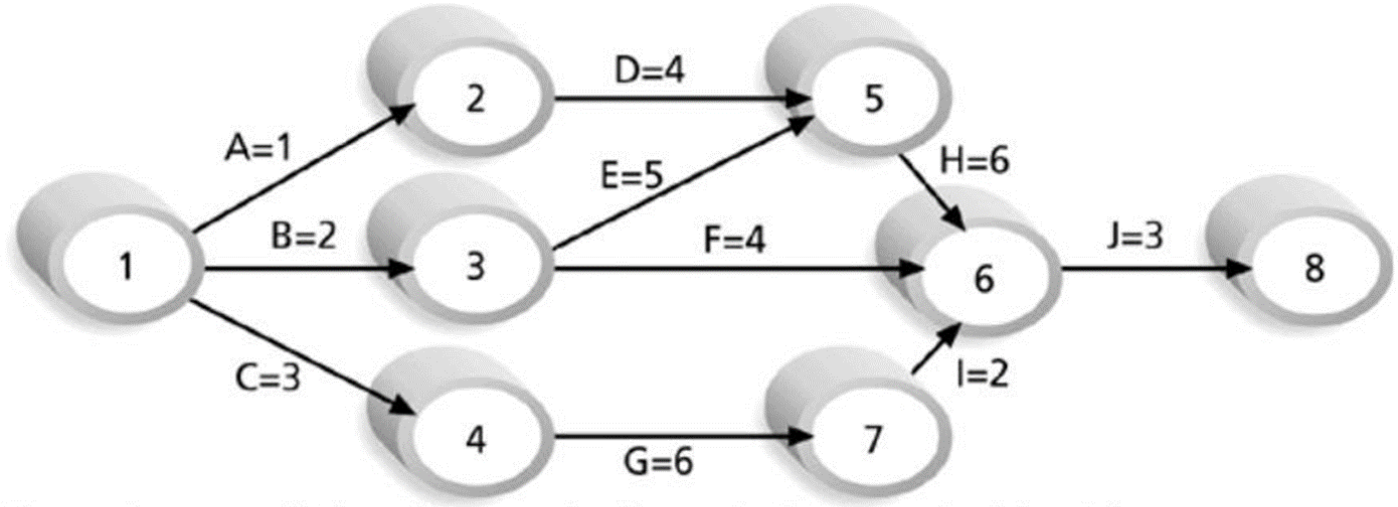
Step 3: Sequencing Activities

- After defining project activities, the next step is activity sequencing
  - Involves reviewing the activity list and attributes, project scope statement, milestone list and approved change requests to determine the relationships between activities
- **A dependency or relationship** is the sequencing of project activities or tasks
- You must determine dependencies in order to use critical path analysis
- There are four types of dependencies,
  1. **Mandatory dependencies:** inherent in the nature of the work being performed on a project, sometimes referred to as hard logic
  2. **Discretionary dependencies:** defined by the project team; sometimes referred to as soft logic and should be used with care since they may limit later scheduling options.
     - Don't start detailed design work until users sign-off on all the analysis – good practice but can delay project
  3. **External dependencies:** involve relationships between project and non-project activities
     - Delivery of new hardware; if delayed can impact project schedule
  4. **Internal Dependencies**: involve relationships between project activities that are generally inside the project team's control

Network Diagrams

- Network diagrams are the preferred technique for showing activity sequencing
- A network diagram is a schematic display of the logical relationships among, or sequencing of, project activities
- Also referred to as project schedule network diagram or PERT charts.
- Two main formats are the **arrow and precedence** diagramming methods.

Sample Activity-on-Arrow (AOA) Network Diagram for Project X



Note: Assume all durations are in days; A=1 means Activity A has a duration of 1 day.

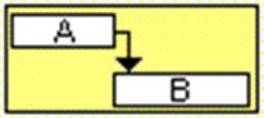
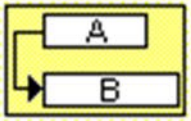
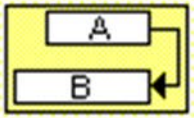
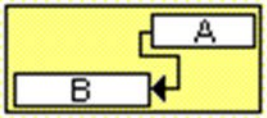
- Also called activity-diagramming-method (ADM)
- Activities are represented by arrows
- Nodes or circles are the starting and ending points of activities
- Can only show finish-to-start dependencies
- Can omit activities that have no dependencies

Precedence Diagramming Method (PDM)

