Project Planning and Execution – Course Introduction

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Course Overview:

- This is the **second course** in the Project Management specialization.
- Focus: **How a project manager executes a project**.

Key Learning Points:

1. **Project Schedule Management**
    - Tools and techniques to **develop and control project schedules**.
    - Track progress to see if the project is **on schedule**.
2. **Budget Management**
    - Methods to **determine budgets** for individual activities and the overall project.
    - Use budget and schedule together to **assess project status**.
3. **Resource Management**
    - How to **obtain necessary resources** for project success.
4. **Risk Management**
    - Analyze potential **risks** that could impact the project.
5. **Quality Management**
    - Techniques to **control quality** and ensure a **high-quality product** is delivered.

Goal: Equip learners with practical skills to **plan, execute, monitor, and control projects effectively**.

Project Management Methodologies

1. Predictive Model (Waterfall / Traditional)

- **Approach:** Linear and sequential; milestones are clearly defined.
- **Project Stages:** Initiating → Planning → Executing → Controlling & Monitoring → Closing.
- **Characteristics:**
    - Planning done upfront; minimal changes allowed.
    - Stage-gate process often used to manage schedule.
    - Scope or budget changes can disrupt the schedule.
    - Works well for projects with **well-defined scope** or **repeatable projects**.

- **Schedule Management:** Planned in advance, low flexibility.

2. Agile Methodology

- **Approach:** Iterative, flexible, and adaptive; focuses on delivering **value early and often**.
- **Characteristics:**
    - Welcomes changes in scope, schedule, or requirements.
    - Smaller iterations of planning, execution, verification, and delivery.
    - Team works collaboratively in **sprints**.
- **Roles & Tools:**
    - Project manager = **Scrum Master**.
    - **Kanban board:** Tracks work in progress → moves tasks from left to right as completed.
- **Focus:** Frequent delivery and continuous value creation.
- **Note:** Agile isn't always better; depends on project type and scope.

Comparison Summary

Feature	Predictive	Agile
Approach	Linear / Sequential	Iterative / Flexible
Scope Changes	Hard to accommodate	Welcomed
Delivery	At end of project	Frequent, incremental
Planning	Upfront	Short cycles (sprints)
Roles/Tools	Traditional PM	Scrum Master, Kanban

Tip: This course focuses mainly on **traditional/project schedule management**, but basic Agile terminology (sprints, Kanban, Scrum Master) is introduced.

Project Schedule Management in the Predictive Model:

Project Schedule Management (Predictive/Traditional Model)

Purpose:
Define processes to deliver the project on time, estimate activity durations, track milestones, and find efficient ways to meet project goals.

Six Key Processes in Project Schedule Management

1. **Plan Schedule Management**
    - Create a **Schedule Management Plan**.
    - Details the process for defining and estimating project activities.
    - Includes assumptions, risks, and methodology for schedule control.
    - Serves as the **playbook for the project manager**.
2. **Define Activities**
    - Break project into **specific, itemized activities**.
    - Use the **Work Breakdown Structure (WBS)** as a guide.
    - Identify major **milestones**.
3. **Sequence Activities**
    - Determine the **order of activities**.
    - Identify **dependencies** (e.g., assembly depends on purchase of components).
    - Software tools can assist in sequencing.
4. **Estimate Activity Duration**
    - Predict how long each activity will take.
    - Methods:
        - Historical data from similar projects
        - Expert judgment
        - Industry-standard estimation techniques
5. **Develop Schedule**
    - Combine sequencing and duration estimates.
    - Create a **formal project schedule**.
    - Determine **critical path** → shortest time to complete the project.
    - Communicate schedule to stakeholders.
6. **Monitor & Control Schedule**
    - Track project progress and deadlines.
    - Take **corrective actions** if dates slip (e.g., schedule compression).
    - Ensure milestones and deliverables stay on track.

Schedule Management Plan (Main Output) **STEP 1 in schedule management**

Includes:

- Overall methodology for schedule management.
- How activities are defined and estimated.
- Reporting plan for stakeholders.
- Assumptions and potential risks.
- Guidelines for **schedule monitoring and control**.

Tip:
Use templates or online resources for creating a Schedule Management Plan. This plan is essential to **keep the project on track**.

Defining Project Activities (Step 2 in Schedule Management)

Purpose:
Break down project components and work packages into **specific, actionable activities** needed to deliver the project scope.

Inputs Needed

1. **Project Scope** – Defines the work required to meet project deliverables.
2. **Work Breakdown Structure (WBS)** – Breaks the project into components.
3. **Work Packages** – Smaller segments of WBS; like "mini-projects" within the larger project.

Process

1. Break work packages into **individual activities**.
2. Estimate **time duration** for each activity.
3. Assign activities to **team members, stakeholders, or suppliers**.

Outputs

1. **Activity List** – All activities identified for the project.
2. **Activity Attributes** – Details for each activity, including:
    - Dependencies (e.g., ordering an engine before installation)
    - Resources needed
    - Estimated duration
3. **Project Milestones** – Significant events marking key achievements (e.g., successful engine test).

Example: Cruise Ship Project

- **Level 1:** Project name – Cruise Ship Project
- **Level 2:** Sub-components – Manufacturing & Assembly, Safety, etc.
- **Level 3:** Components – Hull, Sky Deck, Engines
- **Work Packages (Engines):** Starboard, Portside, Center engines
- **Activities for Starboard Engine:**
    - Order engine → Install engine → Test engine
- **Milestone:** Successful test of the starboard engine

Tip: Breaking work packages into smaller activities makes it easier to **schedule, assign, and monitor progress**.

Step 3: Sequence Project Activities

Purpose:
Determine the **order in which project activities should be performed** based on their dependencies to create an efficient project schedule.

Activity Dependencies

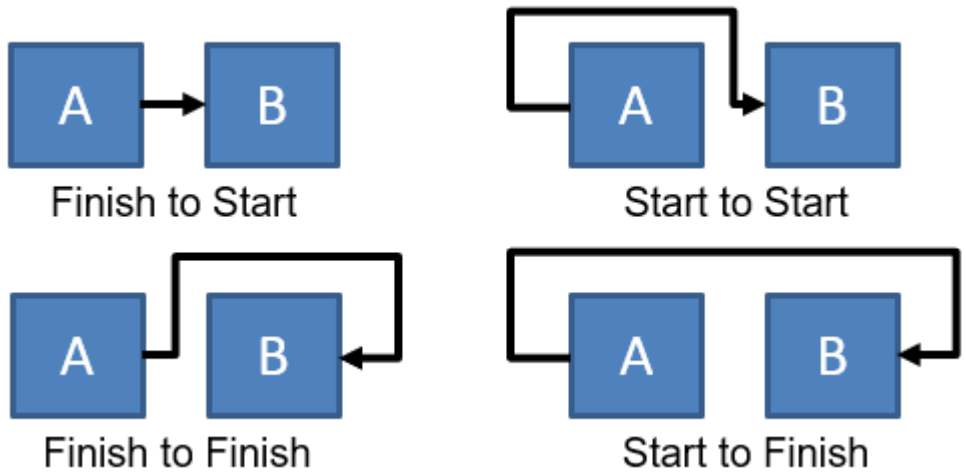
1. **Mandatory Dependency** – Must happen in a specific order; unavoidable.
    - Example: A wall must be built before painting.
2. **Discretionary Dependency** – Preferred order but not mandatory.
    - Example: Paint before moving in furniture.
3. **External Dependency** – Outside factors or suppliers impact the activity.
    - Example: Paint delivery by a supplier.
4. **Internal Dependency** – Within the project; depends on internal resources.
    - Example: Kitchen must be painted before bedroom if using same painters.

Precedence Diagramming (Network Diagramming)

- **Purpose:** Visualize activity dependencies and help determine the **critical path** (earliest possible project completion).
- **Nodes:** Represent activities (e.g., Activity A, Activity B).
- **Arrows:** Represent dependencies between activities.

Types of Activity Relationships

1. **Finish-to-Start (FS)** – Activity A must finish before Activity B starts.
    - Example: Prepare soil → Plant tomato seeds.
2. **Finish-to-Finish (FF)** – Both activities finish at the same time.
    - Example: Tomatoes finish growing → Serve fresh salad.
3. **Start-to-Start (SS)** – Activity A starts before Activity B; can overlap.
    - Example: Plowing land starts → Planting seeds starts simultaneously.
4. **Start-to-Finish (SF)** – Activity A must start before Activity B finishes (rarely used).



Example Precedence Diagram

- Project Start → Activity A → Activities B & C (parallel) → Activity D → Project End
- Shows which activities **must precede others** and which can be done **simultaneously**.
- Helps **visualize dependencies** and plan schedule efficiently.

Tip: Precedence diagrams are essential for understanding the **flow of activities** and for developing the **formal project schedule**.

