Unit 3

1 Objectives of Activity Planning

- Planning are nothing but planning is everything.
- Planning is a continuous process of refinement done during development.
- A detailed plan has to include the schedule of the project comprising of the start and the completion time of every activity defined.
- The actual achievement can be measured using the detailed plan.
- Planning process ensures that necessary resources needed at different stages are precisely available at requirement.
- Planning also produce a cash flow forecasting that indicates when the expenditure and he income takes place in the process.
- First of all, a plan must contain the start and completions of every activity that produces deliverables must be clearly visible in ensuring that the products of each activity are delivered on time.
- Every stage of the development plan must strive to achieve the objectives as the project moves from one to another.
- A plan must be defined with a set of targets that are achieved which can be measured. At the same instance, when target dates are not achievable the plan must be effectively modified to focus on the target.

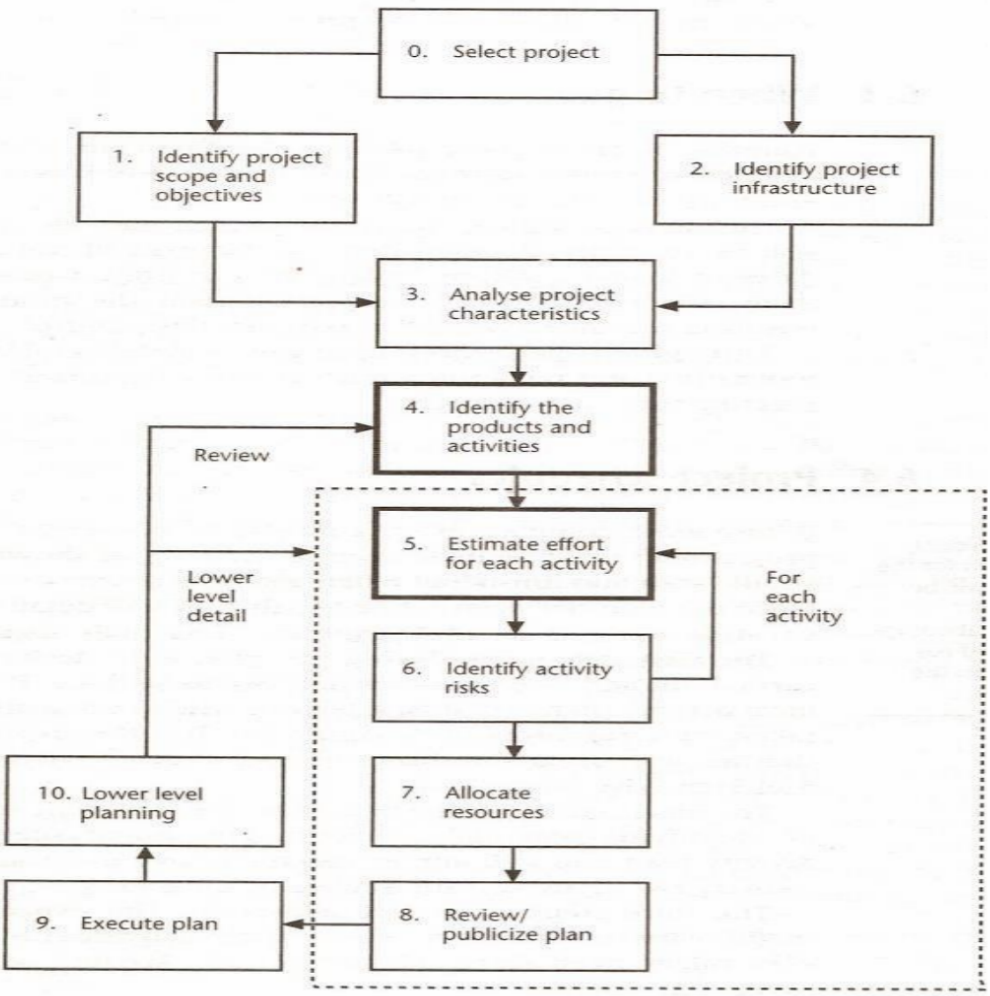
Elements of Detailed Planned Activity- Along with factors described with activity planning, the following elements play a very important role in achieving the target. The elements of a detailed planned activity are:

- Feasibility assessment—A feasibility assessment is a very early stage that describes whether it is feasible for the project to exist within the specified time constraint. A detailed plan will help in forecasting the project as it progresses from one stage to another. The feasibility factor also lies in the availability of resources, including specialized staff to carry out the activities.
- Allocation of resources—The best way to allocate resources to the project depends on availability. The project plan must analyze the available resources and the timescales for each activity. Using resources more than the stipulated timescale will slack the project's progress.
- Estimation of costs -The project plan must provide solutions to the following questions: What is the total expenditure? How much will the project costs? What are the various estimating factors involved in the development process. These can be answered only when a detailed estimation of costs and timing is defined.
- Project coordination- Interaction and communication play a vital role in handling complex projects. Effective team management must be established to carry out the activities in a well-coordinated manner. In particular, the availability of staff for a set of integrated project schedules must be carefully allocated with no period of idleness.
- Personal encouragement -Staff involved in the development process must be motivated in an effective way so that they achieve the target without any delay. The targets provided to the staff are monitored, and personal encouragement must be given to individual staff if they achieve the target on time. Activity planning helps in completing the project in minimum time with a nominal cost with the help of project schedules.
- To shorten the time limit, activities can be carried out in parallel based on the conditions defined for obtaining resources. Project scheduling activities includes the extension of timescale provided with constraints that can be relaxed to have effective usage.

2 Project Schedules

A stage of a larger project, the project plan must be developed to the level of showing dates when each activity should start and finish and when and how much of each resource will be required. Once the plan has been refined to this level of detail we call it a project schedule. Creating a project schedule comprises four main stages.

- First step- in producing the plan is to decide what activities need to be carried out and in what order they are to be done, From this we can construct an ideal activity plan — that is, a plan of when each activity would ideally be undertaken were resources not a constraint • This activity plan is generated by Steps 4 and 5 of Step Wise
- Second step -The ideal activity plan will then be the subject of an activity risk analysis, aimed at identifying potential problems. This might suggest alterations to the ideal activity plan and will almost certainly have implications for resource allocation.
- Third step- This is resource allocation. The expected availability of resources might place constraints on when certain activities can be carried out
- Final step- The final step is schedule production. Once resources have been allocated to each activity, we will be in a position to draw up and publish a project schedule, which indicates planned start and completion dates and resource requirements statement for each activity



Activity planning is carried out in step 4 and step 5

Furthermore, project schedule outlines the tasks, resources, and deadlines for a project, ensuring it's completed on time, and can be visualized using tools like Gantt charts.
Purpose: A project schedule helps project managers and teams plan, organize, and track progress, ensuring that all tasks are completed within the allocated timeframe.
Key Elements:

- Tasks: A list of all activities required to complete the project.
- Dependencies: Identifying which tasks rely on others to be completed first.
- Start and End Dates: Defining when each task should begin and end.
- Milestones: Key checkpoints or deliverables within the project.
- Resources: Identifying the personnel, equipment, and materials needed for each task.
- Tools for Visualization:
- Gantt Chart: A visual representation of the project schedule, showing tasks, durations, and dependencies on a timeline.
- Software: Project management software like Microsoft Project or Asana can help create and manage project schedules.

Benefits of a Project Schedule:

- Improved Planning: A clear schedule helps ensure that all tasks are accounted for and that the project has a realistic timeline.
- Better Resource Allocation: By identifying the resources needed for each task, project managers can ensure that they are available when needed.
- Enhanced Communication: A project schedule provides a clear overview of the project to all stakeholders, ensuring that everyone is on the same page.
- Progress Tracking: A schedule allows project managers to track progress and identify potential delays or issues early on.

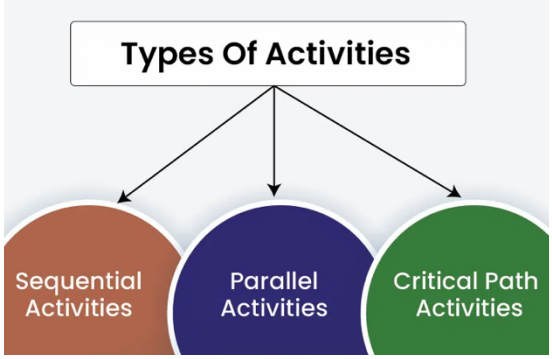
Types of Project Schedules:

- Master Project Schedule: A high-level overview of the project, including key deliverables and milestones.
- Milestone Schedule: A schedule that focuses on the major milestones of the project.
- Detailed Project Schedule: A schedule that provides a detailed breakdown of all tasks and activities.