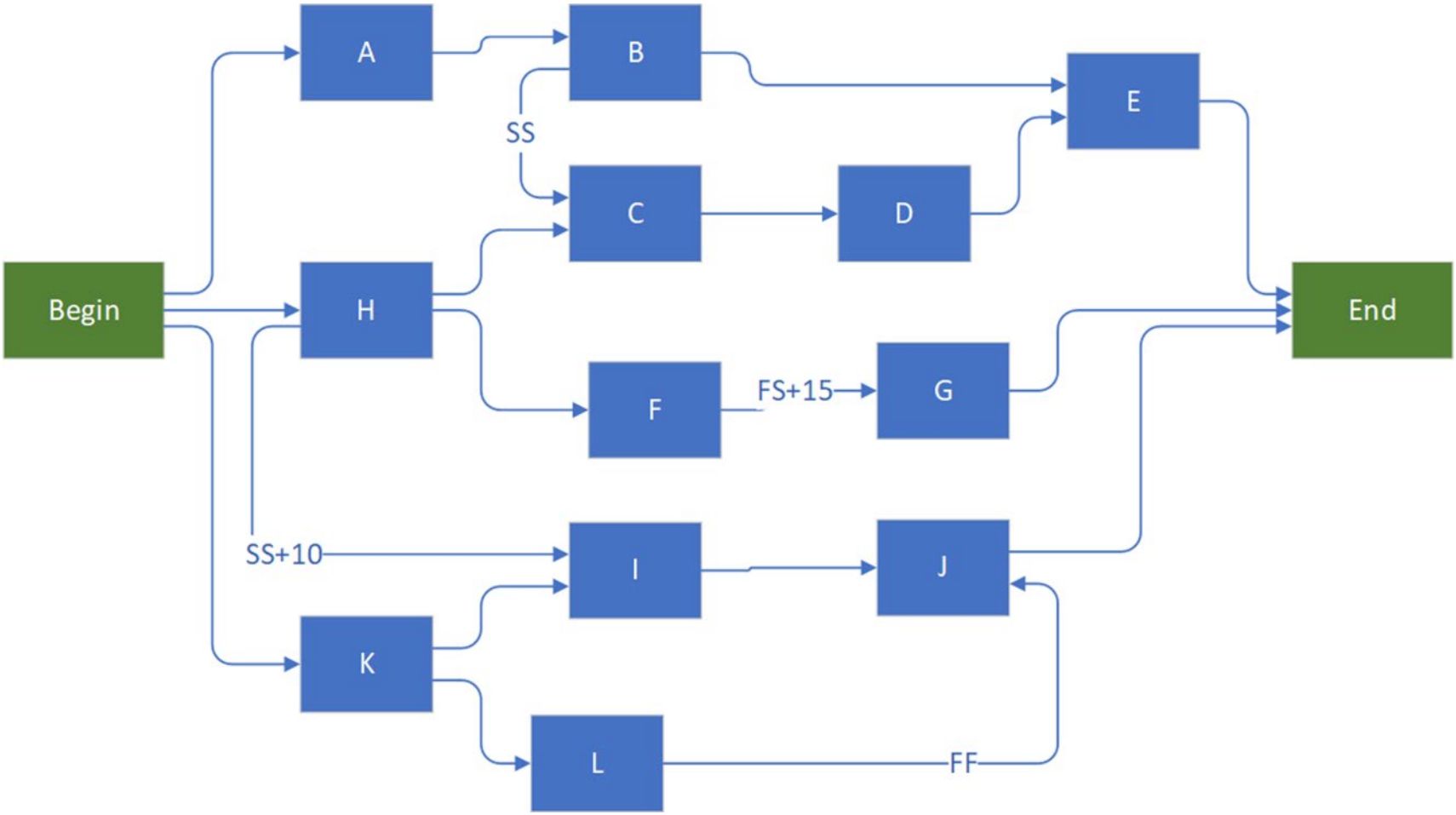
- More popular than ADM method and used by project management software
- Activities are represented by boxes
- Arrows show relationships between activities
- Better at showing different types of dependencies

Task dependencies

The nature of the dependencies between linked tasks. You link tasks by defining a dependency between their finish and start dates. For example, the "Contact caterers" task must finish before the start of the "Determine menus" task. There are four kinds of task dependencies in Microsoft Project:

Task dependency	Example	Description
Finish-to-start (FS)		Task (B) cannot start until task (A) finishes.
Start-to-start (SS)		Task (B) cannot start until task (A) starts.
Finish-to-finish (FF)		Task (B) cannot finish until task (A) finishes.
Start-to-finish (SF)		Task (B) cannot finish until task (A) starts.