Leads and Lags in Project Scheduling:

Leads and Lags

Purpose:
Account for waiting times or delays between project activities when sequencing tasks.

Lead Time

- Time **we wait but can overlap activities**.
- Example: Ordering a cruise ship engine takes 365 days. Schedule the order **one year in advance** so installation can happen on time.

Lag Time

- Time **delayed before the next activity can start**.
- Example: Pouring a concrete driveway. Must wait **2 days for concrete to cure** before deliveries can occur.

Tip:
Leads and lags help create **realistic schedules** and ensure activities start and finish in the correct sequence.

Q: Who is involved in project schedule management? (Select all that apply)

- **The project manager**
- **The project team**
- **Key Stakeholders**

All three are involved ✅:

- **The Project Manager** – Leads schedule planning, sequencing, and monitoring.
- **The Project Team** – Provides input on activity durations, resources, and dependencies.
- **Key Stakeholders** – Give approval, provide requirements, and may influence priorities or constraints.

Q: The process of defining project activities produces documentation needed for sequencing and scheduling those activities. Please select all of the documents that are produced from Defining Activities. (Select all that apply)

- Activity List
- Project Scope Statement
- WBS
- Activity Attributes list
- Milestones

The documents produced from **Defining Activities** ✅ are:

- **Activity List**
- **Activity Attributes List**
- **Milestones**

Not produced directly:

- **Project Scope Statement** → Used as an input.
- **WBS** → Already created during scope management; used as an input.

Q: You are a project manager for the construction of a new school. You have determined that in order to build the walls of the school, you must first build the foundation. This is an example of what type of dependency? (Select best answer)

- Discretionary Dependency
- Mandatory Dependency
- External Dependency
- Regulatory Dependency

The correct answer is:

✅ **Mandatory Dependency**

Explanation:

- A **mandatory dependency** is one that **must happen in a specific order** and cannot be avoided.
- In this case, the **foundation must be built before the walls**, which is a natural, unavoidable sequence.

Other options:

- **Discretionary Dependency** → Preferred but not mandatory.
- **External Dependency** → Depends on outside factors or suppliers.
- **Regulatory Dependency** → Depends on laws or regulations.

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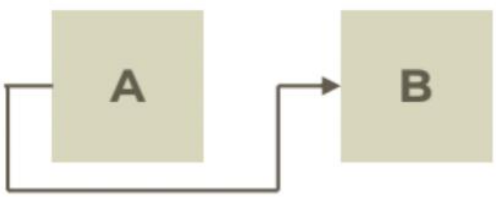
4. The following is an example of which type of activity relationship? (Select best answer)



- Start to start
- Finish to start
- Start to finish
- Finish to finish

Question 5

The time when one phase of a project begins before the conclusion of the previous phase is known as _____? (Select best answer)

- Finish to start
- Lead or lead time
- Lag or Lag time
- Project sequencing

The correct answer is:

✅ **Lead or Lead Time**

Explanation:

- **Lead time** is when an activity or phase **starts before the previous activity is fully completed**, allowing overlap.
- **Finish-to-start** → The next activity starts **only after the previous one finishes**.
- **Lag time** → A delay **before the next activity starts**.
- **Project sequencing** → The overall process of ordering activities.

Estimating Activity Duration: (Step 4)

Estimating Activity Duration

Purpose:
Determine how long each project activity will take with the assigned resources. These estimates feed into the overall project schedule.

Factors to Consider

1. **Law of Diminishing Returns**
    - Adding more resources eventually **doesn't proportionally reduce time** and may reduce efficiency.

    - Example: 40 → 44 hours/week increases output less than expected.
2. **Resource Addition & Learning Curve**
    - Adding people can increase errors and learning time.
3. **Technology**
    - Improved technology can increase productivity.
4. **Motivational Factors**
    - **Student Syndrome:** Procrastination; people work last minute.
    - **Parkinson's Law:** Work expands to fill available time.

Common Estimating Techniques

1. **Analogous Estimating**
    - Uses historical data from similar projects.
    - Fast but less accurate.
2. **Parametric Estimating**
    - Uses formulas based on historical data + project parameters.
    - More accurate than analogous.
3. **Three-Point Estimating**
    - Considers uncertainty and risk to give a **range** of durations.
4. **Bottom-Up Estimating**
    - Aggregates estimates of **lower-level WBS components**.
    - Most accurate but time-consuming.

Decision-Making for Estimates

- Use **team input**, as they are experts on tasks.
- **Fist of Five Technique:**
    - Team votes confidence (0–5 fingers).
    - Less than 3 fingers → discuss and adjust.
    - Repeat until all support the estimate.

Analogous vs Parametric Estimating in project management:

Analogous vs Parametric Estimating

Accurate estimation of **costs and durations** is crucial for successful project execution. Two common techniques: **Analogous Estimation** and **Parametric Estimation**. Both use historical data but differ in approach, accuracy, and data requirements.

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1. Analogous Estimation

Definition:
Uses expert judgment and historical data from similar past projects to estimate cost or duration of a current project.

When to Use:

- Early stages of project planning
- Limited project information available

Advantages:

- Simple and quick to implement
- Requires minimal detailed data
- Cost-effective

Disadvantages:

- Lower accuracy
- Depends heavily on availability of reliable, comparable historical data

Example:
Estimate the cost of a new commercial building based on a similar completed project.

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2. Parametric Estimation

Definition:
Uses **statistical relationships** between historical data and measurable project parameters to calculate estimates.

When to Use:

- When detailed data is available
- Need higher accuracy

Advantages:

- More accurate estimates

- Can scale to different project sizes and complexities

Disadvantages:

- Time-consuming and data-intensive
- Depends on quality and relevance of historical data

Example:
Estimate cost of a building by multiplying historical cost per square foot by planned size.

Key Differences

Aspect	**Analogous**	**Parametric**
Approach	Expert judgment + similarity	Statistical analysis of parameters
Accuracy	Lower, rough estimate	Higher, detailed and analytical
Data Requirements	Minimal	Detailed and specific
Complexity	Simple, quick	Complex, time-consuming

Tip:
Choose the method based on project stage, available data, required accuracy, and resources. Analogous is faster but rough; parametric is more precise but requires effort.

Three-Point and PERT Estimating

Three-Point & PERT Estimating

These techniques help incorporate **risk and uncertainty** into activity duration estimates.

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1. Three-Point Estimating

Definition:
Estimates a range of durations using three scenarios:

- **Optimistic (O):** Best-case scenario, no problems
- **Most Likely (ML):** Most realistic scenario
- **Pessimistic (P):** Worst-case scenario, many problems

Formula:
Estimate = (Optimistic + Most Likely + Pessimistic) ÷ 3

Example:

- Optimistic = 15 hours
- Most Likely = 24 hours
- Pessimistic = 30 hours

Calculation:
Estimate = (15 + 24 + 30) ÷ 3 = 23 hours

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2. PERT Estimating

Definition:
PERT gives **more weight to the most likely estimate** to improve accuracy.

Formula:
PERT Estimate = (Optimistic + 4 × Most Likely + Pessimistic) ÷ 6

Example:
Using the same numbers as above:
PERT Estimate = (15 + 4×24 + 30) ÷ 6
PERT Estimate = (15 + 96 + 30) ÷ 6 = 141 ÷ 6 = 23.5 hours

Key Point:

- **Three-point** = simple average of three scenarios
- **PERT** = weighted average favoring the most likely duration

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Bottom-Up Estimating:

Bottom-Up Estimating

Definition:
Bottom-up estimating is a detailed method to determine project duration by **estimating each individual task or work package** and then aggregating these estimates to get the total project duration. It is highly accurate because it works at the most granular level of the project's **Work Breakdown Structure (WBS)**.

Steps in Bottom-Up Estimating

1. **Break Down the Project into Tasks**
    - Use the WBS to list all individual tasks or work packages.
2. **Estimate Task Durations**

    - Determine the time required for each task.
    - Engage team members for realistic and accurate input.
3. **Sum Up the Estimates**
    - Add all task durations to calculate the total project duration.
    - Account for dependencies or overlapping tasks.
4. **Refine and Validate**
    - Review the estimate to ensure no tasks are missed.
    - Check that dependencies are correctly handled.

Advantages

- Highly **accurate** and detailed
- Ensures **no task is overlooked**
- Provides **team buy-in** and accountability

Disadvantages:

- Time-consuming for large projects
- Requires input from experts familiar with the tasks

Example

Project: Build a mobile app

Task	**Duration (hours)**
User Interface Design	80
Backend Development	120
Testing	60
Deployment	20

Total Estimated Duration: 80 + 120 + 60 + 20 = 280 hours

- If backend development must finish before testing starts, adjust sequencing to reflect dependencies.