3 Activities

In project management, an "**activity**" is simply a specific task or job that needs to be done for a project. These activities are important because they help break down the project into smaller, manageable parts, making it easier to plan and organize. Each activity has its own start and end dates, and it needs certain resources and people to get done. By identifying and defining activities, project managers can create a clear plan for the project, assign resources effectively, and keep track of progress. Activities are the building blocks of the project schedule, ensuring that everything gets done on time and within budget.

Types of Activities



- Sequential Activities: These are tasks that must be completed in a specific order. For example, designing a product must precede manufacturing it.
- Parallel Activities: These are tasks that can be executed simultaneously without dependencies. For instance, while the design team works on product design, the marketing team can start creating promotional materials.
- Critical Path Activities: These are activities that, if delayed, would directly impact the project's overall timeline. The critical path is the longest sequence of dependent activities that determine the shortest possible duration for completing the project.

Characteristics of Activities

- Unique and Measurable: Each activity should be distinct and clearly defined, with measurable outcomes or milestones.
- Time-Bound: Activities have specific start and end dates or durations, contributing to the overall project timeline.
- Resource Consumption: Activities consume various resources such as human resources, materials, equipment, and budget allocation.
- Dependency: Activities may have dependencies on other activities, meaning that the completion of one activity is necessary before another can start.

Why are Project Activities Important?

- Simplifying Complex Projects: Projects can be overwhelming because they involve lots of different tasks. Activities break down these big projects into smaller, easier-to-handle pieces.
- Better Planning and Scheduling: Activities are like building blocks for planning a project. They help figure out when each part of the project should happen, who's needed, and what resources are required.
- Using Resources Wisely: Each activity needs certain things to get done, like people, tools, or materials. By knowing what each activity needs, project managers can make sure resources are used in the best possible way.
- Keeping Track of Progress: Activities are like checkpoints along the way. By seeing which activities are finished and which aren't, project managers can tell if the project is going as planned or if there are any problems.
- Dealing with Problems Early: Because activities help track progress, project managers can spot any issues early on. This means they can fix things before they become big problems that could delay the whole project.
- Talking to Everyone Involved: Activities give everyone involved in the project a common language to talk about what's happening. It's easier to tell stakeholders what's been done, what's happening now, and what's still left to do by referring to specific activities.

Example 1: Designing a Website

- Activity Description: This involves creating wireframes, mockups, and design layouts for the website based on client requirements and industry standards.

- Resources Required: Graphic designers, UX/UI designers, and design software/tools.
- Timeframe: Typically, this activity can take several days to weeks, depending on the complexity of the website and the revisions required.

4 Sequencing and scheduling

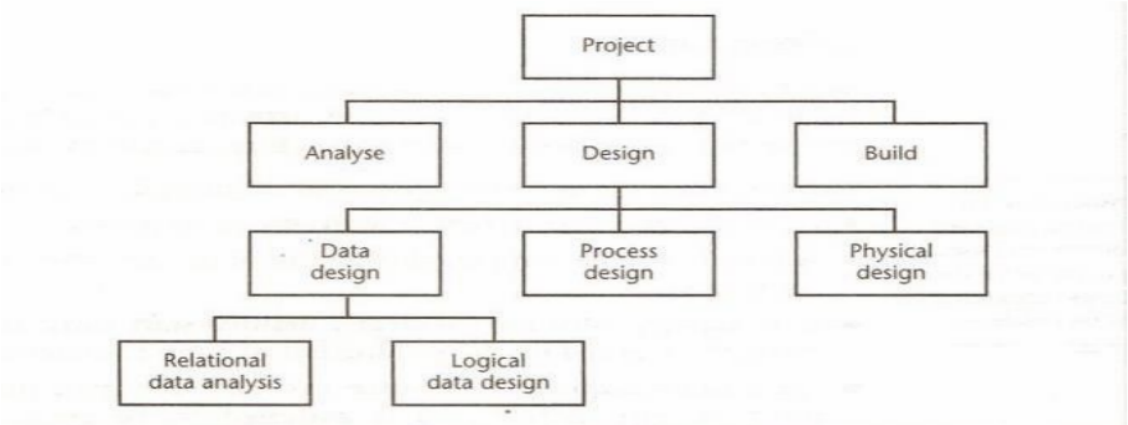
Sequencing is the order of tasks to be done in the chain. Hence, the next task is started once the previous one is completed. **Scheduling**, on the other hand, is the process in which people are assigned time to accomplish different tasks. They improve delivery performance and reduce manufacturing time and cost. The project and its activities must be clearly defined to achieve the target. An activity sequencing or scheduling plan will contain the following factors:

- A project is basically, composed of a number of interrelated activities.
- The initiation of a project happens only if at least one activity is ready to start.
- An activity is clearly defined with its start and end point that produce good deliverables.
- Activity requiring resources must be analyzed well in advance and made available during the execution.
- Some activities would depend on other activities for them to complete.
- A project can attain its completion only when all activities have been completed.

Approaches to Identify Activities for sequencing or scheduling -The various approaches used in identifying activities are:

- Activity-based approach
- Product-based approach
- Hybrid approach

Activity-based approach - In the activity-based approach, all the activities are listed and created for the project. This is achieved by a brainstorming session where the entire project team analyses the various activities needed at different stages with the help of similar projects. This approach usually generates the list of activities using a work breakdown structure (WBS). WBS helps in identifying the lowest level of effort, i.e. the task required to complete a project, by breaking it down into lower sets of tasks. The task defined at the lower level includes everything that is required to complete the task at the higher level. The work breakdown structure provides in-depth knowledge about the lowest level of activity that has to be completed. WBS is a refined structure that clearly defines the milestones that have to be achieved in accomplishing a specific task. The ordering of a sequence of activities can also be done in this approach by defining those activities that have to be completed for others to start. In a purely activity-based approach, activities are identified and defined in five levels: • Level 1: Project – goals, objectives defined • Level 2: Deliverables – software, manuals, training • Level 3: Components – work items, modules, tests • Level 4: Work-packages – major work items, related tasks • Level 5: Tasks – responsibility of an individual in accomplishing it



Product-based approach- The product-based approach produces a product breakdown structure along with a product flow diagram. The approach accepts the products as inputs, which is transformed into an ordered list of activities. Product Flow Diagram does not leave out any activity from its ordered list and adopts a methodology which clearly specifies what products required and what activities required to produce the product.

Using Structured Systems Analysis and Design Method (SSADM), a generic activity network can be derived for a project-specific product breakdown structure. The development of a PFD indicates the sequence of activities of the activity network.

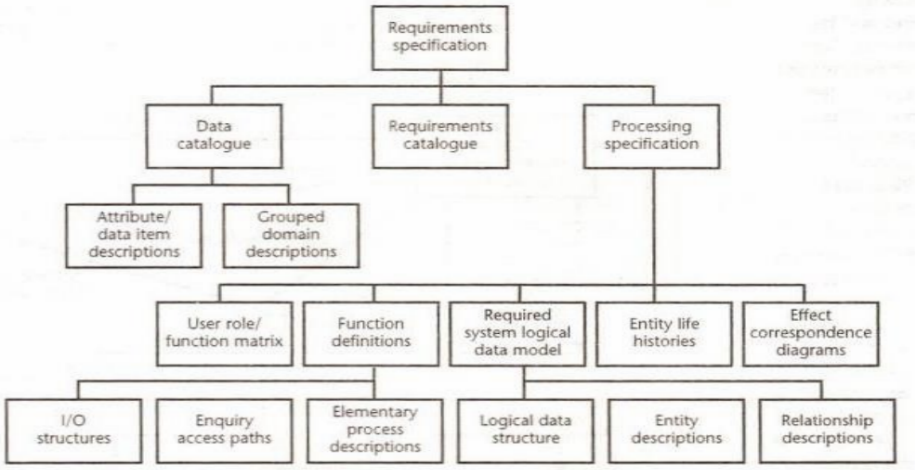
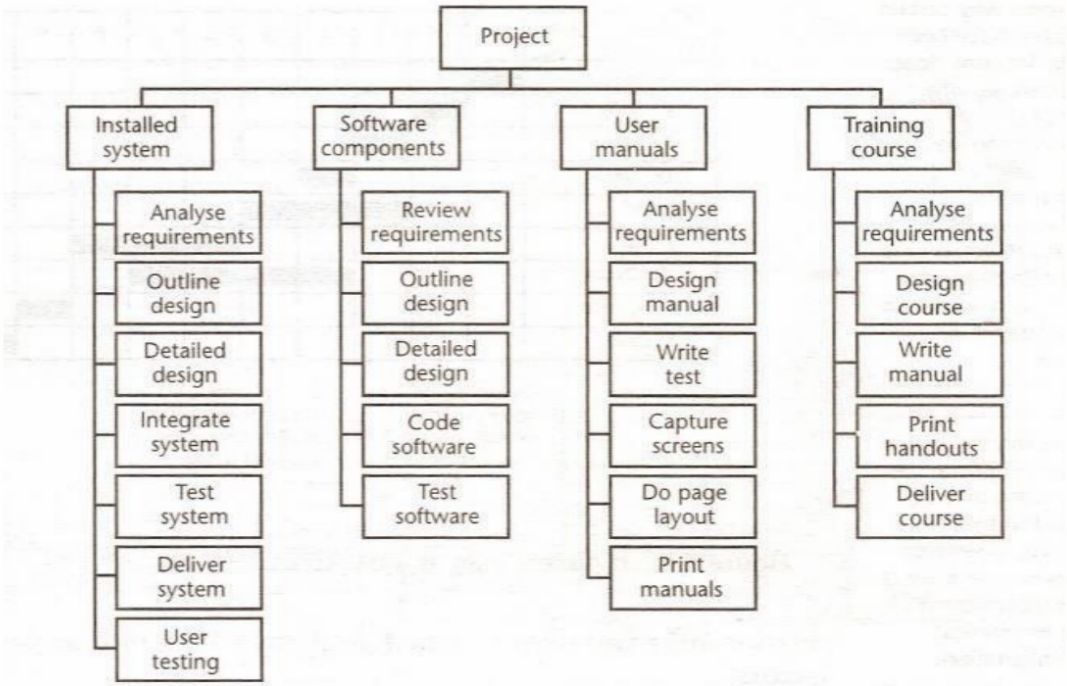