Sample PDM Network Diagram



Step 4: Estimating Activity Durations

- Before estimating activity durations, you must have a good idea of the quantity and type of resources that will be assigned to each activity

- Consider important issues in estimating resources
  - How difficult will it be to do specific activities on this project?
  - What is the organization's history in doing similar activities?
  - Are the required resources available or need to be acquired?

- A resource breakdown structure is a hierarchical structure that identifies the project's resources by category and type

Step 4: Estimating Activity Durations

- **Duration** includes the actual amount of time worked on an activity plus elapsed time/
- **Effort** is the number of workdays or work hours required to complete a task.
- Effort does not normally equal duration.
- People doing the work should help create estimates, and an expert should review them.
- Instead of providing activity estimates as a discrete number, such as four weeks, it's often helpful to create a **three-point estimate.**
- An estimate that includes an **optimistic, most likely, and pessimistic estimate**, such as three weeks for the optimistic, four weeks for the most likely, and five weeks for the pessimistic estimate
- Three-point estimates are needed for PERT and Monte Carlo simulations

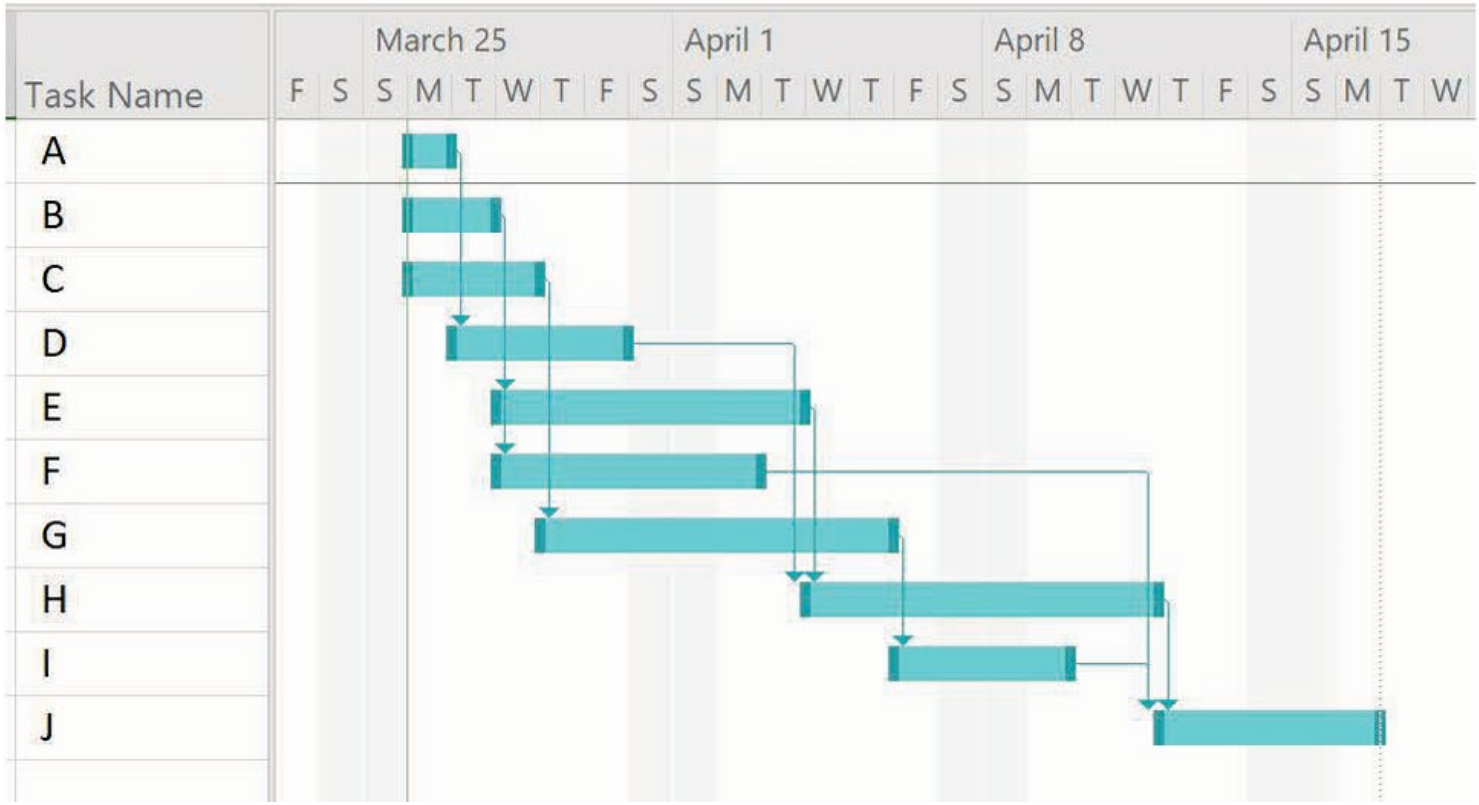
Step 5: Developing Schedule

- Uses results of the other time management processes to determine the start and end date of the project
- Ultimate goal is to create a realistic project schedule that provides a basis for monitoring project progress for the time dimension of the project
- Important tools and techniques include Gantt charts, critical path analysis, critical chain scheduling, and PERT analysis