When to Use

- Project scope and tasks are **well-defined**
- Accuracy is **critical**

- Resources and experts are available for detailed inputs
- Large, complex projects or **tight deadlines**

Key Point:
Bottom-up estimating provides the **most reliable schedule** by focusing on individual tasks and ensuring precise planning and control.

Developing the Project Schedule – Constraints & Risks:

Developing the Project Schedule: Constraints and Risks

Once you have:

- Precedence diagrams (activity sequencing)
- Estimated activity durations
- Assigned resources

…it's time to **develop the overall project schedule**. At this stage, it's critical to consider **constraints** and **risks**.

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1. Schedule Constraints

Constraints are **limitations that restrict flexibility** in scheduling. Common types include:

1. **Must Start On / Must Finish By**
    - Fixed dates often driven by **client or customer requirements**.
    - Example: Updating software during a company's 3-week shutdown window.
2. **Start No Earlier / Start No Later**
    - Begin a task **after another project or event finishes**, or before a critical deadline.
3. **Finish No Earlier / Finish No Later**
    - Finish constraints often tied to dependencies or deadlines for related events.
4. **Resource Availability**
    - Check if key resources (e.g., programmers, trainers) are available when needed.
    - Work around prior commitments.
5. **Business/Profit Considerations**
    - Time product launches for maximum profit (e.g., before holiday season for sales).
6. **Regulatory Compliance**
    - Consider mandatory testing, labs, or reporting timelines dictated by regulations.

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2. Potential Risks Affecting the Schedule

When building the schedule, consider **risks that may impact timelines**:

- **Competing Projects:** Projects that consume your resources or funding.
- **Catastrophic Events:** Natural disasters (earthquakes, hurricanes) – plan activities to reduce exposure.
- **Labor Availability:** Difficulty attracting or retaining skilled labor.
- **Supply Chain Issues:** Delays due to shortages of materials or equipment.
- **Leads and Lags:** Ensure sufficient buffer times for deliveries, curing, or waiting periods.

Key Takeaways

- Constraints and risks **directly influence the schedule**.
- Plan around fixed dates, resource limitations, and regulatory requirements.
- Build contingency time for risks like supply chain delays, labor shortages, or external events.
- Considering these factors helps create a **realistic, achievable schedule**.

Project Schedule Development – Network Diagrams, Critical Path, and Float

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1. Network Diagram

- A **network diagram** is a visual representation of the **sequence of project activities**.
- Purpose:
    - Determine **earliest possible completion date**.
    - Determine **latest completion date**.
    - Identify **efficiencies or delays** in the schedule.
- Can be drawn manually or using project management software.

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2. Critical Path

- The **critical path** is the **longest sequence of dependent activities** in a project.
- Characteristics:
    - Activities on the critical path **cannot be delayed** without delaying the entire project.

- Represents the **fastest possible completion** of the project.

- Example from transcript:

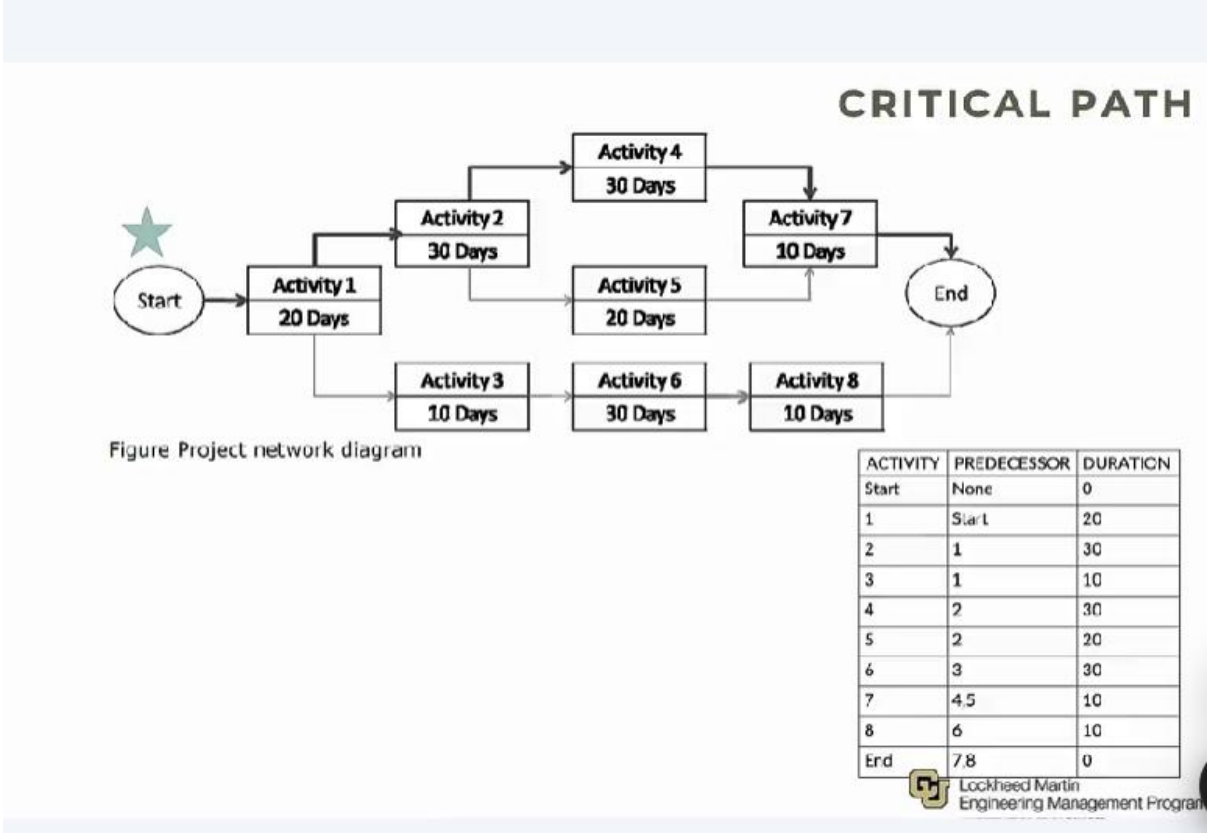

Figure Project network diagram

ACTIVITY	PREDECESSOR	DURATION
Start	None	0
1	Start	20
2	1	30
3	1	10
4	2	30
5	2	20
6	3	30
7	4,5	10
8	6	10
End	7,8	0

Lockheed Martin
Engineering Management Program

  - Activities 1 → 2 → 4 → 7 → total duration = 90 days.

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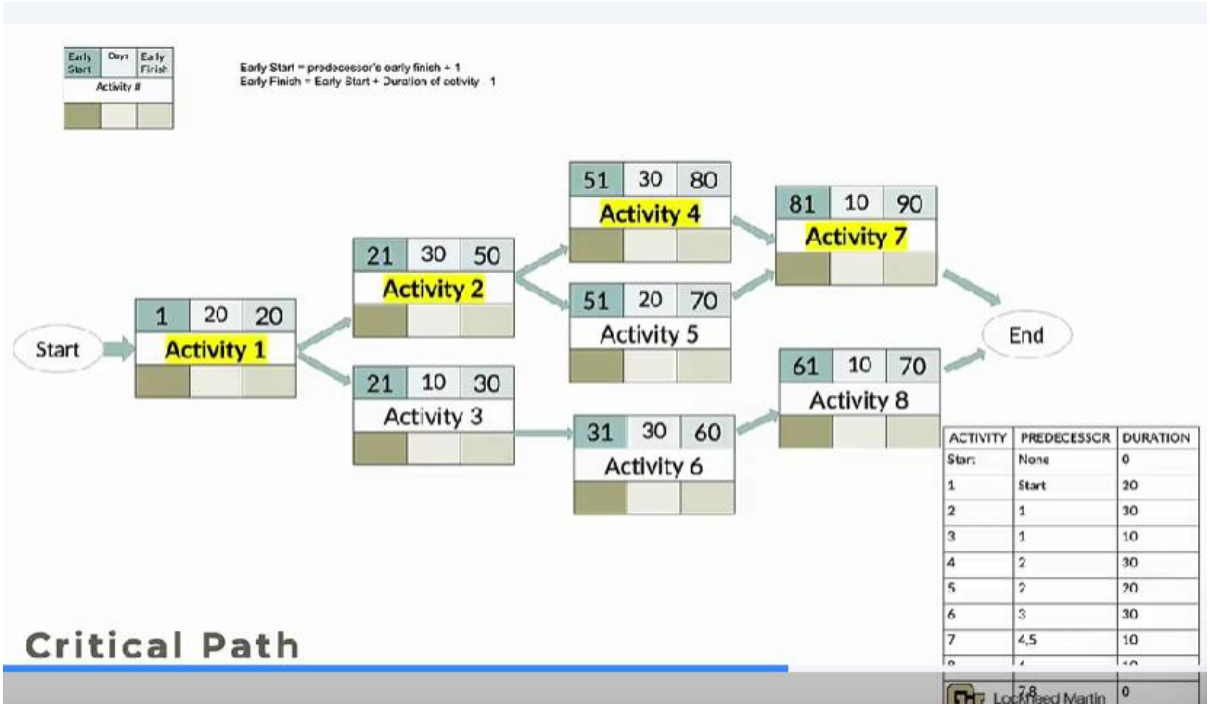
3. Forward Pass (Calculating Early Start & Early Finish)

- **Early Start (ES):** Earliest day an activity can begin (usually predecessor's early finish + 1).
- **Early Finish (EF):** Earliest day an activity can be completed.
  - EF = ES + duration - 1

Example:

- Activity 1: Duration = 20 days, ES = 1 → EF = 20
- Activity 2 (depends on Activity 1): ES = 21 → EF = 50
- Continue for all activities to map earliest possible completion dates.