Figure - SSADM Product Breakdown Structure

Hybrid approach - WBS deals with list of final deliverables whereas PBS deals in producing the products using the product flow diagram. Hybrid approach combines both the activity-based and product-based approach to structure both activities and products. Structuring of product-based or activity-based approach depend on the nature of the project type.



5 Network Planning models and Formulating Network Model

Introduction:

- These project scheduling techniques model the project's activities and their relationships as a network. In the network, time flows from left to right.
- The two best known being CPM (Critical Path Method) and PERT (Program Evaluation Review Technique).
- Both of these techniques used an activity-on-arrow approach to visualizing the project as a network where activities are drawn as arrows joining circles, or nodes which represent the possible start and/or completion of an activity or set of activities.
- More recently a variation on these techniques, called precedence network, has become popular. This method uses activity-on-node networks where activities are represented as nodes and the links between nodes represent precedence (or sequencing) requirements.
- This latter approach avoids some of the problems inherent in the activity-on-arrow representation and provides more scope for easily representing certain situations. It is this method that is adopted in the majority of computer applications currently available. These three methods are very similar and it must be admitted that many people use the same name (particularly CPM) indiscriminately to refer to any or all of the methods.
- In the following sections of this chapter, we will look at the critical path method applied to precedence (activity-on-node) networks followed by a brief introduction to activity-on-arrow networks

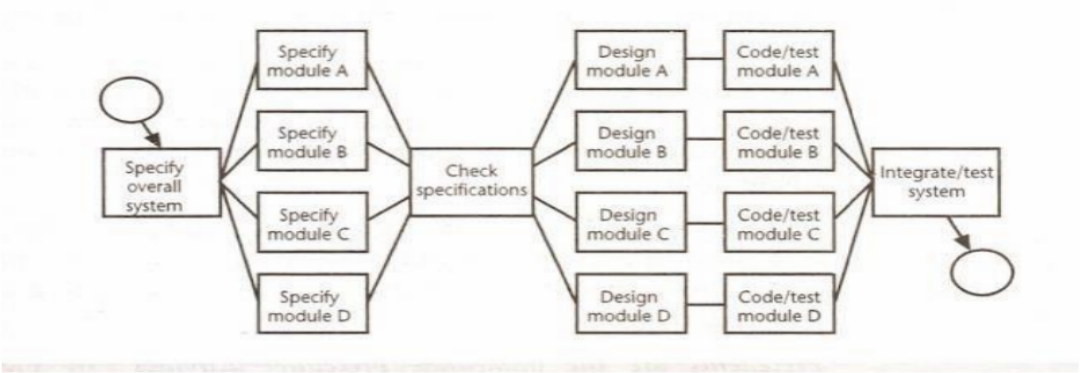


Fig: The IOE maintenance group accounts project activity network fragment with a check point activity added

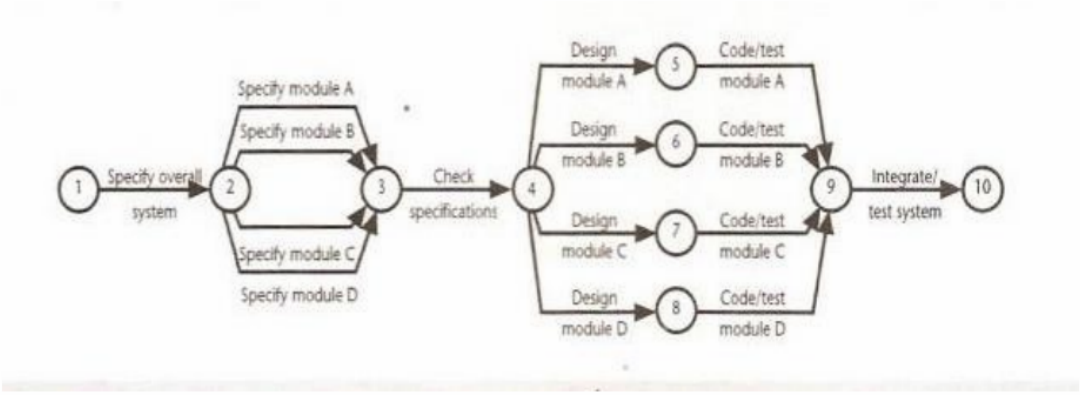


Fig: The IOE maintenance group accounts project activity network fragment represented as a CPM network

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Formulating a network model

- The first stage in creating a network model is to represent the activities and their interrelationships as a graph. In activity-on-node we do this by representing activities as links (arrowed lines) in the graph — the nodes (circles) representing the events of activities starting and finishing.

Constructing precedence networks

- A project network should have only one start node
- A project network should have only one end node
- A node has duration
- A node represents an activity and, in general, activities take time to execute.
- Links normally have no duration
- precedents are the immediate preceding activities In Figure, the activity 'Program test' cannot start until both 'Code' and 'Data take-on' have been completed and activity 'Install' cannot start until 'Program test' has finished. 'Code' and Data take-on' can therefore be said to be precedents of 'Program test', and 'Program test' is a precedent of 'Install'. Note that we do not speak of 'Code' and 'Data take-on' as precedents of 'Install' - that relationship is implicit inthe previous statement. Time moves front left to right

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- Time moves front left to right

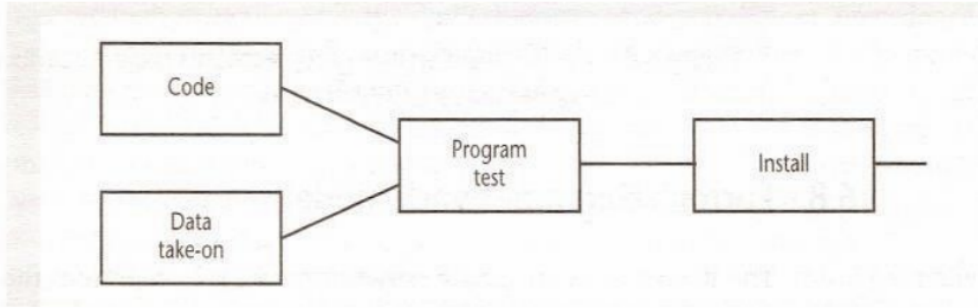


Fig : Fragment of a precedence network

- A network may not contain loops, Figure demonstrates a loop in a network. A loop is anerror in that it represents a situation that cannot occur in practice. While loops, in the sense ofiteration, may occur in practice, they cannot be directly represented in a project network.

