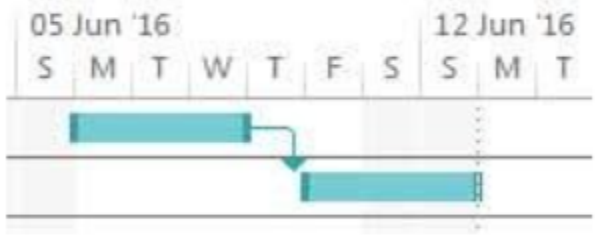
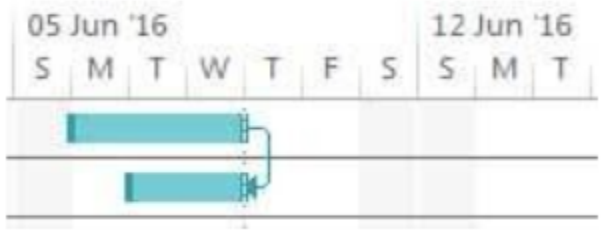
PROJECT MANAGEMENT

Week 5

- **Task dependencies:** The relationships between tasks are displayed as arrows from one task to the next. This makes it clear how the tasks are related to each other, and allows for easy analysis of different scenarios on the project. There are 4 types of task dependencies:
  - Finish-to-Start: Task B cannot start until Task A is complete. This is the most common.

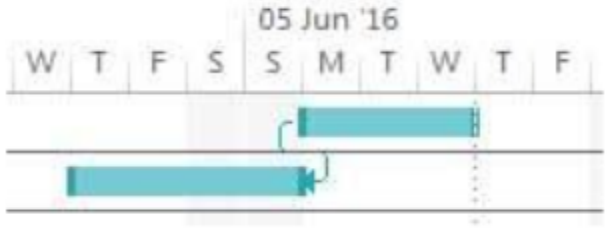


  - Finish-to-Finish: Task B cannot finish until Task A is complete



  - Start-to-Start: Task B cannot start until Task A has begun

  - Start-to-Finish: Task B cannot finish until Task A has begun. This one is rare.



WEEK 6

CRITICAL PATH METHOD(CPM)

Project Management Continued..

Critical Path Method(CPM)

- Critical Path Method is a technique for scheduling project activities.
- The activities in the critical path have effect on the deadline of the project. If an activity of this path is delayed, the project will be delayed.

Critical Path Method

- CPM is a technique where you identify tasks that are necessary for project completion and determine scheduling flexibilities.
- A critical path in project management is the longest sequence of activities that must be finished on time in order for the entire project to be complete
- Any delays in **critical tasks** will delay the rest of the project

Critical Path Method

- Revolves around discovering the most important tasks in the **project timeline, identifying task dependencies,** and **calculating task durations**
- Become popular for **planning projects** and **prioritizing tasks**
- Helps **break down complex projects** into **individual tasks** and gain a better understanding of the project’s flexibility

Critical Path Method - Why?

- **Improves future planning** - used to compare expectations with actual progress. The data used from current projects can inform future project plans
- **Facilitates more effective resource management** - helps project managers prioritize tasks, giving them a better idea of how and where to deploy resources
- **Helps avoid bottlenecks** - Plotting out project dependencies using a network diagram, will give you a better idea of which activities can and can’t run in parallel, allowing to schedule accordingly

