Software Engineering 2UCCE501

Module 4

Module 4
System Implementation, Configuration Management & Risk Management

4.1 Packages & Interfaces: Distinguishing between classes versus interfaces. Exposing class & package interfaces.

4.2 Mapping Model to code, Mapping object models to Database schema.

4.3 Component & Deployment Diagrams: Describing dependencies.

4.4 Managing & Controlling Changes: Managing & Controlling versions.

4.5 Categories of Risks. Nature of risks, Types of risks, Risk identification, Risk assessment, Risk Planning and control, Risk Management, Evaluating risk to schedule, PERT technique.

Risk Management

Risk Definition:

"Tomorrow problems are today's risk."

‘the chance of exposure to the adverse consequences of future events’

‘an uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives’

- Risks relate to possible future problems, not current ones
- They involve a possible cause and its effect(s)
  - e.g.
    - developer leaves -> task delayed
    - Misinterpretation of scope -> failure of acceptance test

Categories of Risk

Project Risks: These risks affect the project schedule, budget, and team performance. They may lead to project delays, increased costs, or failure to meet deadlines.

- Examples:
  - Inadequate resources or skills.
  - Unrealistic timelines.
  - Poorly defined project requirements.

Technical Risks: Technical risks relate to the technologies, tools, or architecture used in the project. They could result in performance issues, integration problems, or difficulties in system implementation.

- Examples:
  - Adoption of new or unproven technologies.
  - Challenges in software integration.
  - Inadequate system performance.

Business Risks: Business risks affect the organization's ability to achieve its objectives or benefit from the project. These risks may arise from changes in market conditions or organizational goals.

- Examples:
  - Shifting business priorities.
  - Project misalignment with market needs.
  - Financial constraints.

Operational Risks: Operational risks involve challenges in daily business operations due to the project. These risks can impact the functionality or usability of the software.

- Examples:
  - Difficulty in transitioning to the new system.
  - Software not meeting user requirements.
  - Disruptions in ongoing operations.

Security Risks: These risks pertain to vulnerabilities in the software that may lead to breaches, data loss, or unauthorized access.

- Examples:
  - Weak data encryption or protection.
  - Cyberattacks and hacking threats.
  - Non-compliance with security standards.

Sources of Risks

Natures of risks

- People (Human factor)
  - Type of resources mismatch,(people with different skill set allocated)
  - Less Number of people, skill gap etc
- Technology

  New technology used for implementation
- Structure

  Organization structure : Projectized / Strong Matrix / Weak matrix/ Open
- Task

  Activities are carried out for the first time
- Complexity:

  As software grows more complex, the likelihood of risks such as miscommunication, errors, and delays increases.
- External Factors

Approaches to resolve risks

- Proactive approaches & reactive approach
- **Proactive:**
- Proactive approaches aim to **anticipate and prevent risks** before they occur.
- The goal is to identify potential risks early in the project and take steps to either avoid them or reduce their likelihood and impact.

    - *Example:* In a project, if you're using a new, untested technology, you identify the risk that the team may face difficulties due to a lack of expertise.
    - You arrange for training in advance, ensuring the team can handle it.