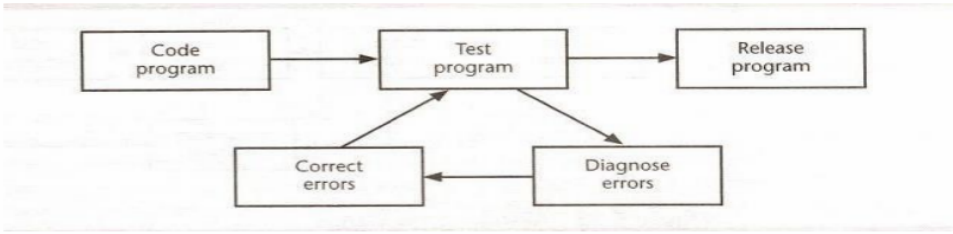


Fig: A Loop representing an impossible sequence

- A network should not contain dangles. A dangling activity such as 'Write user manual' in Figure :should not exist as it is likely to lead to errors in subsequent analysis.
- Redraw the network with a final completion activity — which, at least in this case, is probably a more accurate

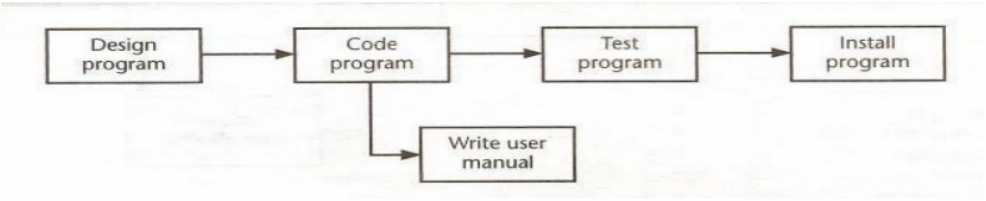


Fig: A Dangle

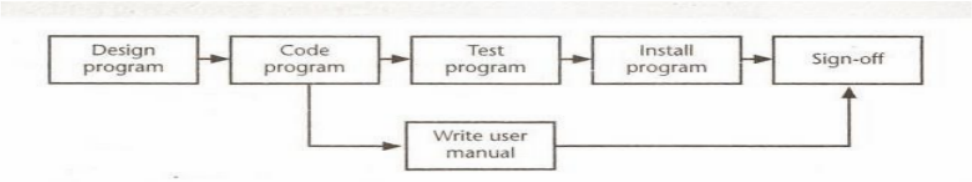


Fig: Resolving the dangle

Representing lagged activities

- We might come across situations where we wished to undertake two activities in parallel so long as there is a lag between the two. We might wish to document amendments to a program as it was being tested - particularly if evaluating a prototype.
- Where activities can occur in parallel with a time lag between them we represent the lag with a duration on the linking arrow as shown in Figure 6.13. This indicates that documenting amendments can start one day after the start of prototype testing and will be completed two days after prototype testing is completed.

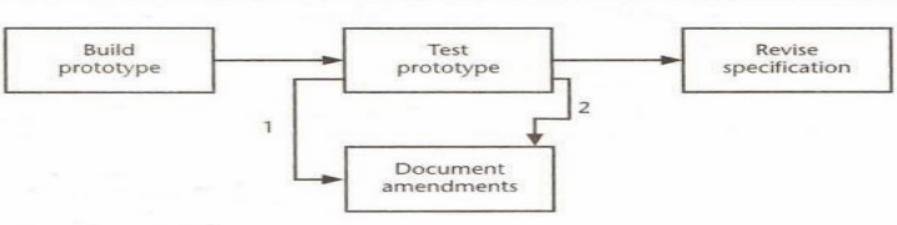


Fig: Indicating lags

6 Forward Pass & Backward Pass techniques

Forward pass is a technique to move forward through network diagram to determining project duration and finding the critical path or Free Float of the project.

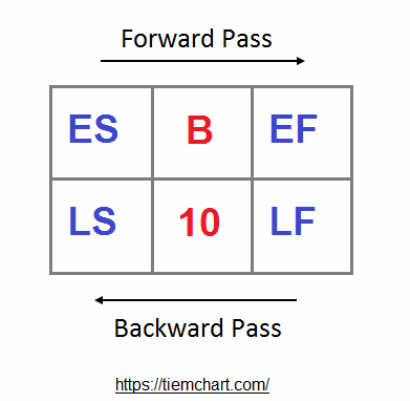
Whereas backward pass represents moving backward to the end result to calculate late start or to find if there is any slack in the activity.

Let us try and understand few terms that as a project manager you will encounter.

How to plot Early Start (ES), Early Finish (EF), Late Start (LS) and Late Finish (LF) in a network diagram?
Early Start (ES) is plotted on the 1st left corner box at the top. Likewise Early Finish (EF) is plotted on top right corner box.

Late Finish (LF) is on the right corner box at the bottom and Late Start (LS) is plotted on the left bottom corner box.

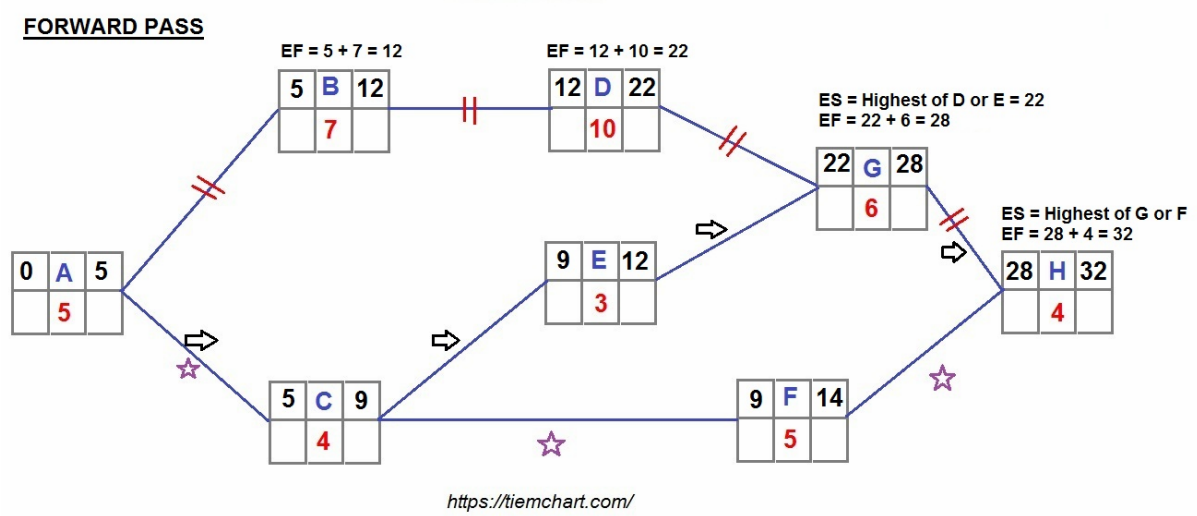
Activity name "B" is in the 2nd box duration represented by 10 is on the 5th box at the middle.



What is Early Start?
Early Start (ES) represents the earliest start of an activity considering the dependency preceding task. If an activity is having more than one dependency predecessor, then ES will be the highest Early Finish (EF) of the dependency task.

Early Start = Maximum (or Highest) EF value from immediate Predecessor(s)
How to apply Forward Pass to calculate Early Finish (EF)?
In order to calculate Early Finish, we use forward pass. Means moving from Early Start towards right to come up with Early Finish of the project.

Early Finish (EF) = ES + Duration, If Early Start is 6 days and duration is 10 days, EF = 6 + 10 = 16 Days

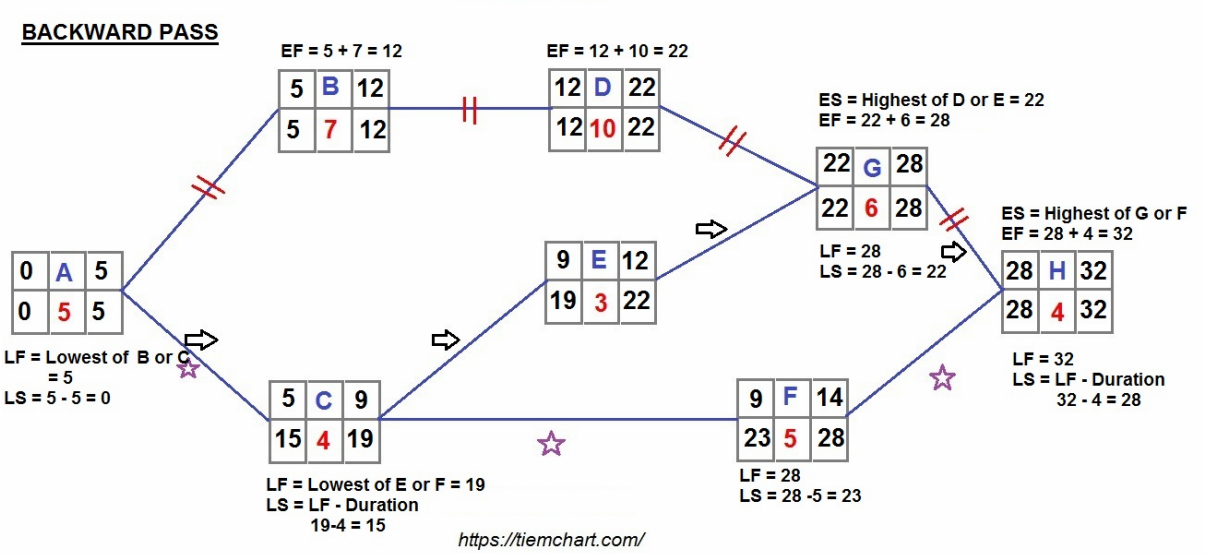


What is Late Finish (LF)?