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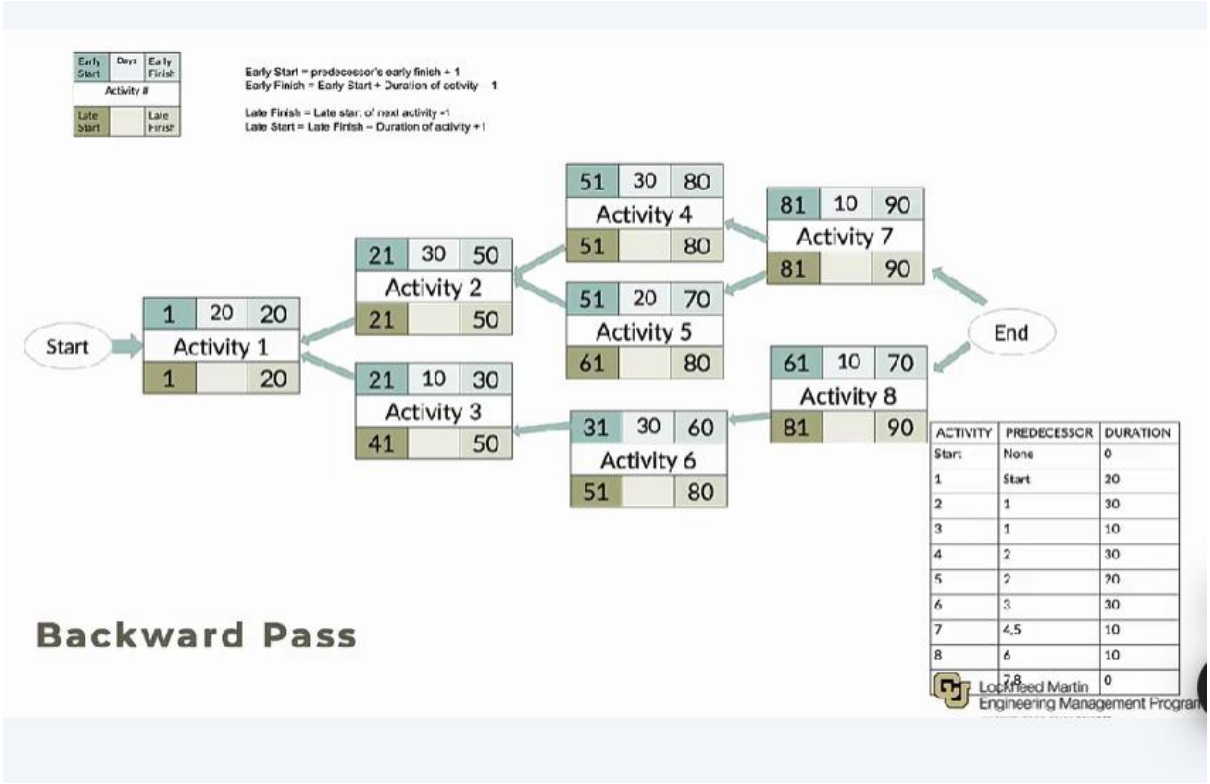
4. Backward Pass (Calculating Late Start & Late Finish)

- **Late Finish (LF):** Latest day an activity must finish without delaying the project.
- **Late Start (LS):** Latest day an activity can start without delaying the project.
    - LS = LF - duration + 1

Example:

- Activity 7: LF = 90 → LS = 81

- Activity 4 (predecessor of 7): LF = 80 → LS = 51



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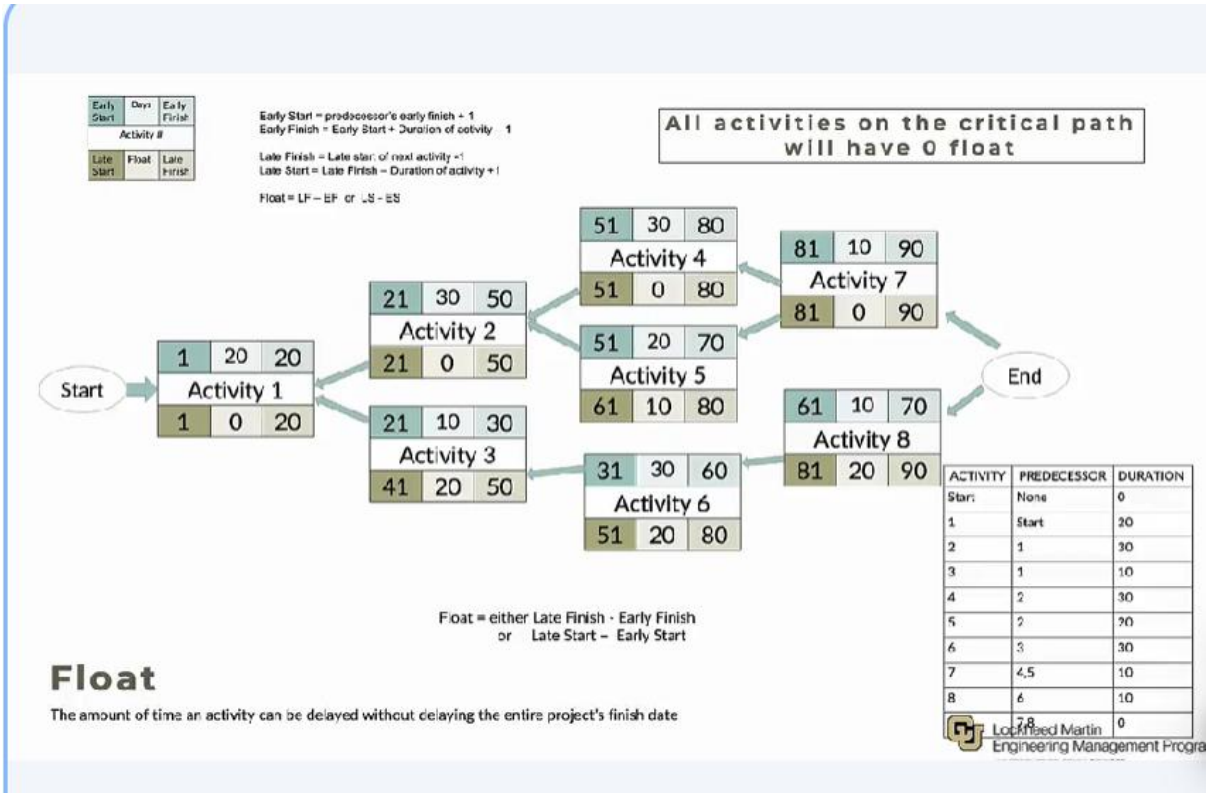
5. Float / Slack

- **Float (or Slack):** Amount of time an activity can be delayed **without affecting the project's finish date**.
- Calculation:
  - Float = LF - EF = LS - ES
- **Critical Path:** Float = 0 (no delay possible)
- **Non-Critical Activities:** Have positive float.
  - Example: Activity 6 → ES = 31, LS = 51 → Float = 20 days



Key Takeaways

- The **network diagram** shows **dependencies** and sequence of activities.
- **Critical path** defines the **minimum project duration**.
- **Forward pass** = earliest start/finish, **Backward pass** = latest start/finish.
- **Float** helps identify **flexible tasks** and scheduling buffers.
- Properly calculating these ensures **realistic, efficient scheduling** and helps manage delays.

Schedule Baseline and Gantt Charts

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1. Schedule Baseline

- **Definition (PMI):**
  The **schedule baseline** is the approved version of a project schedule, which can only be changed through formal change control.
- **Purpose:**
  - Serves as a reference for **comparing actual progress** against planned progress.
  - Includes **baseline start and finish dates**.
- **Stakeholder Involvement:**

    - The baseline is **accepted and approved** by relevant stakeholders.

- **Key Point:**
    - Once set, the schedule baseline is the **official schedule** used for monitoring and controlling project timelines.