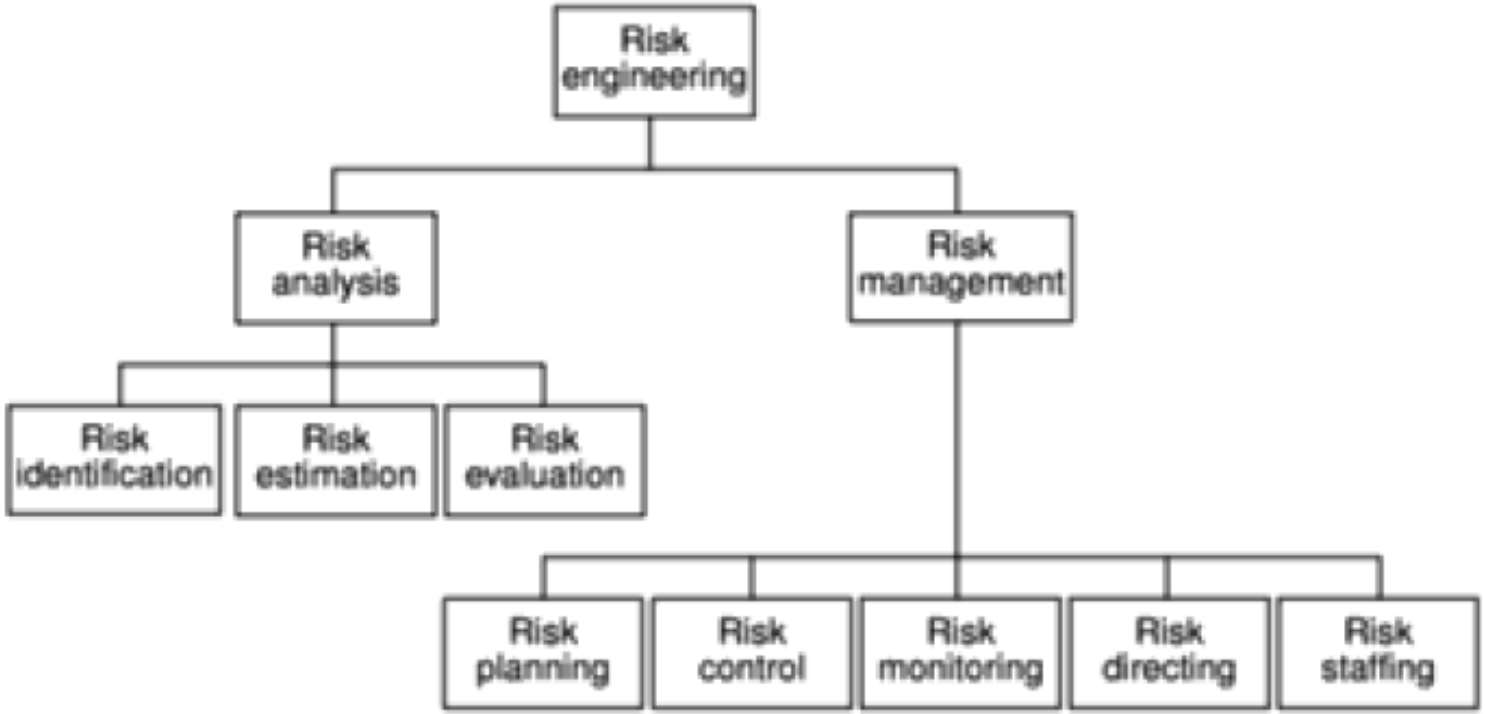
Risk Management

Reactive:

- Reactive approaches focus on responding to risks after they have occurred.
- This means dealing with risks once they manifest and taking steps to minimize their impact or resolve them after the fact.
- Risk Acceptance: Some risks cannot be avoided or mitigated cost-effectively, so they are accepted and dealt with when they occur.

  - Example: If a project experiences minor delays due to a supplier not delivering materials on time

Boehm’s risk engineering task breakdown



Boehm's top development risks & reduction strategies

Risk	*Risk reduction techniques*
Personnel shortfalls	Staffing with top talent; job matching; teambuilding; training and career development; early scheduling of key personnel
Unrealistic time and cost estimates	Multiple estimation techniques; design to cost; incremental development; recording and analysis of past projects; standardization of methods
Developing the wrong software functions	Improved software evaluation; formal specification methods; user surveys; prototyping; early user manuals
Developing the wrong user interface	Prototyping; task analysis; user involvement

Boehm's top development risks & reduction strategies

Risk	Risk reduction techniques
Gold plating	Requirements scrubbing, prototyping, design to cost
Late changes to requirements	Change control, incremental development
Shortfalls in externally supplied components	Inspections, formal specifications, contractual agreements, quality controls
Shortfalls in externally performed tasks	Quality assurance procedures, competitive design etc

Risk management process

The planning for risk includes these steps:

- Risk identification – what risks might there be?
- Risk Assessment – which are the most serious risks?
- Risk planning – what are we going to do about them?
- Risk monitoring – what is the current state of the risk?

Risk identification

- **Objective**: To recognize and document potential risks that could affect the project's success.
- Risk identification involves brainstorming activities.
- It also involves the preparation of a risk list.
- Brainstorming is a group discussion technique where all the stakeholders meet together.
- This technique produces new ideas and promotes creative thinking.

- Preparation of a risk list involves the identification of risks that are occurring continuously in previous software projects.

- **What Happens**:
- In this step, you brainstorm and list all possible risks, including internal and external risks.
- This may involve workshops, interviews, checklists, or analysis of past projects.
- **Example**: Identifying risks such as budget overruns, technology failures, or supply chain disruptions in a project.