Finding the critical path

1. List project tasks and details

2. Identify task dependencies for the project

3. Create a network diagram of tasks

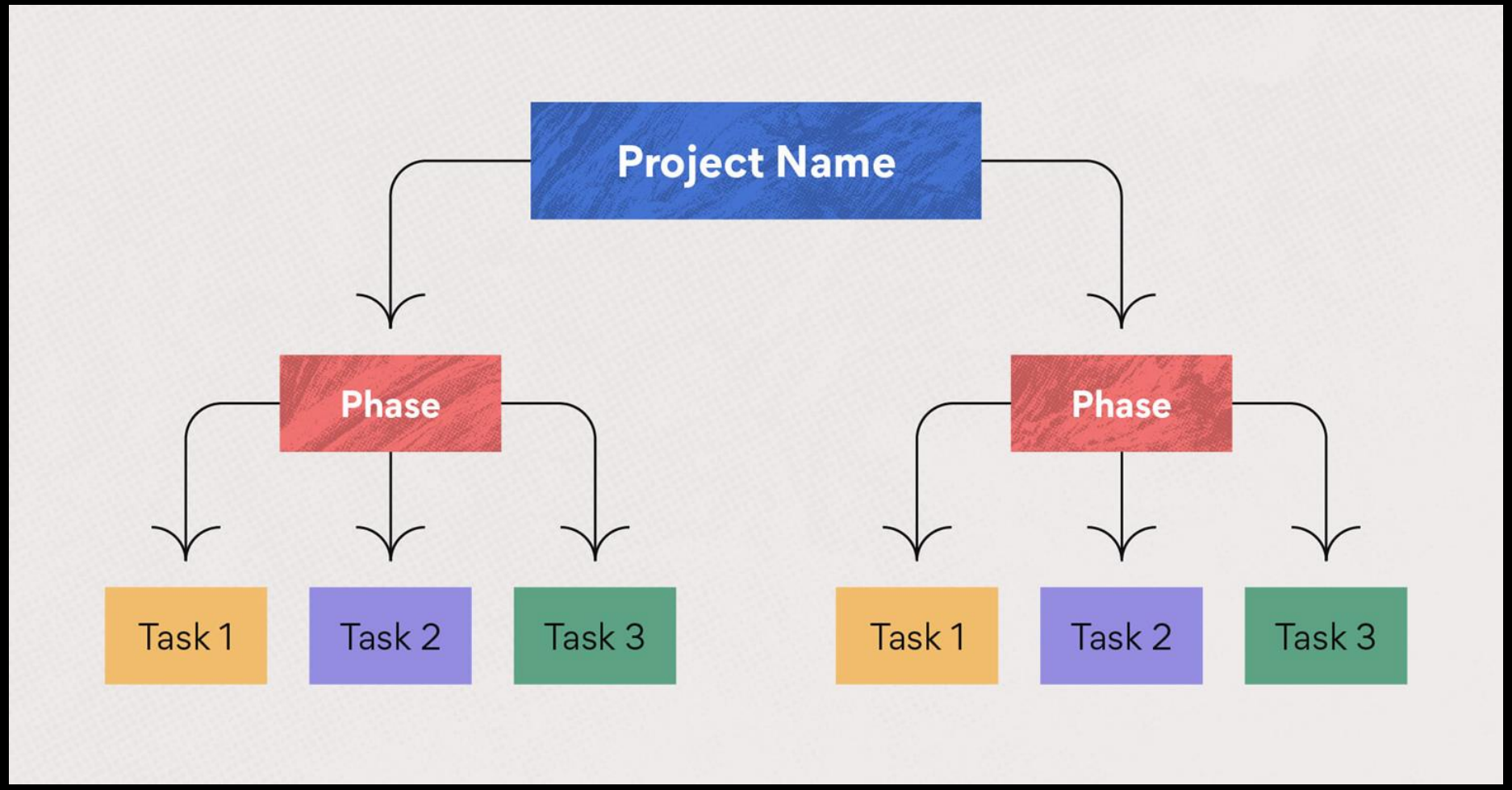
4. Estimate each task duration

5. Find the critical path based on longest sequence

6. Calculate the total float

1. List Activities

- Use a **Work Breakdown Structure** to list all project activities and tasks
- Serves as a **foundation** for CPM


Project Name
Phase
Phase
Task 1
Task 2
Task 3
Task 1
Task 2
Task 3

Marketing team is producing a new interactive blog post

Task ID	Task	Duration (days)
A	Create outline	1
B	Write draft	5
C	Edit and create final draft	2
D	Design post visuals	4
E	Add animations to visuals	2
F	Upload post	1

2. Identify Dependencies

- **Determine the tasks** that are dependent on one another
- Help **identify any work** that can be **done parallel** with other tasks