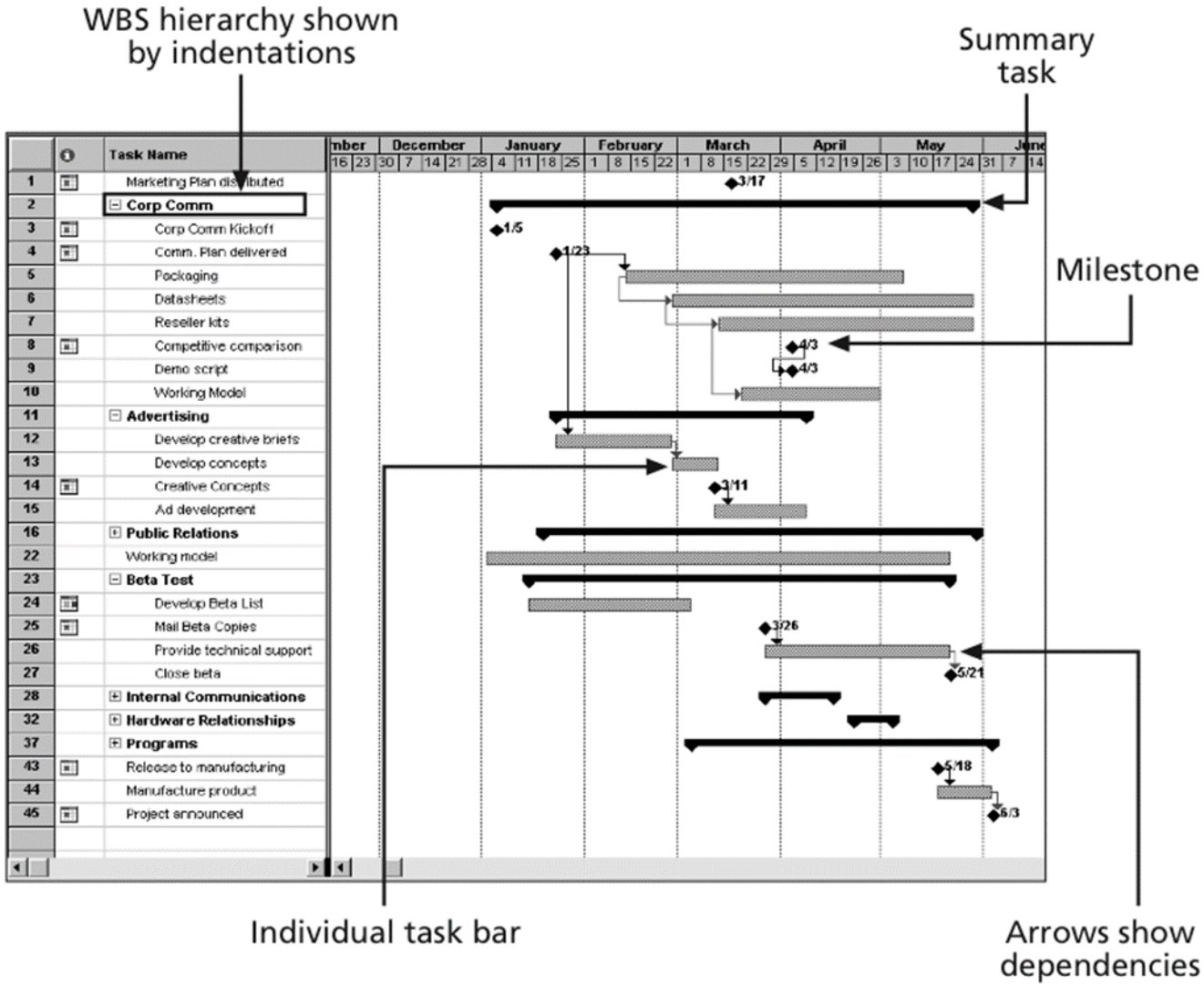
Gantt Charts

- Gantt charts provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in a calendar format
- Symbols include:
  - Black diamonds: milestones
  - Thick black bars: summary tasks
  - Lighter horizontal bars: durations of tasks
  - Arrows: dependencies between tasks

Sample Gantt Chart for Project X



Gantt Chart for Software Launch Project



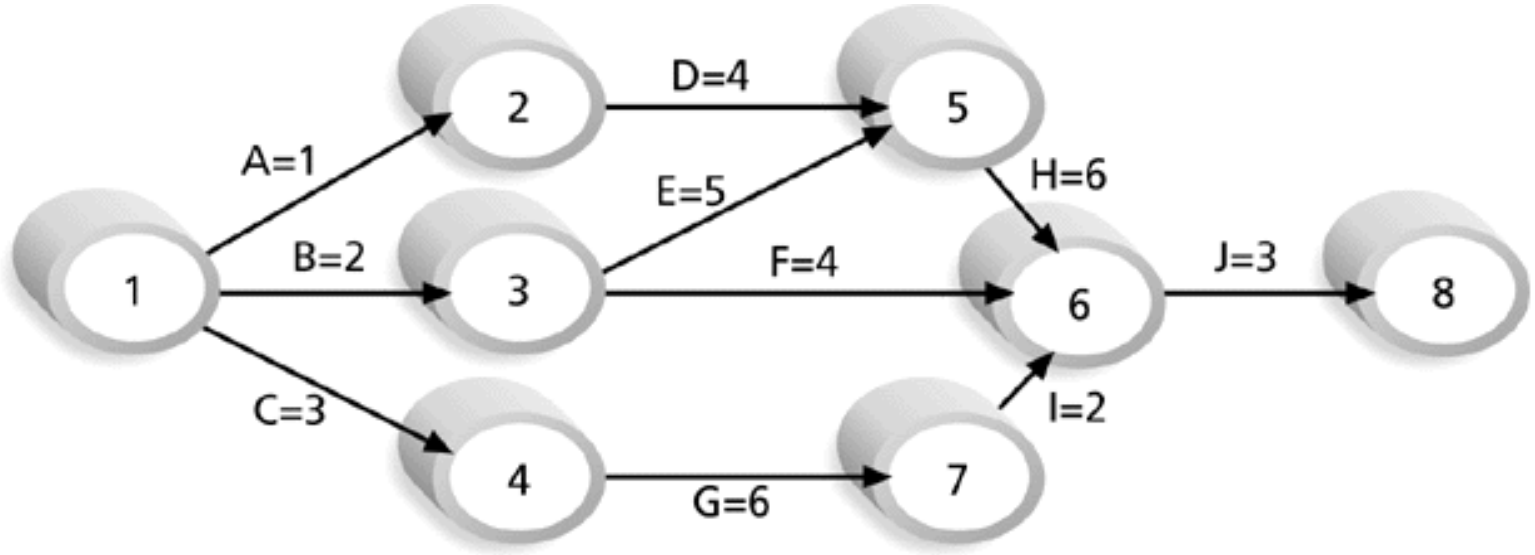
Critical Path Method(CPM)

- CPM is a network diagramming technique used to predict total project duration
- A critical path for a project is the series of activities that determines the earliest time by which the project can be completed
- The critical path is the longest path through the network diagram and has the least amount of slack or float
- Slack or float is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date

Calculating the critical path

- First develop a good network diagram
- Add the duration estimates for all activities on each path through the network diagram
- The longest path is the critical path
- If one or more of the activities on the critical path takes longer than planned, the whole project schedule will slip unless the project manager takes corrective action

Determining the Critical Path for Project X



Note: Assume all durations are in days.