Risk assessment

Risk exposure (RE)

= (potential damage) x (probability of occurrence)

Ideally

Potential damage: (PD) a money value

Probability (P) 0.00 (absolutely no chance) to 1.00 (absolutely certain)

RE = PoD x P

- **Objective**: To analyze and prioritize risks based on their likelihood and potential impact.
- **What Happens**: Each identified risk is evaluated to determine:
  - **Likelihood**: How probable it is that the risk will occur.
  - **Impact**: How severe the consequences will be if the risk occurs.
- The risks are then ranked, often using a risk matrix, so the most critical risks are addressed first.
- **Example**: Determining that a certain technology failure has a high probability and would cause significant delays in the project timeline.

Risk Analysis & Prioritization

- Drawing up contingency plans to deal with the risk should it occur
- Identifying the problems causing risk in projects
- Identifying the probability of occurrence of the problem
- Identifying the impact of the problem
- Reduce the risk exposure by reducing the likelihood or impact
- **Risk Reduction Leverage (RRL)** is a metric used to evaluate the effectiveness of risk mitigation strategies.
- It helps in assessing how much the risk exposure has been reduced compared to the cost of implementing the risk reduction measures.
- Risk Reduction Leverage (RRL)= (RE_{before}- RE_{afte}r)/ risk reduction cost
- Where:
  - REbefore = Risk Exposure before implementing the risk reduction measures.
  - REafter = Risk Exposure after implementing the risk reduction measures.
  - Risk Reduction Cost = The cost incurred to implement the risk mitigation strategy. (The total cost spent on implementing risk reduction activities, such as developing backup plans, buying insurance, or investing in preventive technologies.)
- If RRL > 1. it means the risk mitigation strategy is highly effective

Example:

- **REbefore**: Before implementing any mitigation, the risk exposure of a project is $100,000 (based on the likelihood and impact).
- **REafter**: After implementing a risk reduction strategy, the risk exposure drops to $40,000.
- **Risk Reduction Cost**: The cost of the mitigation strategy is $10,000.

Using the RRL formula:

- $$\text{RRL} = \frac{100,000 - 40,000}{10,000} = \frac{60,000}{10,000} = 6$$ project reduces its risk exposure by $6. An RRL of 6 indicates a very effective risk reduction strategy.

Risk Avoidance and Mitigation/Risk planning

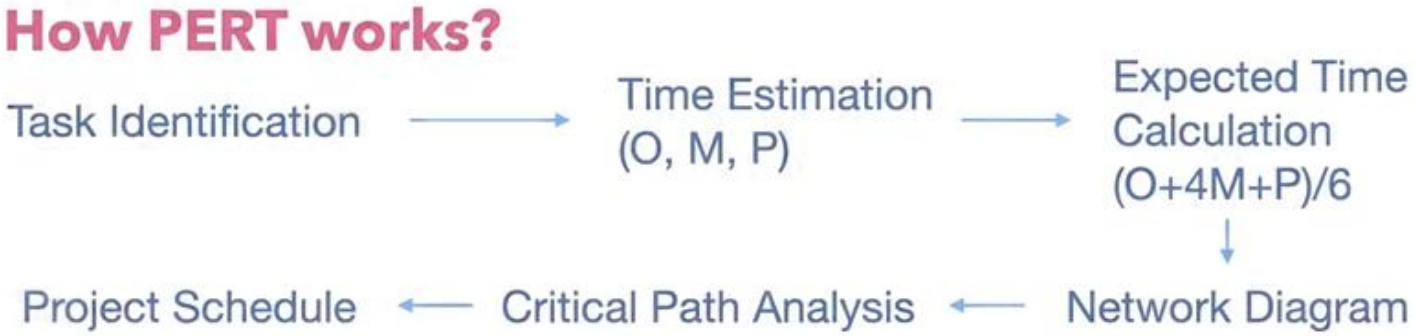
- **Objective**: To develop strategies to handle or mitigate identified risks.
- **What Happens**: Once risks are prioritized, the next step is to plan how to respond to them.
- Responses may include:
  - **Avoiding**: Changing the plan to eliminate the risk.
  - **Mitigating**: Reducing the likelihood or impact of the risk.
  - **Transferring**: Shifting the risk to another party (e.g., through insurance).
  - **Accepting**: Acknowledging the risk and preparing to deal with it if it happens.
- **Example**: Developing a backup plan for critical suppliers in case of supply chain delays.
- Ex. Rain or storms could lead to lower attendance or cancellation of the event.

Risk Monitoring and Control

- **Objective**: To track identified risks, monitor new risks, and ensure that mitigation plans are working effectively.
- **What Happens**:
- This is an ongoing process where risks are continuously monitored, and responses are updated as needed. New risks may emerge, and old ones may change in severity or likelihood.
- **Example**: Regularly reviewing the risk register and monitoring key indicators to ensure that potential supply chain disruptions are being mitigated.