Identify Dependencies

Task ID	Task	Duration (days)
A	Create outline	1
B	Write draft	5
C	Edit and create final draft	2
D	Design post visuals	4
E	Add animations to visuals	2
F	Upload post	1

- Task B is dependent on A
- Task C is dependent on B
- Tasks C and D can run in parallel
- Task E is dependent on D
- Task F is dependent on C, D, and E

3. Create a Network Diagram

- A **flowchart** displaying the chronology of activities
- Create a box for **each task** and **use arrows** to depict task dependencies
- Add other time-bound components to the **network diagram** until a general project schedule is figured out

4. Estimate Task Duration

- To calculate the critical path - need to estimate the duration of each activity

- Estimate the duration by
    - *Making educated guesses based on experience and knowledge*
    - *Estimating based on previous project data*
    - *Estimating based on industry standards*

Estimate Task Duration

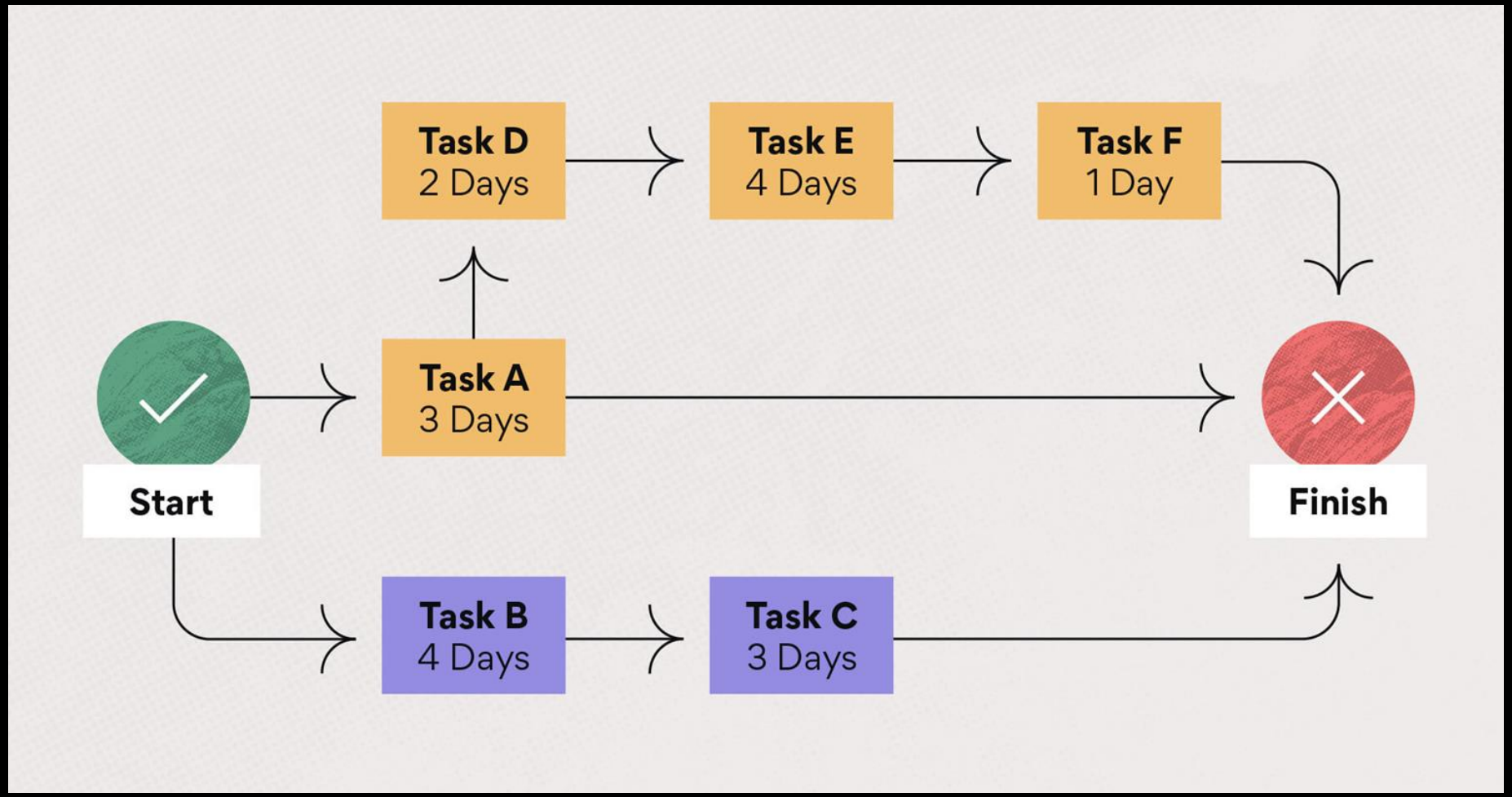
- Estimate the duration by
  - ***Forward pass***
    - This is used to calculate early start (ES) and early finish (EF) dates by using a previously specified start date
    - ES is the highest EF value from immediate predecessors
    - EF is ES + duration
    - The calculation starts with 0 at the ES of the first activity and proceeds through the schedule
    - Determining ES and EF dates allows for early allocation of resources to the project