Path 1:	A-D-H-J	Length = 1+4+6+3 = 14 days
Path 2:	**B-E-H-J**	**Length = 2+5+6+3 = 16 days**
Path 3:	B-F-J	Length = 2+4+3 = 9 days
Path 4:	C-G-I-J	Length = 3+6+2+3 = 14 days

Since the critical path is the longest path through the network diagram, Path 2, B-E-H-J, is the critical path for Project X.

More on critical path

- A project team at Apple computer put a stuffed gorilla on the top of the cubicle of the person currently managing a critical task
- The critical path is not the one with all the critical activities; it only accounts for time
- There can be more than one critical path if the lengths of two or more paths are the same
- The critical path can change as the project progresses

Program Evaluation and Review Technique (PERT)

- PERT is a network analysis technique used to estimate project duration when there is a high degree of uncertainty about the individual activity duration estimates
- PERT uses probabilistic time estimates
  - Duration estimates based on using optimistic, most likely, and pessimistic estimates of activity durations, or a three-point estimate
  - PERT attempts to address the risk associated with duration estimates by developing schedules that are more realistic
    - ✓ It involves more work than CPM since it requires several duration estimates

$$\text{PERT weighted average} = \frac{\text{optimistic time} + 4\text{X most likely time} + \text{pessimistic time}}{6}$$

Example:

$$\text{PERT weighted average} = \frac{8 \text{ workdays} + 4 \text{ X } 10 \text{ workdays} + 24 \text{ workdays}}{6} = \mathbf{12\ days}$$

where optimistic time= 8 days,
most likely time = **10 days**, and
pessimistic time = 24 days

Therefore, you'd use **12 days** on the network diagram instead of 10 when using PERT for the above example

Step 6: Schedule Control

- Perform reality checks on schedules
- Allow for contingencies
- Don’t plan for everyone to work at 100% capacity all the time
- Hold progress meetings with stakeholders and be clear and honest in communicating schedule issues
- Goals are to know the status of the schedule, influence factors that cause schedule changes, determine that the schedule has changed, and manage changes when they occur
- Tools and techniques include:
    - Progress reports
    - A schedule change control system
    - Project management software, including schedule comparison charts like the tracking Gantt chart
    - Variance analysis, such as analyzing float or slack
    - Performance management, such as earned value (future lecture)

Reality checks on Schedule Control

- First review the draft schedule or estimated completion date in the project charter
- Prepare a more detailed schedule with the project team
- Make sure the schedule is realistic and followed
- Alert top management well in advance if there are schedule problems
- Verify schedule progress – just because a team member says a task was completed on time doesn't always mean that it was

- Strong leadership helps projects succeed more than good PERT charts
- Project managers should use:
  - Empowerment
  - Incentives
  - Discipline
  - Negotiation

LA TROBE UNIVERSITY

Project Management: Lecture 6

Project Cost Management

The Importance of Project Cost Management

- IT projects have a poor track record for meeting budget goals
- The CHAOS studies found the average cost overrun (the additional percentage or dollar amount by which actual costs exceed estimates) ranged from 180 percent in 1994 to 43 percent in 2010
- A 2011 Harvard Business Review study reported an average cost overrun of 27 percent.

What Went Wrong?

- The U.S. government, especially the IRS, continues to provide examples of how not to manage costs
  - A series of project failures by the IRS in the 1990s cost taxpayers more than $50 billion a year
  - In 2006, the IRS was in the news for a botched upgrade to its fraud- detection software, costing $318 million in fraudulent refunds that didn't get caught
  - A 2008 Government Accountability Office (GAO) report stated that more than 400 U.S. government agency IT projects, worth an estimated $25 billion, suffer from poor planning and underperformance
- The United Kingdom's National Health Service IT modernization program was called the greatest IT disaster in history with an estimated $26 billion overrun. It was finally scrapped in 2011.