Project Evaluation and Review Technique (PERT)

- PERT is a procedure through which activities of a project are represented in its appropriate sequence and timing. It is a scheduling technique used to schedule, organize and integrate tasks within a project.
- PERT is basically a mechanism for management planning and control which provides blueprint for a particular project.



PERT Method Implementation Steps

Track the following steps while creating a PERT Chart;

1. List the activities and milestones

The first step is to determine the tasks required to complete the project.

2. Determine the sequence of activities

The second step is to determine the order of the activities. Which activity is the predecessor which one is the successor? It is easy to determine the sequence of some activities however the sequence of some tasks may require deep analysis.

3. Build a network diagram

The third step is to create the network diagram with the help of software or by hand and place the activities on the diagram.

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4. Estimate the activity durations

The PERT Method uses three duration estimates for activities which are;

- Optimistic Estimate
- Pessimistic Estimate
- Most Likely Estimate

With the help of three estimates, expected duration is calculated.

5. Determine the critical path

The critical path is the longest path of the network diagram. Forward and backward pass calculations is used to determine the critical path

Example of PERT in Action:

Design Approval (Activity A):

- Optimistic Time (O): 5 days
- Most Likely Time (M): 8 days
- Pessimistic Time (P): 12 days
- Expected Time (TE) = (5+4(8)+12)/6= 8.5days

Foundation Laying (Activity B):

- Optimistic Time (O): 7 days
- Most Likely Time (M): 10 days
- Pessimistic Time (P): 14 days
- Expected Time (TE) = (7+4(10)+14)/6=10.5days

Framing the Structure (Activity C):

- Optimistic Time (O): 10 days
- Most Likely Time (M): 15 days
- Pessimistic Time (P): 25 days
- Expected Time (TE) = (10+4(15)+25)/6=16.7 days

Now, let’s look at the dependency of these activities:

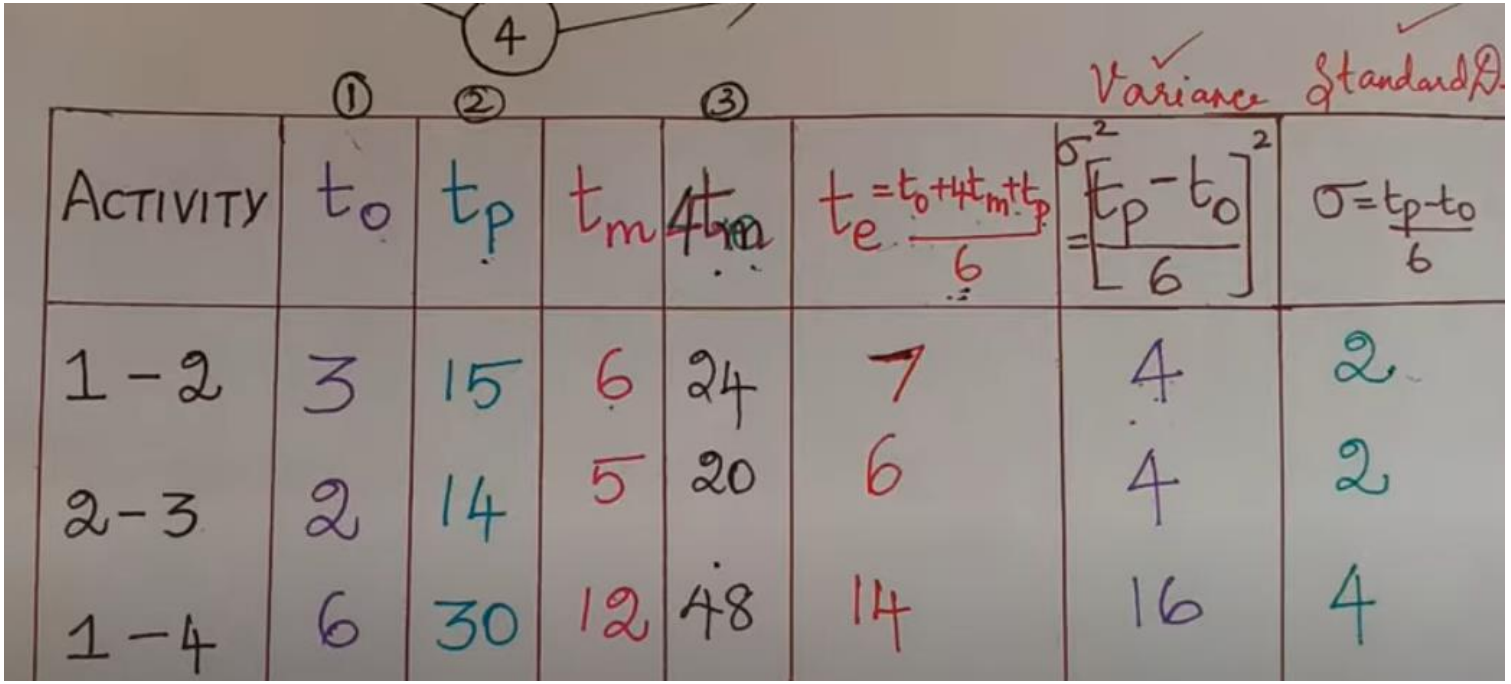
- Activity A (Design Approval) must be completed before Activity B (Foundation Laying) starts.
- Activity B (Foundation Laying) must be completed before Activity C (Framing the Structure) starts.