Late Start (LS) is the latest date that the activity can finish without causing a delay to the project completion date.

How to apply Backward Pass to calculate Late Start (LS)?
In order to calculate Late Start (LS), we apply backward Pass moving from Late Finish and deducting from activity duration.

LS = LF – Duration
If Late Finish is 30 days and duration is 10 days, LS = 30 – 10 = 20 Days



What is Critical Path?
Critical Path is the longest sequence of activity on a project that carry zero free float / slack.

Float Calculation
The whole idea of network diagram and finding the project duration is to identify the critical path and total float. Float represents how much each individual activity can be delayed without delaying successor activities or project completion date.

Total Float = LS – ES or LF – EF
Total Float shows the difference between the Earliest Start (ES) and Latest Start (LS) of an activity before the completion date is delayed.

Free Float = Lowest ES of successors – EF
Free Float represents the amount of time that an activity can be delayed before any successor's activity will be delayed. A zero free float represents the activity is in critical path and there is no space to delay the activity without delaying the entire project.

7 Critical path (CRM) method

It is a sequence of critical tasks/activities and is the largest path in the project network. It gives us the minimum time which is required to complete the entire project. The activities in the critical path are known as critical activities and if these activities are delayed then the completion of the entire project is also delayed.

Benefits of using the critical path method in project management:
- Show the project schedule visually.
- Highlight important tasks with CPM.
- Use CPM to find and handle risks.
- CPM helps the project team communicate better.

How to find the critical path in a project:

Step 1: Identify all tasks required to complete the project
Step 2: Determine the sequence of tasks
Step 3: Estimate the duration of each task
Step 4: Draw a network diagram
Step 5: Identify the critical path
Step 6: Calculate the float
Step 7: Monitor the critical path

The table given below contains the activity label, its respective duration (in weeks), and its precedents. We will use the critical path method to find the critical path and activities of this project.

Activity	Duration (in weeks)	Precedents
A	6	–
B	4	–
C	3	A
D	4	B
E	3	B
F	10	–
G	3	E,F
H	2	C,D

Rules for Designing the Activity-on-Node network diagram:

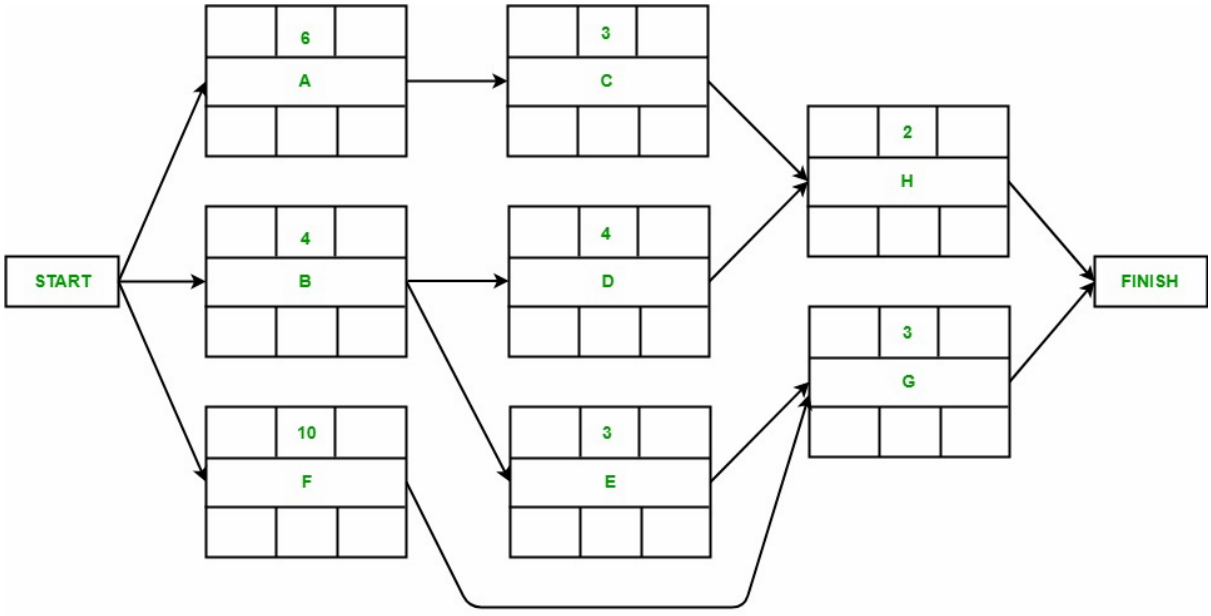
- A project network should have only one start node
- A project network should have only one end node
- A node has a duration
- Links normally have no duration
- “Precedents” are the immediate preceding activities
- Time moves from left to right in the project network
- A network should not contain loops
- A network should not contain dangles

Node Representation:

Earliest Start	Duration	Earliest Finish
Activity Label		
Latest Start	Float	Latest Finish

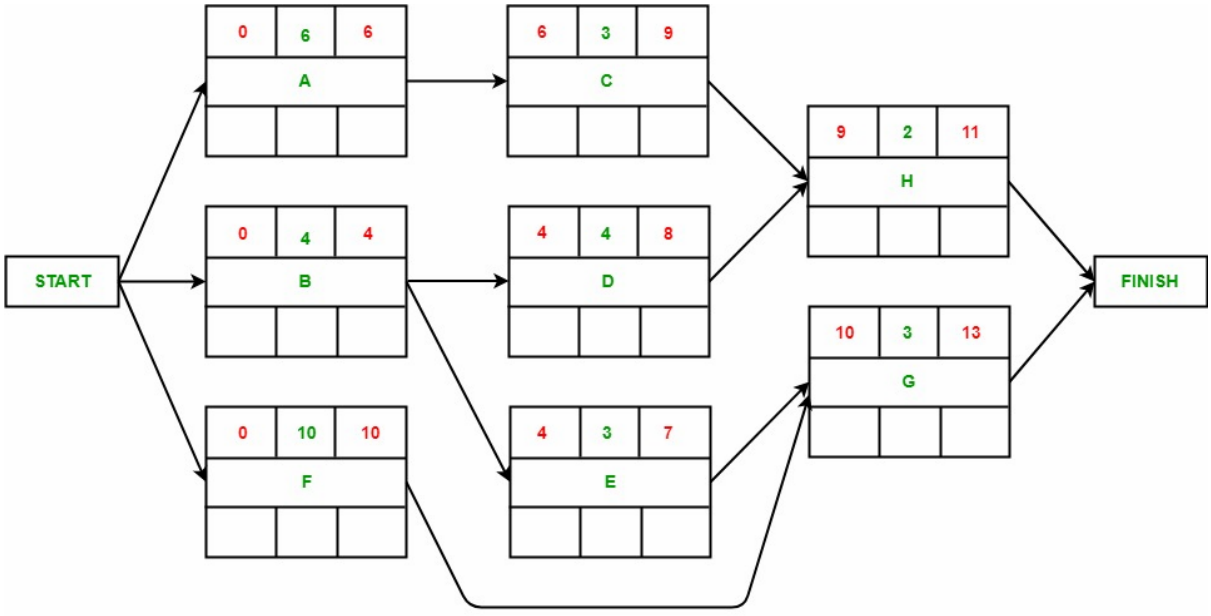
- Activity label is the name of the activity represented by that node.
- Earliest Start is the date or time at which the activity can be started at the earliest.
- Earliest Finish is the date or time at which the activity can be completed at the earliest.
- Latest Start is the date or time at which the activity can be started at the latest.
- The latest Finish is the date or time at which the activity can be finished at the latest.
- Float is equal to the difference between the earliest start and latest start or earliest finish and latest finish.