Estimate Task Duration

- Estimate the duration by
  - ***Backward pass***
    - Used to calculate late start (LS) and late finish (LF) dates
    - LS is LF - duration
    - LF is the lowest LS value from immediate successors
    - The calculation starts with the last scheduled activity and proceeds backward through the entire schedule

5. Calculate the Critical Path

- Write down the start and end time next to each activity
  - *The first activity has a start time of 0, and the end time is the duration of the activity*
  - *The next activity's start time is the end time of the previous activity, and the end time is the start time plus the duration*
  - *Do this for all the activities*
- Look at the end time of the last activity in the sequence to determine the duration of the entire sequence
- The sequence of activities with the longest duration is the critical path


Task D
2 Days
Task E
4 Days
Task F
1 Day
Task A
3 Days
Start
Finish
Task B
4 Days
Task C
3 Days

6. Calculate the Float

- Float, or slack, refers to the amount of flexibility of a given task
- Indicates how much the task can be delayed without impacting subsequent tasks or the project end date
- How much flexibility the project has
- Float is a resource that should be used to cover project risks or unexpected issues that come up

Calculate the Float

- Critical tasks have zero float, which means their dates are set
- Tasks with positive float numbers belong in the non-critical path, meaning they may be delayed without affecting the project completion date. If you’re short on time or resources, non-critical tasks may be skipped.
- Calculating the float can be done with an algorithm or manually

Calculate the Critical Path

- Write down the start and end time next to each activity
  - *The first activity has a start time of 0, and the end time is the duration of the activity*
  - *The next activity's start time is the end time of the previous activity, and the end time is the start time plus the duration*
  - *Do this for all the activities*
- Look at the end time of the last activity in the sequence to determine the duration of the entire sequence
- The sequence of activities with the longest duration is the critical path

Critical Path Method - Advantages

- This gives the project management the correct completion date of the overall project and the flexibility to float activities
- It encourages managers to plan ahead, properly allocate resources, and continuously monitor the timeline and schedule. This creates efficiency, improves productivity, reduces uncertainty and improves the likelihood that deadlines will be met
- Helpful for scheduling, monitoring, and controlling projects

Critical Path Method - Advantages

- Offers a visual representation of the project activities
- Presents the time to complete the tasks and the overall project
- Tracking of critical activities
- Helps to make informed decision
- Expected activity completion time is known