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2. Gantt Chart

- **Definition:**
  A **Gantt chart** is a graphical representation of the project schedule that communicates:
    - Activities/tasks
    - Start and finish dates
    - Duration of tasks
    - Milestones
- **Structure:**
    - **Horizontal axis:** Time
    - **Vertical axis:** Tasks/activities
    - **Bars:** Represent each task; length = duration, position = schedule
    - **Dependencies:** Show sequential flow (often diagonal)
    - **Milestones:** Represented by symbols like diamonds or triangles
- **Highlights / Benefits:**
    - Shows **task duration and sequence** clearly.
    - Can display **parallel work streams**, aiding resource coordination.
    - Helps **identify the critical path** and potential bottlenecks.
    - **Milestones** mark significant project events or decisions.
    - Provides **clarity in communication** with stakeholders (keys/legends for symbols).
    - Supports **planning, monitoring, and controlling** project progress.
- **Origin:**
    - Invented by **Karol Adamiecki**, widely popularized by **Henry Gantt** in English.

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3. Key Insights for Effective Use

- A Gantt chart is **more than a visual tool**; it helps think through the project, communicate plans, and track execution.

- **Clear representation** of tasks, dependencies, and milestones is essential for stakeholder understanding.
- Gantt charts are especially useful for **complex projects** with multiple tasks and parallel work streams.

Creating a Gantt Chart in Google Sheets

1. **Open Google Sheets**
    - Go to **Google Sheets** and create a **new sheet**.
2. **Access Templates**
    - On the **top right**, click **Template Gallery**.
    - Scroll to **General Templates**.
    - You will see several **project management templates**, such as:
        - **Gantt Chart Project Timeline**
        - **Project Tracking**
        - **Event Marketing Timeline**
    - Any of these can be used to set up a Gantt chart.
3. **Customize the Template**
    - **Project Name:** Edit the title to reflect your project (e.g., “Building a Deck”).
    - **Tasks and Dates:** Customize cells to reflect your tasks, start dates, durations, and dependencies.
    - **Bars/Timeline:** Adjust as needed to match your schedule.
    - **Fully Editable:** You can cut, paste, or move tasks around according to your project timeline.
4. **Uses**
    - Suitable for **course projects, personal projects, or professional use**.
    - Easy way to **visualize task sequencing, durations, and milestones** without specialized software.

Control Schedule Process

Purpose:

- Ensures the project is progressing according to the **schedule baseline**.

- Part of the **Monitoring & Controlling Process Group**.
- Happens **throughout the life of the project**.

Key Activities in Control Schedule:

1. **Measure Project Performance**
    - Track actual start and finish dates of activities.
    - Compare progress against the **schedule baseline**.
2. **Analyze Variances**
    - Identify **delays or accelerations**.
    - Determine which activities are ahead or behind schedule.
3. **Take Corrective Actions**
    - Adjust resources, priorities, or sequencing to **bring the project back on track**.
    - Use tools like **schedule compression techniques**:
        - **Crashing** – add resources to shorten critical path activities.
        - **Fast Tracking** – perform activities in parallel that were originally sequential.
4. **Update Schedule and Documents**
    - Keep all stakeholders informed of **changes and impacts**.
    - Document **lessons learned** for future projects.

Tools & Techniques Often Used:

- **Project Management Software** (MS Project, Primavera, etc.)
- **Earned Value Management (EVM)** to measure schedule performance.
- **Variance Analysis** to identify deviations.
- **Trend Analysis** to predict future performance.

Outcome:

- Helps ensure **on-time project delivery**.
- Maintains **alignment with the schedule baseline**.
- Provides **insight for decision-making** to manage delays or risks.

Schedule Compression

Purpose:

- Applied when a project is **behind schedule** or needs to meet an earlier deadline.
- Helps shorten the project duration **without changing the project scope**.

Two Common Methods:

1. **Fast-Tracking**
    - **Definition:** Perform activities in parallel that were originally planned **sequentially**.
    - **Example:** Start system testing while development is still finishing minor modules.
    - **Advantages:** Can shorten schedule without adding costs.
    - **Risks:** Increases the chance of **rework** or errors because activities overlap.
2. **Crashing**
    - **Definition:** Add extra resources to critical path activities to **complete them faster**.
    - **Example:** Assign more team members to finish a key task sooner.
    - **Advantages:** Directly reduces project duration.
    - **Risks:** Increases **costs** and may lead to **diminishing returns** if too many resources are added.

Key Considerations:

- Always focus on activities in the **critical path**, as compressing non-critical activities doesn't shorten the overall project.
- Balance **cost, risk, and schedule** when choosing a compression method.
- Communicate changes to stakeholders, as they may impact budgets, quality, or dependencies.

Question 1

You are a project manager for a large multinational corporation. You have been asked to manage a new project since you just successfully completed a similar project for a different business unit. During your project duration estimates you draw upon data from your previous similar project to estimate activity durations. This is an example of: (Select best answer)

- Three-point Estimation
- Parametric Estimation
- **Analogous Estimation**

The correct answer is: **Analogous Estimation** ✅

Explanation:

- Analogous estimation uses **historical data from a similar project** and expert judgment to estimate activity durations.
- In this scenario, the project manager is leveraging experience from a **previous similar project** to estimate durations.

- **Three-point estimation** and **parametric estimation** involve calculations or statistical methods, not just referencing a similar past project.

Question 2

Which of the following is true about Three-Point Estimating and/or PERT Estimating? (Select all that apply)

- Three-Point estimation gives more weight to the most likely scenario.
- **PERT estimation gives more weight to the most likely scenario.**
- **PERT and Three-Point estimation techniques incorporate both optimistic and pessimistic estimates to determine activity duration**

The correct answers are:

- ✅ **PERT estimation gives more weight to the most likely scenario.**
- ✅ **PERT and Three-Point estimation techniques incorporate both optimistic and pessimistic estimates to determine activity duration.**

Explanation:

- **Three-Point Estimating** calculates a simple average of optimistic, most likely, and pessimistic estimates.
- **PERT Estimating** gives more weight to the **most likely estimate** using the formula: (O + 4×ML + P)/6.
- Both methods use **optimistic, most likely, and pessimistic estimates** to account for uncertainty.

Question 3

Which of the following estimation techniques offer the most accurate estimates? (Select best answer)

- **Bottom-Up Estimating**
- Sequence Estimation
- Three-Point Estimation

The correct answer is:

- ✅ **Bottom-Up Estimating**

Explanation:

- **Bottom-Up Estimating** provides the most accurate estimates because it breaks the project into the smallest tasks, estimates each individually, and then aggregates them.
- **Three-Point Estimation** gives a range and averages it, which is less precise.
- **Sequence Estimation** is not a standard estimation technique.

Question 4

Which of the following are true of the project's Critical Path? (Select all that apply)

- The Critical Path represents the shortest amount of time to complete the project.
- The Critical Path is the longest total duration through the network diagram.
- The Critical Path is the total number of days an activity can be delayed.

The correct answers are:

- ✅ **The Critical Path represents the shortest amount of time to complete the project.**
- ✅ **The Critical Path is the longest total duration through the network diagram.**

Explanation:

- The **Critical Path** is the longest sequence of dependent activities, which determines the **minimum project duration**.
- It does **not** represent the number of days an activity can be delayed—that is called **float** or **slack**.

Question 5

This is often shared with stakeholders to communicate the overall project schedule. (Select best answer)

- **Gantt Chart**
- Network Diagram
- Precedence Diagram

The correct answer is:

- ✅ **Gantt Chart**

Explanation:

- A **Gantt Chart** is a visual tool that shows tasks, durations, start and finish dates, dependencies, and milestones. It's commonly shared with stakeholders for clear communication of the project schedule.
- **Network Diagrams** and **Precedence Diagrams** are primarily used by project managers for planning and identifying the critical path, not typically for stakeholder communication.

Question 6

Which of the following can the project manager do to compress the project schedule? (Select best answer)

- **Fast Tracking**
- Backward Pass
- Float

The correct answer is:

- ✅ **Fast Tracking**

Explanation:

- **Fast Tracking** is a schedule compression technique where activities that were originally planned to be done sequentially are performed in parallel to shorten the project duration.

- **Backward Pass** is a method for calculating late start and finish dates, not for compressing the schedule.
- **Float** (or slack) indicates how much an activity can be delayed without affecting the project end date; it is not a method to compress the schedule.

Question 7

Which of the following are risks associated with project crashing? (Select best answer)

- Schedule delay, increased learning curves, and increased project cost
- Increased activity dependency, communication issues, and lower stakeholder engagement.
- **Increased project cost, lower quality, and team burnout**

The correct answer is:

- ✅ **Increased project cost, lower quality, and team burnout**

Explanation:

- **Project crashing** involves adding extra resources or working overtime to shorten the schedule.
- This can lead to **higher costs** (extra resources/overtime), **lower quality** (rushed work), and **team burnout** (overworking team members).
- The other options describe unrelated risks or general project issues, not specifically tied to crashing.