Activity-On-Node diagram:



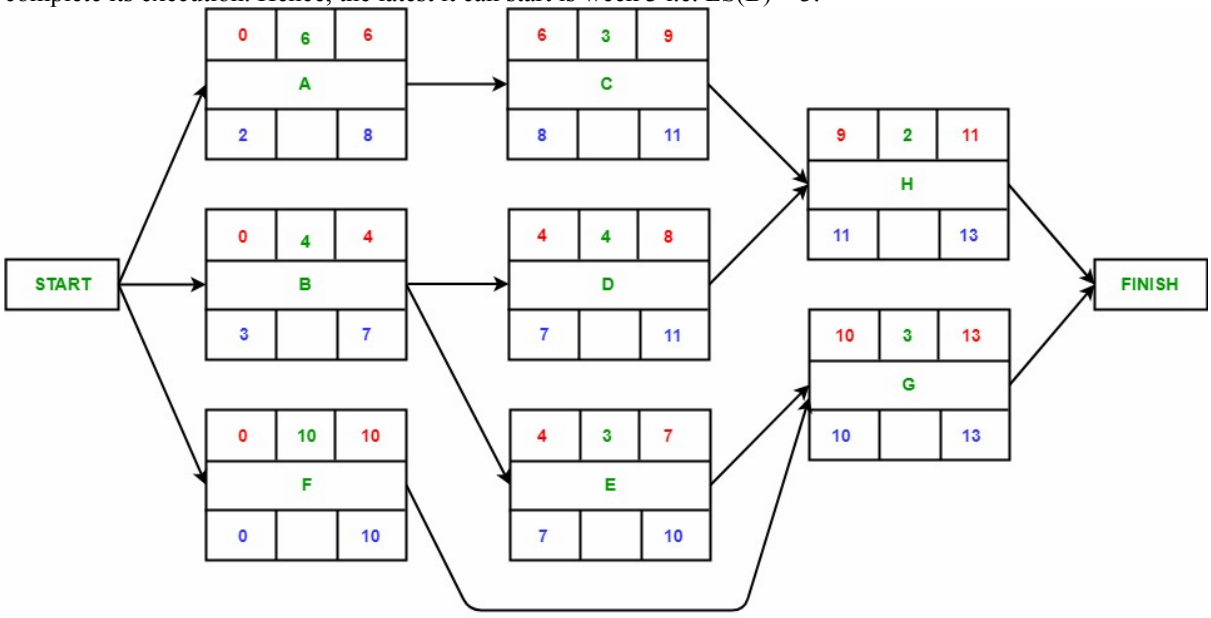
Forward Pass in Critical path in project management: The forward pass is carried out to calculate the earliest dates on which each activity may be started and completed.

- Activity A may start immediately. Hence, the earliest date for its start is zero i.e. ES(A) = 0. It takes 6 weeks to complete its execution. Hence, earliest it can finish is week 6 i.e. EF(A) = 6.
- Activity B may start immediately. Hence, the earliest date for its start is zero i.e. ES(B) = 0. It takes 4 weeks to complete its execution. Hence, the earliest it can finish is week 4 i.e. EF(B) = 4.
- Activity F may start immediately. Hence, the earliest date for its start is zero i.e. ES(F) = 0. It takes 10 weeks to complete its execution. Hence, the earliest it can finish is week 10 i.e. EF(F) = 10.
- Activity C starts as soon as Activity A completes its execution. Hence, the earliest week it can start its execution is week 6 i.e. ES(C) = 6. It takes 3 weeks to complete its execution. Hence, the earliest it can finish is week 9 i.e. EF(C) = 9.
- Activity D starts as soon as Activity B completes its execution. Hence, the earliest week it can start its execution is week 4 i.e. ES(D) = 4. It takes 4 weeks to complete its execution. Hence, the earliest it can finish is week 8 i.e. EF(D) = 8.
- Activity E starts as soon as Activity B completes its execution. Hence, the earliest week it can start its execution is week 4 i.e. ES(E) = 4. It takes 3 weeks to complete its execution. Hence, the earliest it can finish is week 7 i.e. EF(E) = 7.
- Activity G starts as soon as activity E and activity F completes their execution. Since the activity requires the completion of both for starting its execution, we would consider the MAX(ES(E), ES(F)). Hence, the earliest week it can start its execution is week 10 i.e. ES(G) = 10. It takes 3 weeks to complete its execution. Hence, the earliest it can finish is week 13 i.e. EF(G) = 13.
- Activity H starts as soon as activity C and activity D completes their execution. Since the activity requires the completion of both for starting its execution, we would consider the MAX(ES(C), ES(D)). Hence, the earliest week it can start its execution is week 9 i.e. ES(H) = 9. It takes 2 weeks to complete its execution. Hence, the earliest it can finish is week 11 i.e. EF(H) = 11.



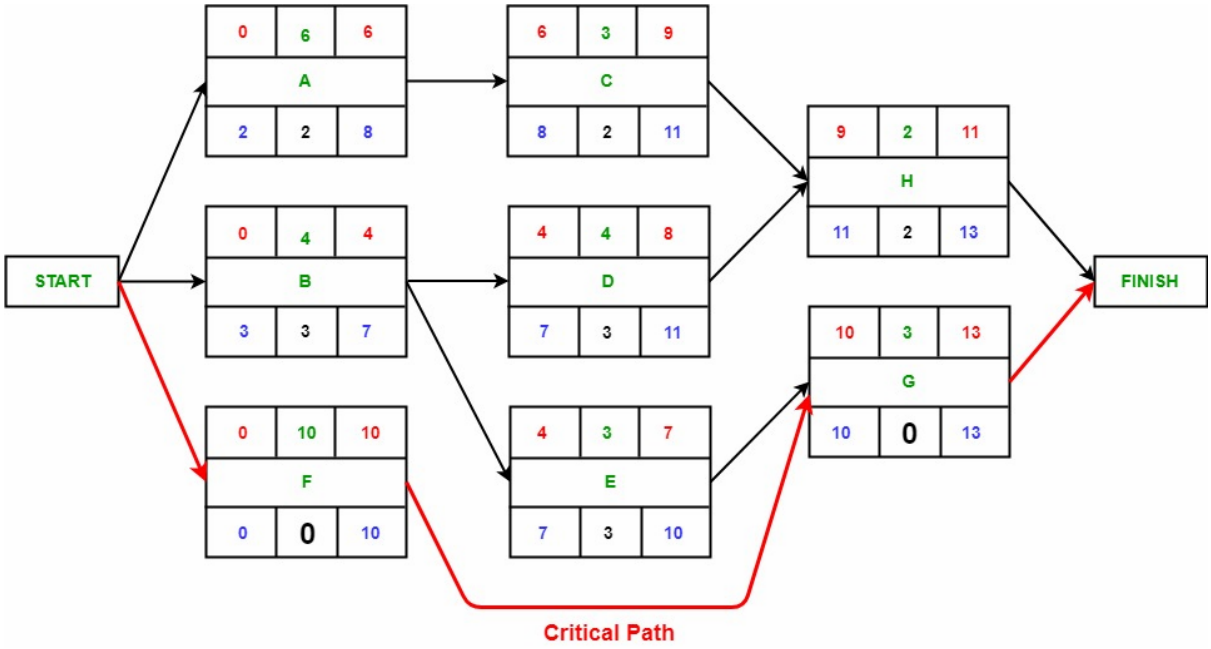
Backward Pass in Critical path in project management: The backward pass is carried out to calculate the latest dates on which each activity may be started and finished without delaying the end date of the project. Assumption: Latest finish date = Earliest Finish date (of project).

- Activity G's latest finish date is equal to the earliest finish date of the precedent activity of finish according to the assumption i.e. LF(G) = 13. It takes 3 weeks to complete its execution. Hence, the latest it can start is week 10 i.e. LS(G) = 10.
- Activity H's latest finish date is equal to the earliest finish date of the precedent activity of finish according to the assumption i.e. LF(H) = 13. It takes 2 weeks to complete its execution. Hence, the latest it can start is week 11 i.e. LS(H) = 11.
- The latest end date for activity C would be the latest start date of H i.e. LF(C) = 11. It takes 3 weeks to complete its execution. Hence, the latest it can start is week 8 i.e. LS(C) = 8.
- The latest end date for activity D would be the latest start date of H i.e. LF(D) = 11. It takes 4 weeks to complete its execution. Hence, the latest it can start is week 7 i.e. LS(D) = 7.
- The latest end date for activity E would be the latest start date of G i.e. LF(G) = 10. It takes 3 weeks to complete its execution. Hence, the latest it can start is week 7 i.e. LS(E) = 7.
- The latest end date for activity F would be the latest start date of G i.e. LF(G) = 10. It takes 10 weeks to complete its execution. Hence, the latest it can start is week 0 i.e. LS(F) = 0.
- The latest end date for activity A would be the latest start date of C i.e. LF(A) = 8. It takes 6 weeks to complete its execution. Hence, the latest it can start is week 2 i.e. LS(A) = 2.
- The latest end date for activity B would be the earliest of the latest start date of D and E i.e. LF(B) = 7. It takes 4 weeks to complete its execution. Hence, the latest it can start is week 3 i.e. LS(B) = 3.