Critical Path Method - Advantages

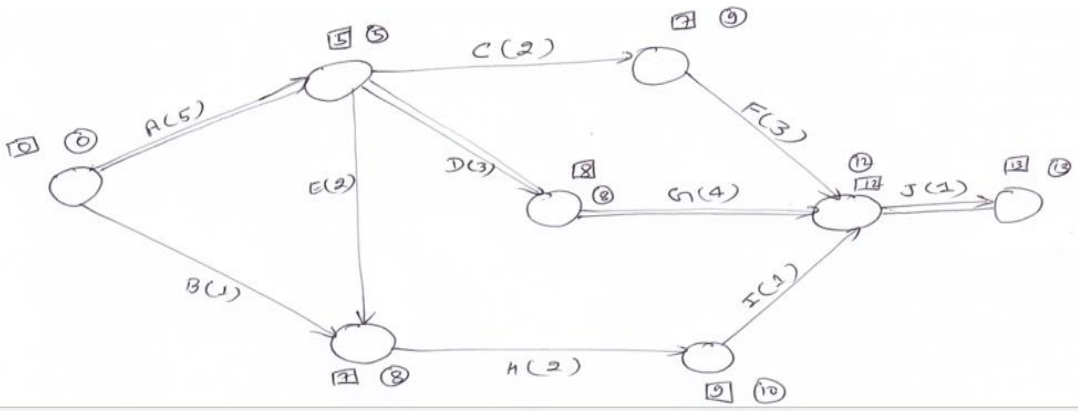
- Does not handle the scheduling of personnel or the allocation of resources
- CPM is not suitable for large and complex projects comprising of thousands of activities and relationship as it is almost impossible to draw network diagram for such case

Example 1:

Draw CPM Network Diagram, Identify Critical Path and Critical Activity for the following:

Activity	*Predecessor*	*Duration*
A	(None)	5 months
B	(None)	1
C	A	2
D	A	3
E	A	2
F	C	3
G	D	4
H	B, E	2
I	H	1
J	F, G, I	1

CPM Network Diagram for above activity is as shown below:



Calculation of ES, EF, LF, LS and slack time for above activities is shown below:

Activity	*Duration*	*ES*	*EF*	*LF*	*LS*	*Slack Time*
A	5 months	0	5	5	0	0
B	1	0	1	8	7	7
C	2	5	7	9	5	2
D	3	5	8	8	5	0
E	2	5	7	8	6	1
F	3	7	10	12	9	2
G	4	8	12	12	8	0
H	2	7	9	10	8	1
I	1	9	10	12	11	2
J	1	12	13	13	12	0

In above figure critical activity are a, D, G, J and critical Path = A-D-G-J

Note: i) ES represented by rectangle is calculated for each activity during forward pass and LF represented by circle is calculated for each activity during backward pass. During forward pass, if a node has more than one predecessor, higher value is taken consideration whereas in backward pass, if a node has more than one successor, lower value is taken under consideration.
ii) EF = ES +d
iii) LS = LF –d
iv) Slack Time = LF –EF or LS – ES.
v) Activity with slack time =0 are critical activity.

Forward Pass and Backward Pass

•During the forward pass, we calculate Early Start Time (ES) for first node and carry on calculating EF. Once we have ES, EF can be calculated as: (EF) =ES + activity duration. Moreover, if a particular node has more than one predecessor, **then maximum value is taken.**

•During backward pass, we calculate LF(last node) and carry on calculating LS towards the starting node. Once we have LF, LS can be calculated as: (LS) =LF - activity duration. Moreover, if a particular node has more than one successor, **then minimum value is taken.**

CPM keywords

- **Late Start (LS) :** Late possible time at which an activity might begin without delaying its successor activity
- **Late Finish (LF) :** Late possible time at which an activity can be completed without delaying the project duration

- **Early Start (ES):** Earliest possible time at which an activity can start
- **Early Finish (EF) :** Earliest possible time at which an activity can be completed without delaying a successor activity

Relation

- **Earliest finish time (EF) =ES + activity duration(d).**
- **Latest start time (LS) = LF - activity duration(d).**

Note: If activities outside the critical path speed up or slow down (within limits), the total project time does not change. The amount of time that a non-critical path activity can be delayed without delaying the project is referred to as *slack time*.