Project Budget and Procurement

Project Cost Management Overview

Project Cost Management is the knowledge area in project management that focuses on **planning, estimating, budgeting, and controlling costs** to ensure the project is delivered **on scope, on schedule, and on budget**.
It includes **four main processes** across the Planning and Monitoring & Controlling process groups:

1. **Plan Cost Management**
    - Develop a **Cost Management Plan**.
    - This plan defines **how project costs will be planned, estimated, and controlled** throughout the project.
    - Sets the framework for cost estimation and cost control.
2. **Estimate Costs**
    - Determine the cost of individual activities and overall project.
    - Can use methods like:
        - Historical data from similar past projects.
        - Supplier quotations or expert input.
        - Industry-standard estimation techniques.
    - Produces an **estimate of the total project costs**.
3. **Determine Budget**
    - Aggregate all activity cost estimates to develop the **project budget**.
    - Establish a **cost baseline**, which is the approved budget used as a reference to compare actual costs during project execution.
    - Includes all funds needed to successfully complete the project.
4. **Control Costs**
    - Monitor and control the project budget throughout the project lifecycle.
    - Compare **actual costs vs. the cost baseline**.
    - Tools such as **Earned Value Management (EVM)** are used to track performance and communicate budget status to stakeholders.
    - Ensures that the project stays within budget and corrective actions are taken if deviations occur.

Key Takeaways:

- Cost management ensures the project stays financially on track.
- A **cost baseline** is the reference point for all future cost tracking.
- Continuous monitoring is critical for project success.
- Tools like **EVM** help in measuring cost performance and communicating with stakeholders.

Estimating Project Cost

Estimating the cost of a project answers the crucial question: **“How much will it cost?”**

The **accuracy of estimates** depends on the method used:

- **Rough Order of Magnitude (ROM) Estimate:** Accuracy of **-25% to +75%**. Used in early project phases.
- **Budget Estimate:** Accuracy of **-10% to +25%**. More refined than ROM.
- **Definitive Estimate:** Accuracy of **-5% to +10%**. Most detailed and precise, used when the project scope is well-defined.

Considerations for Cost Estimating

The project team must decide:

- Should costs be based on **previous similar projects**?
- Should costs be estimated by **breaking down the WBS into individual components**?

Cost Estimating Techniques

Many scheduling techniques can also be applied to cost estimation:

- **Analogous Estimating:** Use costs from previous similar projects to estimate current project costs.
- **Parametric Estimating:** Use statistical relationships between historical data and variables (e.g., cost per unit) to estimate costs.
- **Bottom-Up Estimating:** Break down each WBS component and estimate costs for each task, then sum them up.
- **Three-Point Estimating & PERT:** Use optimistic, most likely, and pessimistic cost estimates to calculate expected costs.

Key Takeaway:
Estimating project costs is a combination of historical data, detailed task-level analysis, and applying estimation techniques to achieve the required accuracy for planning and budgeting.

Estimating Project Costs

To determine the total project cost, the project team must estimate the cost of each activity component and then sum them up. The same tools used for schedule estimation can be applied to cost estimation.

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1. Categories of Costs

A. Direct vs Indirect Costs

- **Direct Costs:** Can be easily attributed to the project.
  Examples:
    - Project team wages (if 100% dedicated)
    - Materials required for deliverables
- **Indirect Costs:** Cannot be easily linked to a single project; often shared across multiple projects.
  Examples:
    - Quality control resources
    - PMO office overhead
    - Corporate tech support

B. Fixed vs Variable Costs

- **Fixed Costs:** Do not change over time or with the level of output.
  Examples: Lease payments, monthly software subscriptions
- **Variable Costs:** Change proportionally with output.
  Examples: Material costs that increase with production volume

Note:

- Costs can be either direct or indirect, and either fixed or variable.
- A cost **can be both direct and variable**.
  Example: Hiring additional assembly workers for more output:
- Direct (because they work on the project)
- Variable (because cost increases with more units produced)

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2. Types of Cost Estimates

Different levels of cost estimates are used at different stages of a project, each with a defined accuracy range:

1. **Rough Order of Magnitude (ROM) Estimate**
    - Very early, approximate estimate
    - Accuracy: **-25% to +75%**
    - Used when project details are limited
2. **Budget Estimate**
    - More refined than ROM
    - Accuracy: **-10% to +25%**

- Often used for planning and project approval

3. **Definitive Estimate**
    - Highly accurate, detailed analysis of all activities and costs
    - Accuracy: **-5% to +10%**
    - Used when the project is fully planned

Key Insight

Understanding the **type of cost** (direct/indirect, fixed/variable) and the **estimate accuracy** helps project managers plan budgets effectively and provide realistic financial projections throughout the project life cycle.

Cost Estimating Techniques

1. Analogous Estimating (Top-Down)

- Uses historical project data to estimate costs for the current project.
- Quick but less accurate.
- **Example:**
    - Last year: $500,000 for converting 1,000 sq. ft.
    - This year: 2,000 sq. ft. → estimated cost $1,000,000

2. Parametric Estimating

- Uses a mathematical model based on a unit cost or rate.
- Adjusts for size or scope differences using historical data.
- **Example:**
    - Aluminum cost: $10/meter × 50 meters = $500
    - Programming labor: $800/day × 6 days = $4,800

3. Bottom-Up Estimating

- Estimates costs for each WBS activity individually (direct, indirect, fixed, variable).
- Adds all activity costs to get total project cost.
- More time-consuming but highly precise.

4. Three-Point Estimating

- Uses three scenarios: **Optimistic (O), Most Likely (M), Pessimistic (P)**.
- Simple average: (O + M + P) / 3

- **Example:** O=$4,000, M=$8,000, P=$15,000 → Estimate = $9,000

5. PERT Estimating

- Similar to three-point, but gives **more weight to the most likely scenario**.
- Formula: (O + 4M + P) / 6
- **Example:** O=$4,000, M=$8,000, P=$15,000 → Estimate = $8,500

Key Insight

- **Analogous & Parametric** → quick estimates, less precise
- **Bottom-Up** → highly detailed and accurate
- **Three-Point & PERT** → incorporate uncertainty; PERT leans toward the most likely outcome

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Determine Project Budget

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1. Project Budget

- **Definition:** Total projected costs needed to complete the project scope within the project schedule.
- Represents **all authorized funds** to execute the project from start to finish.

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2. Cost Performance Baseline (Cost Baseline / BAC)

- **Definition:** Approved version of the budget, including **contingency reserves** for known risks.
- Serves as the **baseline to measure actual project performance** over time.
- **Includes:**
    - Estimated costs of all project activities
    - Contingency reserves for known risks
    - Key dates and milestones

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3. Contingency Reserves

- Extra funds added to **cover known risks** for specific activities or work packages.
- Typical range: **2–5% per activity** or an overall **5–10% for the project**.
- Ensures the project can handle predictable uncertainties, like supply delays or expedited fees.

- Applies to both **costs** and **schedules**.

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4. Management Reserve

- Funds set aside for **unknown risks** or uncertainties.
- **Not controlled by the project manager**; controlled by management, sponsor, or PMO.
- Access requires **formal change control**.

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5. Total Project Budget

- **Formula:**
- Total Project Budget = Cost Baseline + Management Reserve
- Cost Baseline (with contingency) = **BAC (Budget at Completion)**
- Total budget includes BAC + management reserve.

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6. Cost Baseline Over Time

- **Graph Components:**
    - **X-axis:** Project timeline
    - **Y-axis:** Cumulative project expenditure
    - **Cost Baseline Line (BAC):** Planned expenditure including contingency
    - **Funding Requirement Line:** Amount of funding needed at different points
    - **Actual Expenditure Line:** Real spending over time
- If actual spending exceeds the cost baseline, the **management reserve** covers the excess.

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7. Purpose of Cost Baseline

- Forecast funding requirements throughout the project lifecycle.
- Compare **actual expenditures vs. planned budget**.
- Measure project performance in terms of **cost and schedule**.
- Used in **Earned Value Management (EVM)** for performance tracking.

Earned Value Management (EVM) is a project management technique that integrates scope, schedule, and cost to assess project performance and progress. It provides a comprehensive view of a project's performance relative to its budget and schedule, allowing for early identification of potential issues. (PLANERGY Software)

https://www.youtube.com/watch?v=QTL0NU_S2Mc

📘 Key Concepts in Earned Value Management

1. Planned Value (PV)

The total budgeted costs for the work scheduled to be completed by a specific time. It represents the baseline against which actual performance is measured.