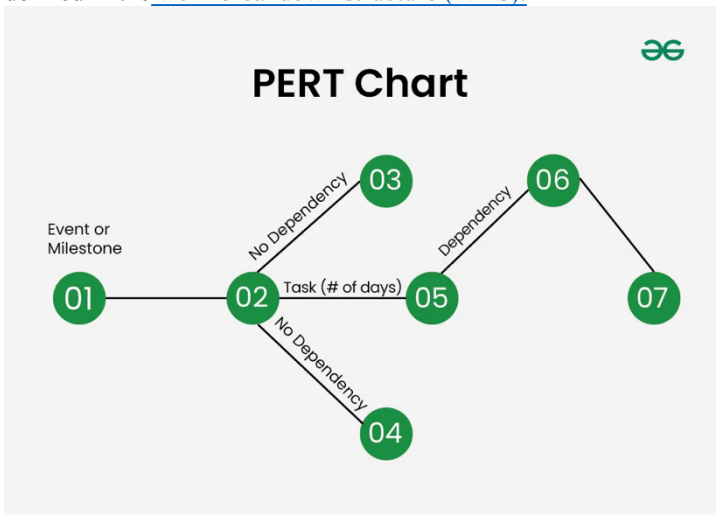
Backward Pass in Critical path in project management

Identifying Critical Path: The critical path is the path that gives us or helps us estimate the earliest time in which the whole project can be completed. Any delay to an activity on this critical path will lead to a delay in the completion of the entire project. To identify the critical path, we need to calculate the activity float for each activity. Activity float is the difference between an activity's Earliest start and its latest start date or the difference between the activity's Earliest finish and its latest finish date, and it indicates how much the activity can be delayed without delaying the completion of the entire project. If the float of an activity is zero, then the activity is critical and must be added to the critical path of the project network. In this example, activities F and G have zero float and hence, are critical activities.



8 PERT technique

Project Evaluation and Review Technique (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. All of the primary elements or events of a project have been finally identified by the PERT. In this technique, a PERT Chart is made which represent a schedule for all the specified tasks in the project. The reporting levels of the tasks or events in the PERT Charts is some what same as defined in the work breakdown structure (WBS).



What is PERT Chart?

A PERT chart is a project management tool used to plan and schedule tasks, illustrating the sequence and timing of project activities. The PERT chart is used to schedule, organize and co-ordinate tasks within the project. the objective of PERT chart is to determine the critical path, which comprises critical activities that should be completed on schedule. This chart is prepared with the help of information generated in project planning activities such as estimation of effort, selection of suitable process model for software development and decomposition of tasks into subtasks.

What does a PERT Chart Contain?

Here are the main components of a PERT chart:

- **Nodes:** it represents the task or milestones. every node represents the task name and may also show duration of the task.
- **Arrows:** it indicates the direction or sequence of task and also dependencies between them. suppose an array from A to B, then task A must be completed before task B.
- **Time Estimation:** It estimates the time duration to complete the task.
- **Critical Path:** The critical path is the largest path in project management that always results in the shortest time to complete the project.
- **Milestones:** It is Key point in the project timeline that represent significant events or deadlines.

How a PERT Chart Works?

A **PERT** chart used to plan and visualize tasks in a project. It breaks down the project into individual tasks and shows the sequence in which they must be completed. Each task is represented by a node, and arrows indicate the dependencies between tasks. By analyzing the chart, teams can identify the critical path, which helps determine the shortest time to complete the project and allocate resources effectively.

How to Create a PERT chart?

To create a PERT chart, we can follow the below steps:

Step 1: Identify Project Tasks

List all the tasks required to complete the project. Identifying tasks means listing all the steps needed to complete a project. Start by figuring out what the main goal is, then break it down into smaller actions. Ask team members for ideas and use clear action words for each task.

Step 2: Define task dependencies

Defining task dependencies means figuring out which tasks must be completed before others can start. Look at your task list and identify connections by asking if one task relies on another. This helps you establish the order of work, ensuring everything is done in the right sequence.

Step 3: Estimate Timeline

Estimating the timeline involves figuring out how long each task will take to complete. For each task, think about the quickest time it could be done (optimistic), the longest it might take (pessimistic), and the most likely time it will actually take. This gives you a better idea of the overall project duration and helps with planning.

Step 4: Calculate Critical Path

Calculate Critical Path means finding the longest sequence of tasks that determines the shortest time to complete the project. Identify which tasks can't be delayed without affecting the overall project deadline, helping you focus on what's most important.

Step 5: Manage task progress

It involves tracking how each task is going. Regularly check if tasks are on schedule, address any delays, and adjust plans if needed. This ensures the project stays on track and any issues are resolved quickly.

PERT Chart Vs Gantt Chart

Here is a comparison of PERT and Gantt charts in a detailed way:

Feature	PERT Chart	Gantt Chart
Purpose	Visualize project tasks and dependencies	Schedule tasks over time
Focus	Task relationships and sequence	Task duration and timeline
Representation	Network diagram with nodes and arrows	Horizontal bar chart
Time Estimation	Includes optimistic, pessimistic, and most likely durations	Shows start and end dates
Complexity	More complex, suitable for large projects	Simpler, easier to read
Flexibility	Adaptable for changing project paths	Less flexible once established
Best Use Case	Research and development projects	Construction and production schedules

What is PERT vs CPM?

Here are the following difference between PERT and CPM:

Aspect	PERT	CPM
Abbreviation	PERT stands for Project Evaluation and Review Technique.	CPM stands for Critical Path Method
Definition	PERT is a technique of project management which is used to manage uncertain (i.e., time is not known) activities of any project.	CPM is a technique of project management which is used to manage only certain (i.e., time is known) activities of any project.
Orientation	It is event oriented technique which means that network is constructed on the basis of event.	It is activity oriented technique which means that network is constructed on the basis of activities.
Model Type	It is a probability model.	It is a deterministic model.
Focus	It majorly focuses on time as meeting time target or estimation of percent completion is more important.	It majorly focuses on Time-cost trade off as minimizing cost is more important.
Precision	It is appropriate for high precision time estimation.	It is appropriate for reasonable time estimation.
Nature of Job	It has Non-repetitive nature of job.	It has repetitive nature of job.
Crashing	There is no chance of crashing as there is no certainty of time.	There may be crashing because of certain time bound.
Dummy Activities	It doesn't use any dummy activities.	It uses dummy activities for representing sequence of activities.
Sustainability	It is suitable for projects which required research and development.	It is suitable for construction projects.

Characteristics of PERT Chart

The main characteristics of PERT are as following:

- It serves as a base for obtaining the important facts for implementing the decision-making.
- It forms the basis for all the planning activities.
- PERT helps management in deciding the best possible resource utilization method.
- PERT take advantage by using time network analysis technique.
- PERT presents the structure for reporting information.
- It helps the management in identifying the essential elements for the completion of the project within time.
- It specifies the activities that from the critical path.
- It describes the probability of completion of project before the specified date.
- It describes the dependencies of one or more tasks on each other.
- It represents the project in graphical plan form.

Advantages of PERT Chart

It has the following advantages:

- Estimation of completion time of project is given by the PERT.
- It supports the identification of the activities with slack time.
- The start and dates of the activities of a specific project is determined.
- It helps project manager in identifying the critical path activities.
- PERT makes well organized diagram for the representation of large amount of data.

Disadvantages of PERT Chart

It has the following disadvantages:

- The complexity of PERT is more which leads to the problem in implementation.
- The estimation of activity time are subjective in PERT which is a major disadvantage.
- Maintenance of PERT is also expensive and complex.
- The actual distribution of may be different from the PERT beta distribution which causes wrong assumptions.
- It under estimates the expected project completion time as there is chances that other paths can become the critical path if their related activities are deferred.

The main objective in the analysis through PERT is to find out the completion for a particular event within specified date. The PERT approach takes into account the uncertainties. The three time values are associated with each activity

1. **Optimistic time** – It is the shortest possible time in which the activity can be finished. It assumes that every thing goes very well. This is denoted by t_0.
2. **Most likely time** – It is the estimate of the normal time the activity would take. This assumes normal delays. If a graph is plotted in the time of completion and the frequency of completion in that time period, then most likely time will represent the highest frequency of occurrence. This is denoted by t_m.
3. **Pessimistic time** – It represents the longest time the activity could take if everything goes wrong. As in optimistic estimate, this value may be such that

only one in hundred or one in twenty will take time longer than this value. This is denoted by t_p.