Question 1

Activity	Predecessor	Duration
A	(None)	5 months
B	(None)	3
C	(None)	4
D	A	2
E	C	4
F	A	5
G	B,D,E	6

Question 2

Activity	Predecessor	Duration
A	(None)	5 months
B	A	4
C	A	5
D	B	6
E	C	3
F	D,E	4

Question 3

Activity	Predecessor	Duration
A	(None)	5 months
B	(None)	2
C	A	4
D	B	6
E	A	3
F	C,D	3
G	E	5

Project Evaluation and Review Technique

- Used to schedule, organize, and map out tasks within a project
- Visual representation of a project’s timeline and breaks down individual tasks

Project Evaluation and Review Technique

- Works by visually representing a project's task and dependencies connected to each one

- Creates a roadmap - accomplishing several project planning activities
    - *Getting schedule and timeline signoff from leadership*
    - *Communicating project objectives to stakeholders*
    - *Visually mapping out a complex project*
    - *Estimating the time needed to complete individual tasks*

The 5 steps of creating a PERT chart

Step 1 - Identify project tasks

Step 2 - Define task dependencies

Step 3 - Connect project tasks

Step 4 - Estimate project timeframe

Step 5 - Manage task progress

Identify Project Tasks

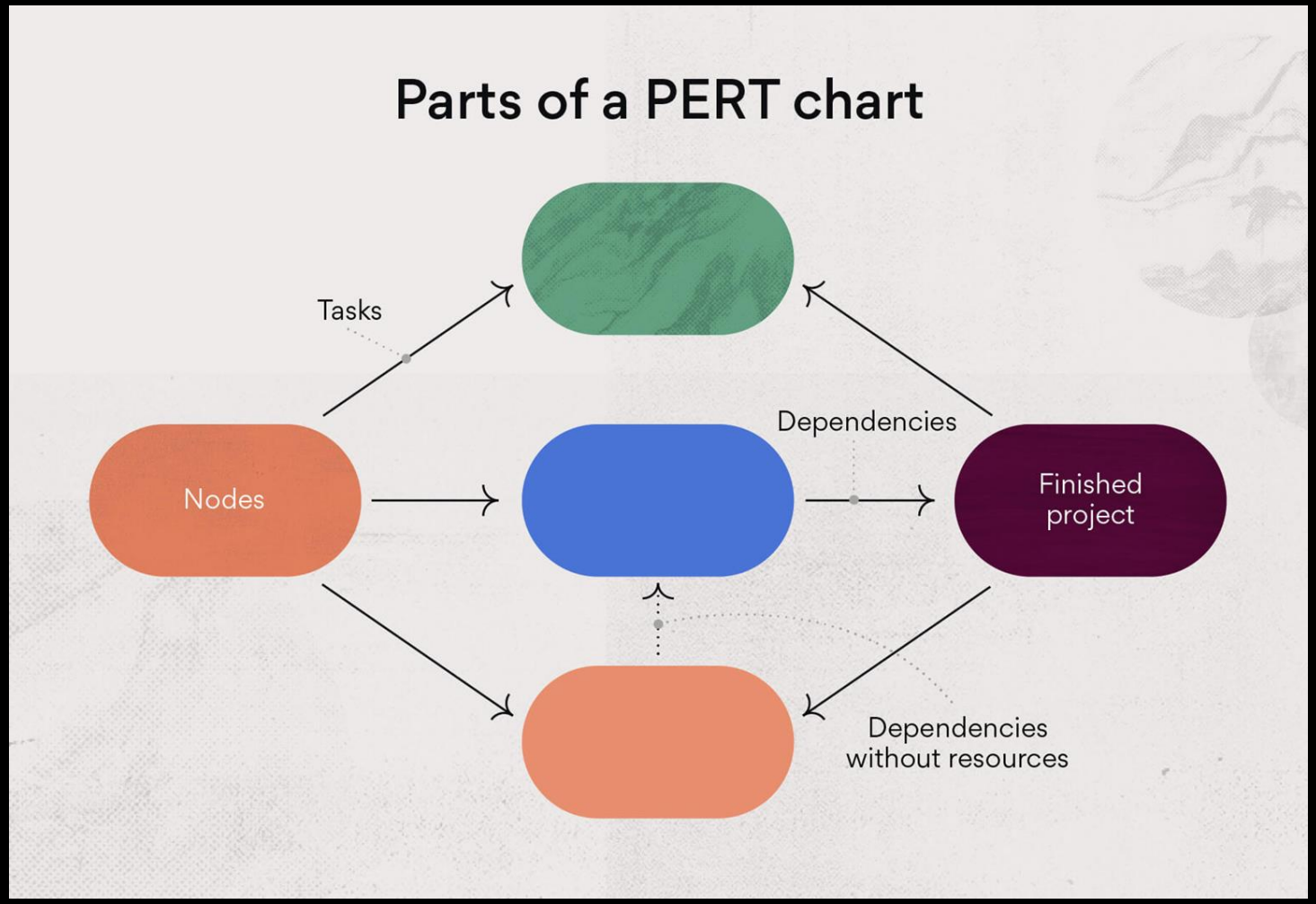
- Identifying and collecting necessary project information and tasks
- Can be done by:
  - *A business case*
  - *A communication plan*
  - *An initial kick off meeting*
- Early planning - prepared to defined dependencies and connect tasks during the next phases