2. Actual Cost (AC)

The actual costs incurred for the work performed during a specific time period. Also known as the actual cost of work performed (ACWP).(PLANERGY Software, PLANERGY Software)

3. Earned Value (EV)

The value of the work actually performed up to a specific point in time, measured in terms of the approved budget assigned to that work. Also referred to as the budgeted cost of work performed (BCWP).(PLANERGY Software)

4. Cost Variance (CV)

The difference between earned value and actual cost.
CV = EV - AC
A positive CV indicates under budget, while a negative CV indicates over budget.(PLANERGY Software)

5. Schedule Variance (SV)

The difference between earned value and planned value.
SV = EV - PV
A positive SV indicates ahead of schedule, while a negative SV indicates behind schedule.(PLANERGY Software)

6. Cost Performance Index (CPI)

A measure of cost efficiency and financial effectiveness.
CPI = EV / AC
A CPI greater than 1 indicates cost efficiency, while less than 1 indicates cost overruns.(PLANERGY Software)

7. Schedule Performance Index (SPI)

A measure of schedule efficiency.
SPI = EV / PV
An SPI greater than 1 indicates ahead of schedule, while less than 1 indicates behind schedule.(PLANERGY Software)

8. Estimate at Completion (EAC)

The forecasted cost of the project at completion, based on current performance.

9. Estimate to Complete (ETC)

The expected cost to complete the remaining work.

10. Variance at Completion (VAC)

The difference between the budget at completion (BAC) and the estimate at completion (EAC).
VAC = BAC - EAC
A positive VAC indicates under budget, while a negative VAC indicates over budget.(PLANERGY Software)

📊 **Benefits of Implementing EVM**

- **Early Detection of Issues**: Identifies potential problems early, allowing for timely corrective actions.
- **Improved Forecasting**: Provides accurate forecasts of project performance, aiding in better decision-making.
- **Objective Performance Measurement**: Offers a quantitative basis for assessing project performance.
- **Enhanced Communication**: Facilitates clear communication of project status to stakeholders.(PLANERGY Software)

Question 1

Costs that can be directly associated with or assigned to your project are: (Select best answer).

- Sunk Costs
- Overhead Costs
- **Direct Costs**

The correct answer is:

Direct Costs ✅

Explanation: Direct costs are expenses that can be specifically traced and assigned to a project, such as labor, materials, or equipment used exclusively for that project.

- **Sunk Costs** are past costs that have already been incurred and cannot be recovered.
- **Overhead Costs** are indirect costs that are shared across multiple projects and cannot be directly assigned to one project.

Question 2

Of the following options, which is the most precise method of estimating?(Select best answer).

- Rough Order of Magnitude
- Preliminary
- Budget

- **Definitive**

The correct answer is:

Definitive ✅

Explanation: A **definitive estimate** is the most accurate and precise, typically developed when the project is planned in detail and all activities and associated costs are well analyzed. It usually has an accuracy range of **-5% to +10%**.

- **Rough Order of Magnitude (ROM):** Very early estimate, wide accuracy range (-25% to +75%).
- **Preliminary Estimate:** Early project planning, moderately refined.
- **Budget Estimate:** Refined estimate for planning and approval, accuracy range roughly -10% to +25%.

Question 3

Which estimating tool uses information from previous projects as a basis for current estimation?(Select best answer).

- PERT
- 3-Point Estimation
- Parametric
- **Analogous Estimates**

The correct answer is:

Analogous Estimates ✅

Explanation: Analogous estimating, also called **top-down estimating**, uses **historical data from previous similar projects** to estimate costs or durations for the current project. It is quick but less precise than other methods like bottom-up or parametric estimating.

- **PERT / 3-Point Estimation:** Use optimistic, most likely, and pessimistic values to calculate estimates.
- **Parametric:** Uses mathematical formulas based on unit cost or productivity rates.

Question 4

The amount of money added to cover any known project risks is called _____. (Select the best answer).

- **Contingency Reserve**
- Management Reserve
- Cost Baseline

- Expenditures Buffer

The correct answer is:

Contingency Reserve ✅

Explanation: A **contingency reserve** is an amount of money included in the project budget to account for **known risks**. It is planned as part of the **cost baseline** and is used to handle uncertainties that have been identified in advance.

- **Management Reserve:** Funds set aside for **unknown or unforeseen risks** and is not controlled directly by the project manager.
- **Cost Baseline:** Approved budget including contingency reserves, used to measure project performance.
- **Expenditures Buffer:** Not a standard project management term.

Question 5

You have a project with four major tasks. The following budget for each task is as follows:

Hardware = $50,000

Software = $30,000

Peripherals = $10,000

Installation = $30,000

Total Budgeted Cost = $120,000

In terms of Earned Value Management, the $120,000 is also known as _____. (Select best answer)

- **Budget at Completion (BAC)**
- Planned Value (PV)
- Earned Value (EV)

The correct answer is:

Budget at Completion (BAC) ✅

Explanation:

- **Budget at Completion (BAC): The total approved budget for the project, which in this case is $120,000. It represents the total planned cost of all tasks when the project is complete.**
- **Planned Value (PV): The portion of the BAC that is planned to be spent at a given point in time.**
- **Earned Value (EV): The value of work actually completed, measured in terms of the approved budget.**

Project Procurement

Project Procurement Management

This knowledge area focuses on acquiring goods, services, or results from outside the project team—things your organization cannot provide internally.

Processes

Project procurement management has three key processes across the planning, executing, and monitoring/controlling process groups:

1. **Plan Procurement Management (Planning Group)**
    - **Develops the Procurement Management Plan.**
    - **Outlines how procurements will be handled.**
    - **Includes:**
        - **Whether to send requests for bids (RFQs, RFPs).**
        - **Which suppliers/vendors to consider.**
        - **Criteria for evaluating competitive bids.**
        - **Stakeholder roles and responsibilities.**
        - **Constraints or requirements.**

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2. **Conduct Procurements (Executing Group)**
    - **Involves obtaining and evaluating seller responses.**
    - **Selecting the seller and awarding contracts.**
    - **May involve:**
        - **Preferred vendors.**
        - **Formal bidding/RFP processes.**
        - **Procurement or legal review teams to reduce bias in vendor selection.**

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3. **Control Procurements (Monitoring & Controlling Group)**
    - **Managing vendor relationships during execution.**
    - **Ensuring contract terms are met.**
    - **Measuring and monitoring vendor performance.**
    - **Making corrective actions if needed.**

- Closing out contracts (fulfilled or canceled).

Why It Matters

- **Suppliers are extensions of the project team and crucial stakeholders.**
- **Effective procurement management ensures:**
  - **Vendors meet expectations.**
  - **Resources and services arrive on time.**
  - **Contracts are closed properly.**
- **Strong vendor relationships can make or break project success.**

Procurement in Project Management

Why Procurement Matters

- **Projects create value by delivering outputs (deliverables).**
- **To produce deliverables, we need resources (people, materials, services).**
- **If resources aren't available in-house → we must buy (procure) them externally.**

Procurement Steps (Framed as Key Questions)

These steps mirror personal buying decisions but with added rigor for fairness, cost-effectiveness, and accountability.

1. **What do we need?**
   → Defined in the scope management process.
2. **When do we need it?**
   → Answered through schedule management.
3. **Do we make or buy?**
   → Make-or-Buy Analysis determines if it's better to create in-house or outsource.
4. **Who will supply it?**
   → Supplier selection process (RFPs, bids, vendor qualification).
5. **How do we formalize the agreement?**
   → Through contracts (Fixed Price, Cost Plus, Time & Materials).
6. **How do we maintain strong supplier relationships?**
   → Vendor management, clear communication, performance monitoring, and fairness.

Key Takeaway

Procurement isn't just buying things—it's about:

- **Strategic decision-making (make vs. buy).**
- **Selecting the right suppliers fairly.**
- **Managing relationships so suppliers become trusted extensions of the project team.**

Make or Buy Decisions

🔹 Definition

- **A make or buy decision is the process of deciding whether:**
    1. **To make (produce internally) the required resources/products/services**
    2. **Or to buy (outsource externally) from another company.**

🔹 What Can Be Outsourced

- **Equipment needed for building a part of the deliverable**
- **People (human resources)**
- **Expertise/skills for a specific part of the project**

🔹 Key Consideration

- **Cost Analysis → Compare the costs of:**
    - **Internal production (make)**
    - **External sourcing (buy)**

🔹 Factors Influencing the Decision

1. **Cost Efficiency**
    - **Which option is cheaper without sacrificing quality?**
2. **Core Competency**
    - **Does the company have the skills/expertise in-house?**
3. **Capacity & Resources**
    - **Do we have enough workforce, time, and technology to handle it internally?**
4. **Quality**
    - **Can outsourcing provide higher or lower quality compared to internal efforts?**

5. **Time Constraints**
    - **Which option allows faster completion?**
6. **Strategic Importance**
    - **Is this resource critical to the project's success?**
    - **If yes, maybe better to keep it internal.**
7. **Confidentiality & Risk**
    - **Will outsourcing risk sensitive information or intellectual property?**

✅ **Summary:**
Make-or-buy decisions require analyzing cost, time, expertise, and risk to determine whether producing internally or outsourcing is more beneficial.