Based on these dependencies, a **network diagram** can be created showing the flow of activities.

PERT CHART

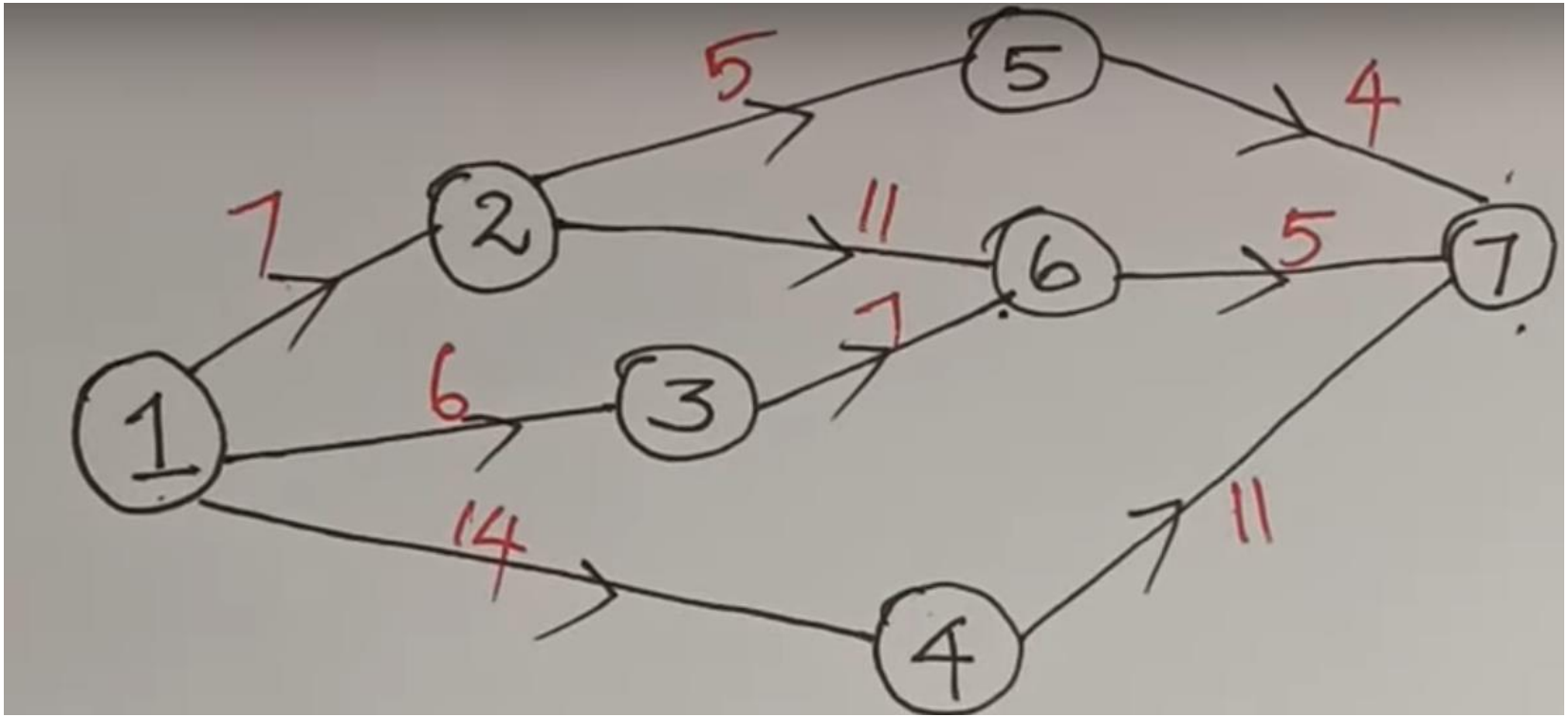
Milestones | Activities | Critical Activities | Critical Path