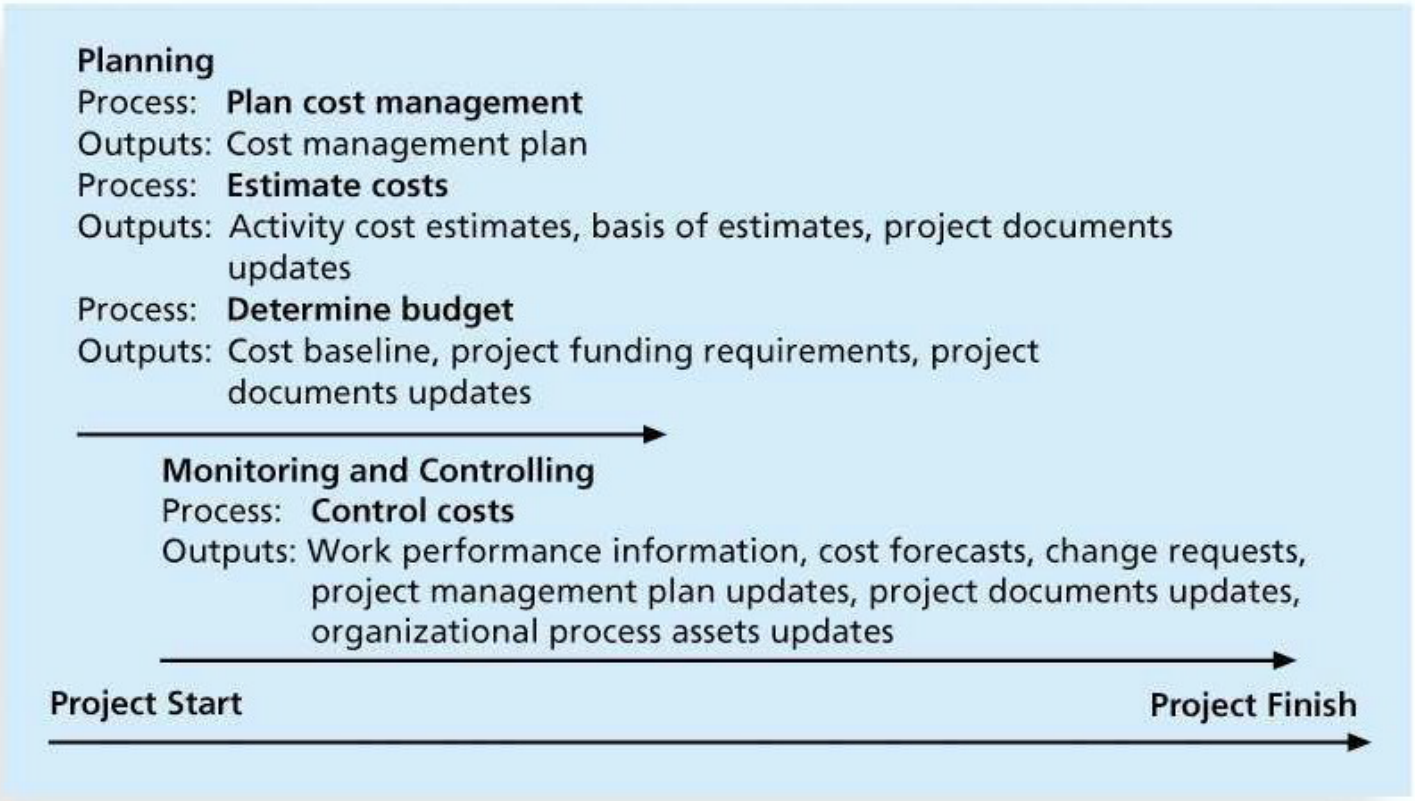
What is Cost and Project Cost Management?