Supplier Selection & Management

🔹 Why Supplier Selection Matters

- **Suppliers become key stakeholders once awarded a contract.**
- **Strategic supplier selection ensures project success.**
- **Companies need a clear, structured process to choose the best vendor partners.**

🔹 High-Level Supplier Selection Process

1. **Decision to Outsource & Approval**
    - **Trigger: A need arises that cannot be handled internally.**
    - **Gain approval to enter into procurement with an external supplier.**
2. **Develop Statement of Work (SOW)**
    - **Describes project details:**
        - **Deliverables**
        - **Timelines**
        - **Invoicing & payment terms**
    - **Must be comprehensive so vendors fully understand requirements.**
3. **Develop Terms of Reference (TOR)**
    - **Especially important for technical projects.**

- **Details:**
  - **Technical/engineering requirements**
  - **Required credentials or licenses**
  - **Expected expertise levels**

4. **Request for Quote/Proposal (RFQ/RFP)**
   - **Formal document sent to suppliers inviting bids.**
   - **Suppliers submit quotes or proposals.**
5. **Evaluation of Bids/Quotes**
   - **Consider:**
     - **Supplier history (worked with us before?)**
     - **Risk of new supplier**
     - **References**
     - **Quality standards**
   - **Compare and shortlist best options.**
6. **Negotiation**
   - **Buyer & supplier discuss terms:**
     - **Pricing**
     - **Payment terms**
   - **Often involves back-and-forth before final agreement.**
7. **Contract Award**
   - **Contract is finalized and signed.**
   - **Supplier begins to perform/deliver.**
   - **Could be:**
     - **One-time delivery (equipment, goods)**
     - **Ongoing service (outsourced staff, long-term work).**
8. **Control & Monitor Supplier Performance**
   - **Supplier performance is continuously tracked.**
   - **Issues → corrective actions required.**
   - **Strong communication is essential.**
   - **Supplier is treated as a project stakeholder.**

✅ **Summary: Supplier selection is not just about finding the lowest cost option — it's about choosing reliable partners, negotiating fair terms, and maintaining strong relationships to ensure project success.**

📌 Procurement Documents – Notes

Statement of Work (SOW)

- **Definition: Legally binding document describing the project scope, requirements, and contractual terms.**
- **Purpose: To provide detailed overview of what needs to be delivered.**
- **Contents may include:**
    - **Introduction**
    - **Purpose statement (project objective)**
    - **Scope statement**
    - **Work location**
    - **Schedule & duration**
    - **Tasks / Deliverables**
    - **Milestones**
    - **Testing requirements**
    - **Payment terms / schedule**
    - **Any other contractual details**

⚡ **Difference from Project Charter: Charter = high-level authorization; SOW = detailed binding requirements.**

Terms of Reference (TOR)

- **Definition: Description of technical requirements in RFP/bidding documents.**
- **Purpose: Ensure suppliers meet necessary technical/credential requirements.**
- **Contents:**
    - **Project scope**
    - **Schedule**
    - **Technical/credential requirements (licenses, certifications)**
    - **Stakeholder interests (permits, standards, regulations)**
    - **Why outsourcing (lack of internal expertise/qualified staff)**

✅ **Quick Memory Tip:**

- **SOW = "What, Where, When, How Much" (scope + deliverables + payment).**
- **TOR = "Technical & Regulatory Conditions" (qualifications + standards).**

Evaluating Vendors

- **After issuing RFPs (Request for Proposals), project managers receive bids from vendors.**
- **The next step is evaluating vendors to choose the most suitable partner.**
- **A case study highlights that the vendor selection process is a strong predictor of project success.**
- **Key evaluation factors:**
    - **Cost and budget alignment**
    - **Technical expertise and past performance**
    - **Reliability, reputation, and financial stability**
    - **Ability to meet deadlines and quality requirements**
    - **Alignment with project goals and long-term partnership potential**

✅ **Careful vendor evaluation helps reduce risks, avoid project failure, and ensure smoother execution.**

Contracts in Procurement

Definition:

- **A contract = legally binding agreement between two parties that creates mutual obligations enforceable by law.**
- **More than a promise → enforceable in court.**

Essential Elements of a Contract:

1. **Offer – proposal to do something (e.g., supply equipment).**
2. **Consideration – value exchanged (e.g., payment).**
3. **Acceptance – agreement to the offer and terms.**
4. **Mutuality ("meeting of the minds") – both parties understand and agree, and have authority to contract.**

5. **Legality – contract must be for a legal purpose.**

Types of Contracts

1. **Fixed Price Contract (FP):**
    - **Deliverables clearly defined.**
    - **Buyer pays agreed fixed price.**
    - **Risk: with seller (they absorb cost increases).**
2. **Fixed Price Incentive (FPIF):**
    - **Fixed price + performance incentives (e.g., early delivery bonus).**
3. **Fixed Price with Economic Price Adjustment (FP-EPA):**
    - **Price adjustable based on external factors (materials, labor costs).**
4. **Time & Materials Contract (T&M):**
    - **Buyer reimburses seller for time worked + materials used.**
    - **Useful when scope/time unclear.**
    - **Risk: with buyer (costs can escalate).**
5. **Cost Plus Contract (CP):**
    - **Buyer pays actual costs + additional fee.**
    - **Used when requirements unclear.**
    - **Risk: with buyer (costs may exceed expectations).**
6. **Retainer Agreement:**
    - **Prepayment for a set number of hours/resources.**
    - **Popular in freelance/gig economy.**
    - **Risk: with buyer (paid before work is complete).**

✅ **Key Point:**

- **Each contract type shifts risk between buyer and seller.**
- **Project managers must choose contract type based on clarity of scope, cost certainty, and risk tolerance.**

Supplier Relationship Management (SRM):

📌 **Supplier Relationship Management (SRM)**

Context:

- **After suppliers are selected and contracts/orders are placed, the project enters the "Control Procurements" phase.**
- **This involves:**
    - **Monitoring supplier performance**
    - **Managing the supplier relationship**
    - **Closing out contracts upon completion**

Importance of SRM:

- **Builds positive customer–supplier relationships.**
- **Helps drive innovation (new ideas/products/processes).**
- **Growing importance as supply chains tighten globally.**

Deloitte Report (2022) – Key Takeaways:

- **Strong supplier relationships benefit both buyer and supplier.**
- **Strategic partnering increases value for all stakeholders.**
- **SRM focuses on identifying and maximizing value from suppliers.**

✅ **Summary:**
Supplier Relationship Management ensures long-term collaboration, innovation, and mutual benefits. It is critical during the Control Procurements process to not only ensure smooth delivery but also foster innovation and strategic value.

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1. When selecting a supplier, the document that you provide potential vendors that describes the project details, deliverables, timelines, and supplier expectations is called: (Select best answer)

    ○ Contract

    ○ Formal Quote

    ◉ Statement of Work

    Correct. All of those are included in the Statement of Work.

2. A legally-binding document that explains a formal agreement between two parties is also known as what? (Select best answer)

- (●) Contract

  Correct. A legally-binding document that explains a formal agreement between two parties is also known as a contract.

- ( ) Statement of Work
- ( ) Project Charter

3. In order for a contract to be enforceable it must have which of the following conditions?(Select all that apply). 1 / 1

- [x] Consideration

  Correct. Something of value is exchanged for an action or inaction.

- [x] Offer

  Correct. Contracts contain an offer from one party to another.

- [x] Acceptance

  Correct. The offer must be accepted by the party.

- [x] Mutuality

  Correct. Both parties have authority, understand, and agree to the terms.

4. Which type of contract allows the buyer to reimburse the seller for the cost of material and labor needed to complete the work? (Select best answer)

- ( ) Cost Plus
- ( ) Retainer
- ( ) Fixed Price Contract
- (●) Time and Materials Contract

  Correct. Time and materials is a type of reimbursement contract.

5. Companies who engage in Supplier Relationship Management (SRM) experience the following benefits: (Select all that apply) 1 / 1 pc

- [ ] Corporate Takeovers
- [x] Increased Transparency

  Correct. SRM allows for compliance with ethics and regulatory requirements.

- [x] Reduced Costs

  Correct. SRM allows for reduced costs across the supply chain through continuous optimization of operations and a win-win relationship.

- [x] Increased Innovation

  Correct. SRM partnerships allow for opportunities that create long-term value for both organizations.