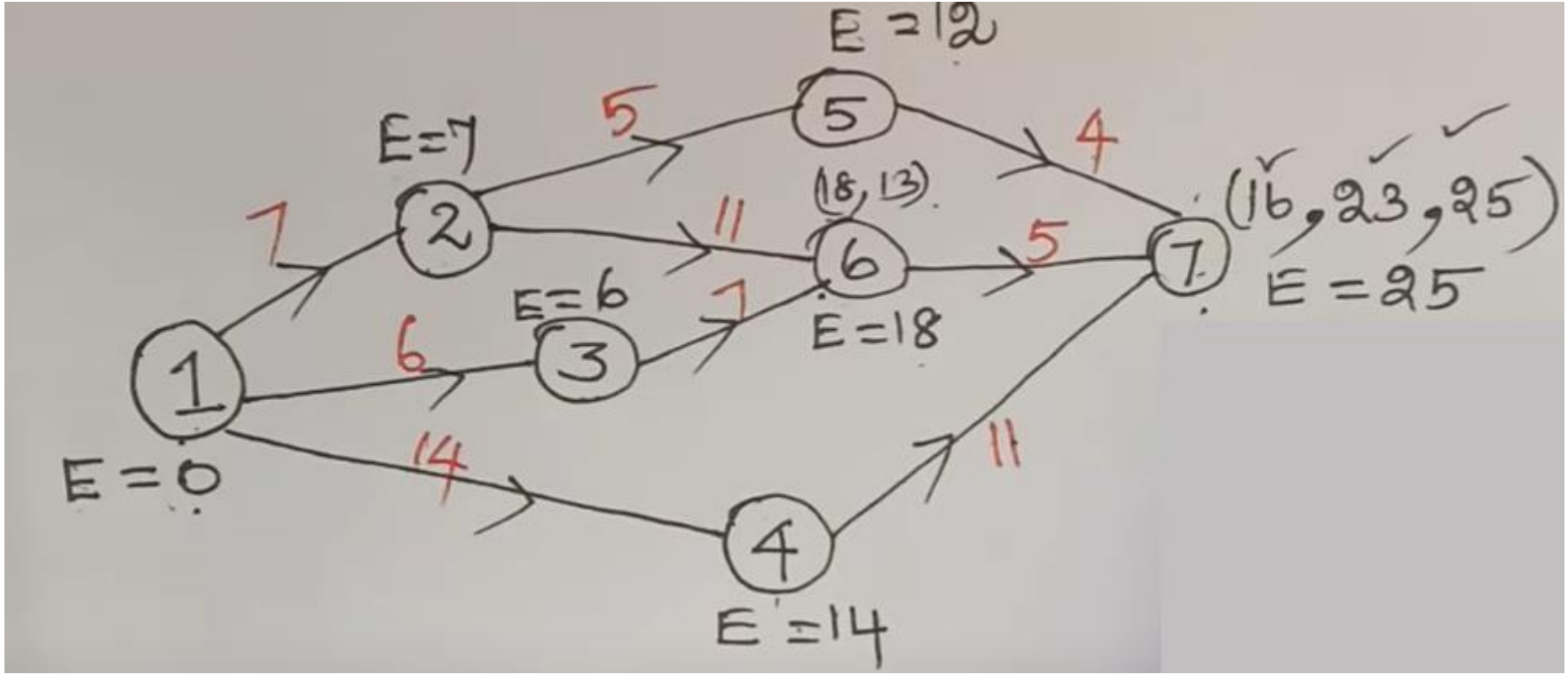
ProjectManager

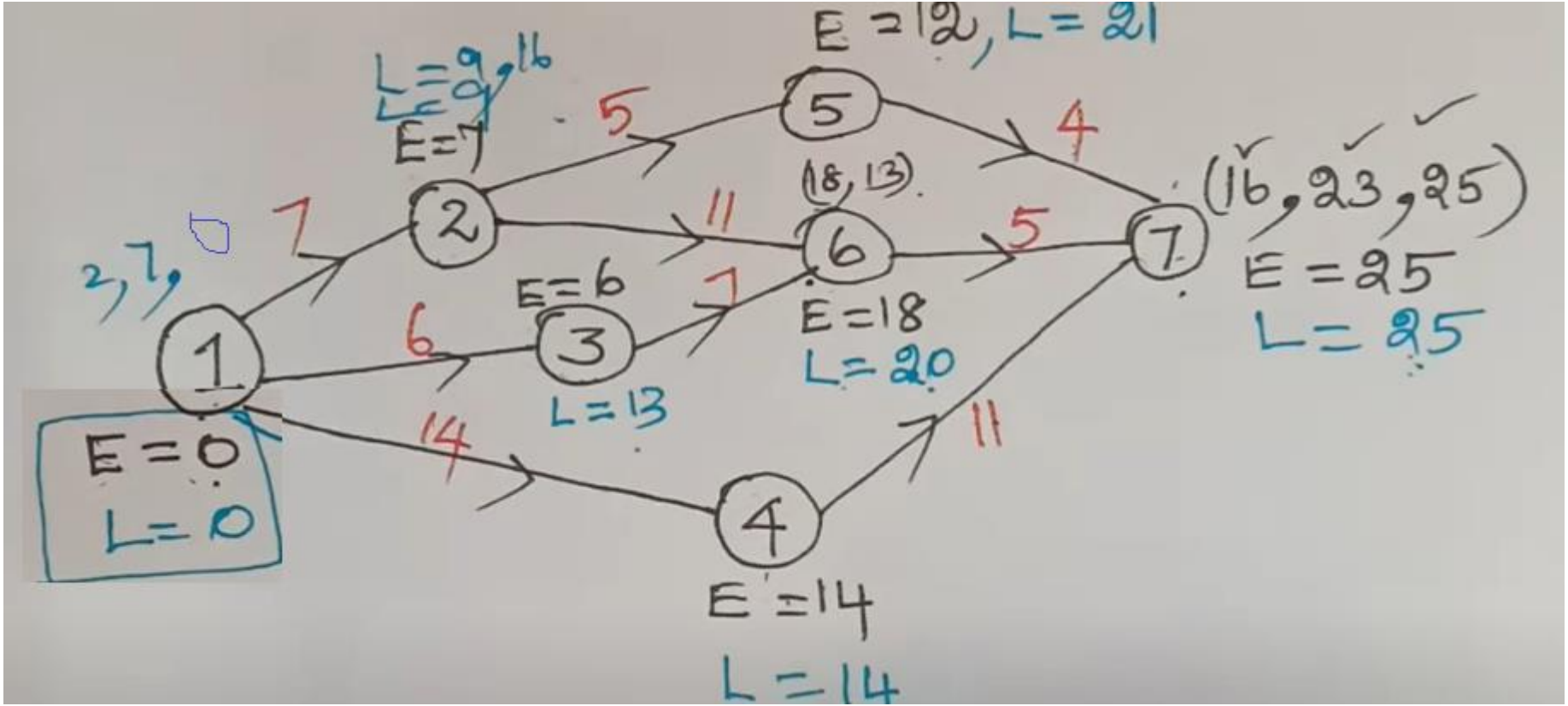


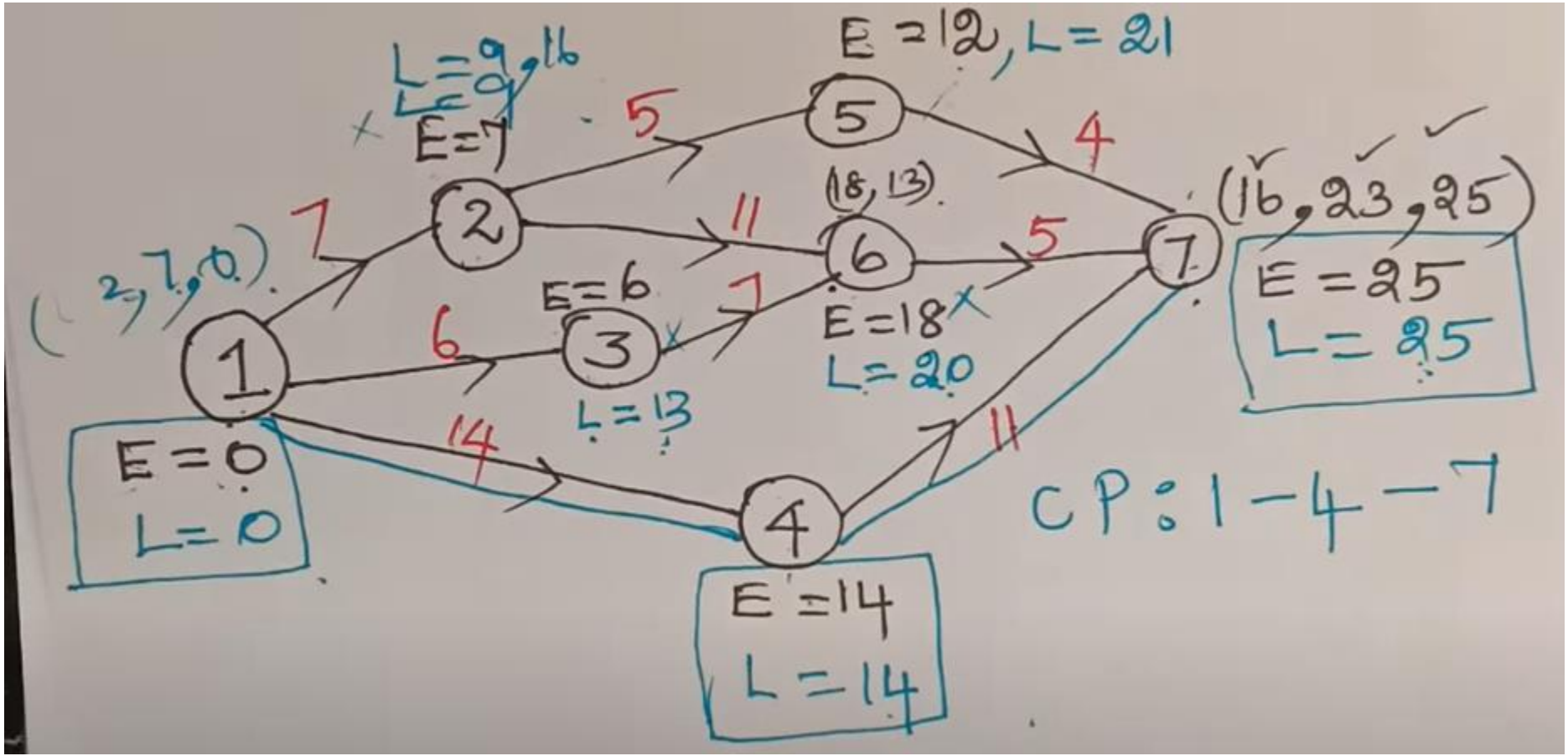
	①	②	③				
Activity	t_o	t_p	t_m	$4t_m$	$t_e = \frac{t_o + 4t_m + t_p}{6}$	$\sigma^2 = \left[\frac{t_p - t_o}{6}\right]^2$	$\sigma = \frac{t_p - t_o}{6}$
1-2	3	15	6	24	7	4	2
2-3	2	14	5	20	6	4	2
1-4	6	30	12	48	14	16	4
2-5	2	8	5	20	5	1	1
2-6	5	17	11	44	11	4	2
					4	4	2

Example :




E=12
5
E=7
5
4
(18,13)
(16,23,25)