Define Task Dependencies

- A task dependency is a task or milestone that relies on another task to be completed before the task at hand can be started.
- Creating dependencies can help you properly track work, ensure tasks are completed, and establish clear communication
- In a PERT diagram, dependencies are visualized by connecting and numbering tasks
- It helps to show a high-level visualization of tasks and the work needed to complete them.

Connect Project Tasks

- Connecting project tasks to one another
- These connections consist of arrows, which represent tasks, and nodes, which represent events or milestones


Parts of a PERT chart
Tasks
Nodes
Dependencies
Finished project
Dependencies without resources

Estimate Project Time Frame

- Estimate your overall project time frame using the critical path method (CPM) and the PERT formula
- The critical path is the longest sequence of tasks that must be completed to successfully finish a project

Estimate Project Time Frame

- The objective is to find the longest path that will take the most time to complete in order to estimate the shortest overall project duration

- Time estimates can be calculated based on the following:
  - ***Optimistic time:*** *The minimum amount of time needed to accomplish a task*
  - ***Pessimistic time:*** *The maximum amount of time needed to accomplish a task*
  - ***Most likely time:*** *The best estimate of how long it will likely take to accomplish a task*

Estimate Project Time Frame

- PERT Formula

$$O + (4 \times M) + P) \div 6$$

Estimate Project Time Frame

- For example, if the optimistic time is 30 minutes, the pessimistic time is 60 minutes, and the most likely time is 45 minutes