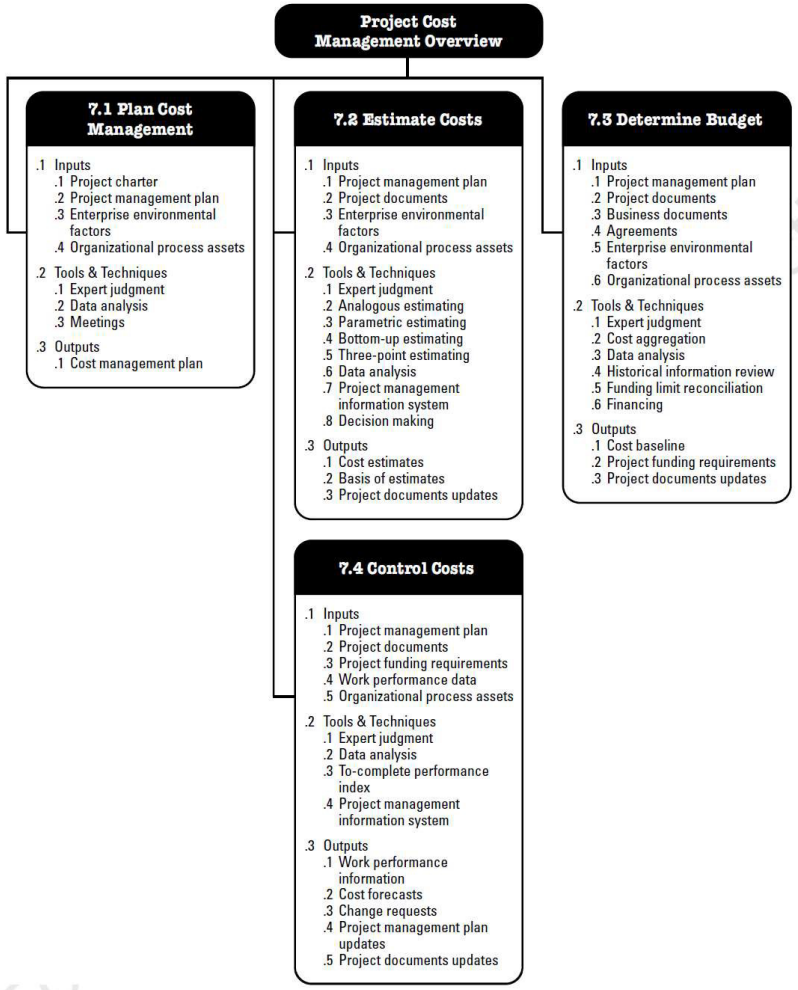
- Cost is a resource sacrificed or foregone to achieve a specific objective or something given up in exchange
- Costs are usually measured in monetary units like dollars
- Project cost management includes the processes required to ensure that the project is completed within an approved budget

Project Cost Management Processes

- **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

Project Cost Management Summary





Project Cost Management Overview

Source: PMBOK Guide- Sixth Edition, Project Management Institute, Inc(2017)

Basic Principles Of Cost Management

- Most members of an executive board better understand and are more interested in financial terms than IT terms , so IT project managers must speak their language

    - **Profit**s 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

Cost of Downtime in IT Applications

Type of IT Application	Cost/Minute
Securities trading	$73,000
Enterprise Requirements Planning (ERP)	$14,800
Order processing	$13,300
Electronic commerce	$12,600
Supply chain	$11,500
Point of sale (POS)	$ 4,700
Automatic teller machine (ATM)	$ 3,600
E-mail	$ 1,900

What Went Right?

- Many organizations use IT to reduce operational costs
- Technology has decreased the costs associated with processing an ATM transaction:
    - In 1968, the average cost was $5.
    - In 1978, the cost went down to $1.50
    - In 1988, the cost was just a nickel.
    - In 1998, it only cost a penny.
    - In 2008, the cost was just half a penny!
- Investing in green IT and other initiatives has helped both the environment and companies' bottom lines. Michael Dell, CEO of Dell, reached his goal to make his company "carbon neutral" in 2008. As of March 2012, Dell had helped its customers save almost $7 billion in energy costs

Type 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

More 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 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)

Step 1:Planning Cost Management

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

- A cost management plan includes:

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

Step 2: Estimating Costs

- Project managers must take cost estimates seriously if they want to complete projects within budget constraints
- It's important to know the types of cost estimates, how to prepare cost estimates, and typical problems associated with IT cost estimates

Type of Cost Estimates

Type of Estimate	When Done	Why Done	How Accurate
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%

Cost Estimation Tools and Techniques

- Basic tools and techniques for cost estimates:
    - **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:** involves estimating most likely, optimistic and pessimistic cost of items
    - **Parametric modeling** uses project characteristics (parameters) in a mathematical model to estimate project costs

Typical Problems with IT Cost Estimates

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

Step 3: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

Example cost estimate for a software development project

Surveyor Pro Project Cost Baseline Created October 10*

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

Step 4: 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
- Many organizations around the globe have problems with cost control

Earned Value Management(EVM)

- **EVM** is a 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 its goals
- You must enter actual information periodically to use EVM
- More and more organizations around the world are using EVM to help 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

- 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

Example EV Calculation for one activity after week 1

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%

Term	Formula
Earned value (EV)	EV = PV to date * RP
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 time to complete	Original time estimate/SPI

Rule 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

Global Issues

- EVM is used worldwide, and it is particularly popular in the Middle East, South Asia, Canada, and Europe
- Most countries require EVM for large defense or government projects
- EVM is also used in such private-industry sectors as IT, construction, energy, and manufacturing.
- However, most private companies have not yet applied EVM to their projects because management does not require it, feeling it is too complex and not cost effective

Thank you