7
2
11
6
5
7
E=25
E=6
7
E=18
6
3
1
E=0
14
11
4
E=14


E = 12, L = 21
L = 9, 16
E = 7
5
4
(18, 13)
(16, 23, 25)
2, 7,
7
11
5
E = 6
7
E = 18
E = 25
L = 25
6
3
L = 20
L = 13
14
11
E = 0
L = 0
4
E = 14
L = 14


E = 12, L = 21
L = 9, 16
E = 7
5
4
(18, 13)
(16, 23, 25)
E = 25
L = 25
11
5
7
(2, 7, 0)
E = 6
6
E = 18
L = 20
1
3
L = 13
E = 0
L = 0
14
11
4
E = 14
L = 14
CP: 1 - 4 - 7

Expected Project duration along the Critical Path } = 14 + 11 = 25 days

Expected Variance of the Critical Path } = 16 + 16 = 32.

Expected Standard deviation of the Critical Path } = $\sqrt{32}$.

$= \sqrt{16 \times 2} = 4\sqrt{2}$

Calculate:

- Variance
- Standard deviation
- Expected project duration along the critical path
- Expected variance of the critical path
- Expected standard deviation of critical path

Activity	To	Tm	Tp
1-6	1	7	13
1-2	2	5	14
2-3	2	14	26
2-4	2	5	8
3-5	7	10	19
4-5	5	5	17
6-7	5	8	29
5-8	3	3	9
7-8	8	17	32