- PERT formula would be

  = (30 min + (4 × 45 min) + 60 min) ÷ 6

  = 45 minutes

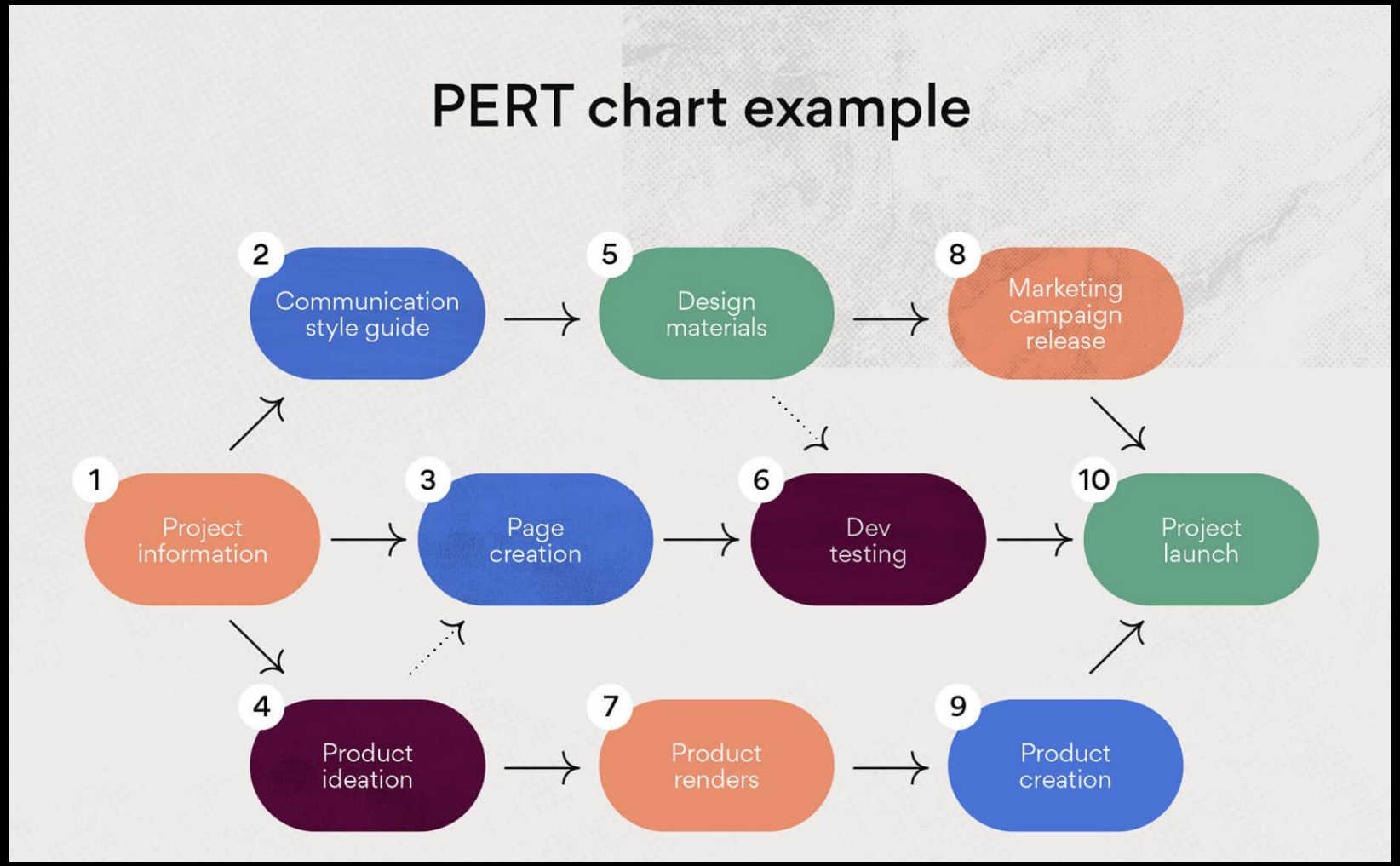
Managing Task Progress

- Done by closing dependencies and mitigating issues along the way until all tasks are completed
- Remember that a PERT diagram should be updated throughout the project as changes occur. This could be paired with a change control process, which helps map and communicate project changes.
- Once all tasks within the project have been completed, you can archive materials in a shared space to be referred to later on if needed

PERT Chart Creation

- **Drawing your numbered nodes:** Remember, these are the parent tasks of your project which, when completed, will make up the project at hand. Your diagram may have any number of tasks, but 10 is a good number to start with.

- **Connect your nodes to tasks:** Draw arrows to represent task dependencies. These tasks are what need to be done for the events to be completed. Your diagram should have a clear beginning and end, though the middle may look more complex


PERT chart example
1
Project information
2
Communication style guide
3
Page creation
4
Product ideation
5
Design materials
6
Dev testing
7
Product renders
8
Marketing campaign release
9
Product creation
10
Project launch

PERT Chart - Components

- **Nodes:** Nodes represent project events. These events are the large components that make up your project. For example, when launching a website design, a node might represent a new logo design

- **Tasks:** Your tasks are what need to be completed in order for your nodes to be implemented. For example, a task might represent designing three logo mockups

PERT Chart - Components

- **Dependencies**: A dependency is when a task is connected to another task. These tasks rely on one another and one cannot be completed without the other

- **Dependencies without resources**: A dependency without resources is one that, while connected to another, doesn’t have tangible tasks that need to be completed. For example, while a product launch and landing page might be correlated, no one task is connected to each