In PERT calculation, all values are used to obtain the percent expected value.

1. **Expected time** – It is the average time an activity will take if it were to be repeated on large number of times and is based on the assumption that the activity time follows Beta distribution, this is given by

$$t_e = (t_0 + 4\, t_m + t_p) / 6$$

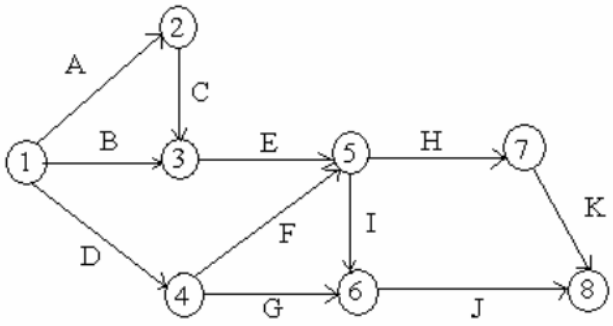
2. The **variance** for the activity is given by

$$\sigma^2 = [(t_p - t_o) / 6]^2$$

3.3 Worked Examples

Example 1

For the project



Task:	A	B	C	D	E	F	G	H	I	J	K
Least time:	4	5	8	2	4	6	8	5	3	5	6

Greatest time:	8	10	12	7	10	15	16	9	7	11	13
Most likely time:	5	7	11	3	7	9	12	6	5	8	9

Find the earliest and latest expected time to each event and also critical path in the network.

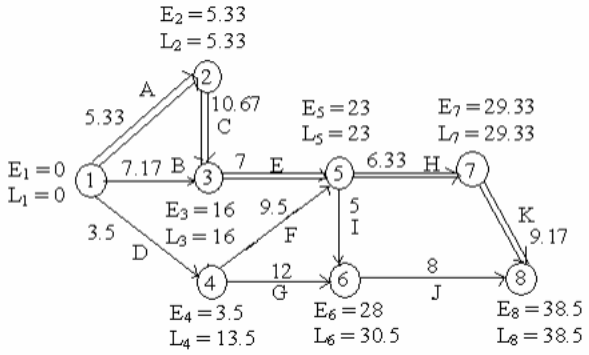
Solution

Task	Least time(t_0)	Greatest time (t_p)	Most likely time (t_m)	Expected time ($to + t_p + 4t_m$)/6
A	4	8	5	5.33
B	5	10	7	7.17
C	8	12	11	10.67
D	2	7	3	3.5
E	4	10	7	7
F	6	15	9	9.5
G	8	16	12	12
H	5	9	6	6.33
I	3	7	5	5
J	5	11	8	8
K	6	13	9	9.17

Task	Expected time (t_e)	Start		Finish		Total float
		Earliest	Latest	Earliest	Latest	
A	5.33	0	0	5.33	5.33	0
B	7.17	0	8.83	7.17	16	8.83
C	10.67	5.33	5.33	16	16	0
D	3.5	0	10	3.5	13.5	10
E	7	16	16	23	23	0

F	9.5	3.5	13.5	13	23	10
G	12	3.5	18.5	15.5	30.5	15
H	6.33	23	23	29.33	29.33	0
I	5	23	25.5	28	30.5	2.5
J	8	28	30.5	36	38.5	2.5
K	9.17	29.33	29.33	31.5	38.5	0

The network is



The critical path is A →C →E → H → K

9 Risk identification – Assessment – Risk Planning – Risk Management

The 9 Risk management steps are: Risk Identification, Risk Assessment, Risk Planning, Risk Mitigation, Risk Monitoring, Risk Control, Risk Acceptance, Risk Transfer, and Risk Communication.
Here's a more detailed breakdown of each step:

1. Risk Identification:
- **Purpose:** Identifying potential threats and opportunities that could impact the project or organization's objectives.
- **Methods:** Brainstorming, SWOT analysis, checklists, expert opinions, historical data analysis, and scenario planning.
- **Goal:** To create a comprehensive list of potential risks.

2. Risk Assessment:
- **Purpose:** Evaluating the likelihood and potential impact of each identified risk.
- **Methods:** Qualitative and quantitative risk analysis, risk matrices, probability and impact analysis.
- **Goal:** To prioritize risks based on their potential severity and likelihood.

3. Risk Planning:
- **Purpose:** Developing strategies and plans to address identified risks.
- **Methods:** Risk mitigation plans, contingency plans, risk response strategies (avoidance, mitigation, transfer, acceptance).
- **Goal:** To have a proactive approach to managing risks.

4. Risk Mitigation:
- **Purpose:** Implementing actions to reduce the likelihood or impact of identified risks.
- **Methods:** Implementing controls, developing contingency plans, transferring risks to third parties, accepting risks.
- **Goal:** To minimize the potential negative impact of risks.

5. Risk Monitoring:
- **Purpose:** Tracking the progress of risk mitigation plans and identifying new or changing risks.
- **Methods:** Regular reviews, performance monitoring, risk register updates.
- **Goal:** To ensure that risks are being managed effectively and to adapt to changing circumstances.

6. Risk Control:
- **Purpose:** Implementing and maintaining controls to manage identified risks.
- **Methods:** Standard operating procedures, training programs, internal controls, and security measures.
- **Goal:** To prevent risks from occurring or to minimize their impact if they do occur.

7. Risk Acceptance:

- **Purpose:** Deciding to accept the potential impact of a risk because the cost of mitigation is too high or the risk is deemed low enough.
- **Methods:** Documenting the decision to accept the risk and monitoring for any changes in the risk profile.
- **Goal:** To make an informed decision about whether to accept the risk or to take action to mitigate it.

8. Risk Transfer:

- **Purpose:** Shifting the responsibility for a risk to a third party, such as through insurance or contracts.
- **Methods:** Purchasing insurance, outsourcing tasks, or using contracts to assign responsibility for specific risks.
- **Goal:** To reduce the financial impact of a risk by transferring it to another party.

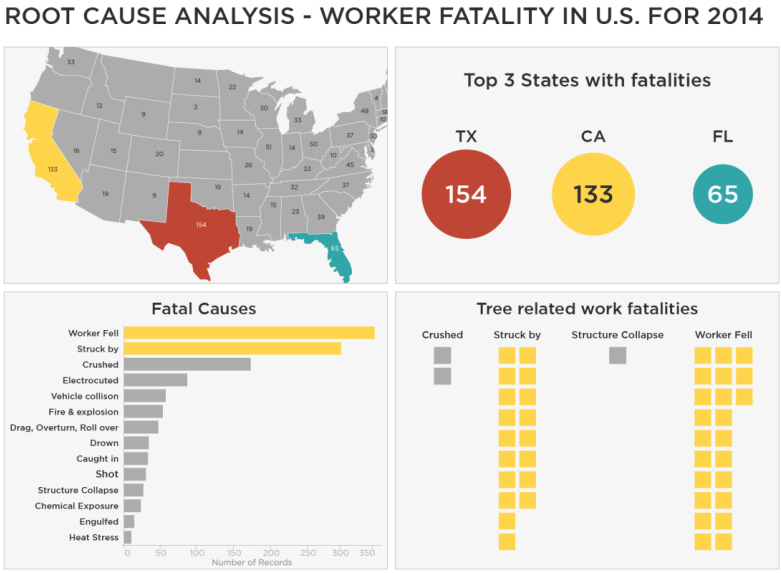
9. Risk Communication:

- **Purpose:** Ensuring that all stakeholders are aware of the risks and the plans to manage them.
- **Methods:** Regular communication, reports, presentations, and training sessions.
- **Goal:** To foster a culture of risk awareness and to ensure that everyone is on the same page regarding risk management.

SWOT analysis is a classical tool for vulnerability detection. It allows decision-makers to take a closer look at all possible directions for business planning as well as prioritize the work you have.

Root cause analysis

Tableau offers the best guide for it. This type of analysis helps discover the root causes of potential risks and find relevant solutions.



Brainstorming

Before the brainstorming session, an organizer needs to make sure who exactly should attend it. Stakeholders, employees, clients, and key executives are all valid sources of quality feedback and ideas about potential challenges.

Brainstorming sessions work well under a comfortable time limit and with a list of the most urgent points to discuss.

Documentation review

While performing a systematic review, you will more likely focus on these types of fundamental documents:

- project timing;
- project scope;

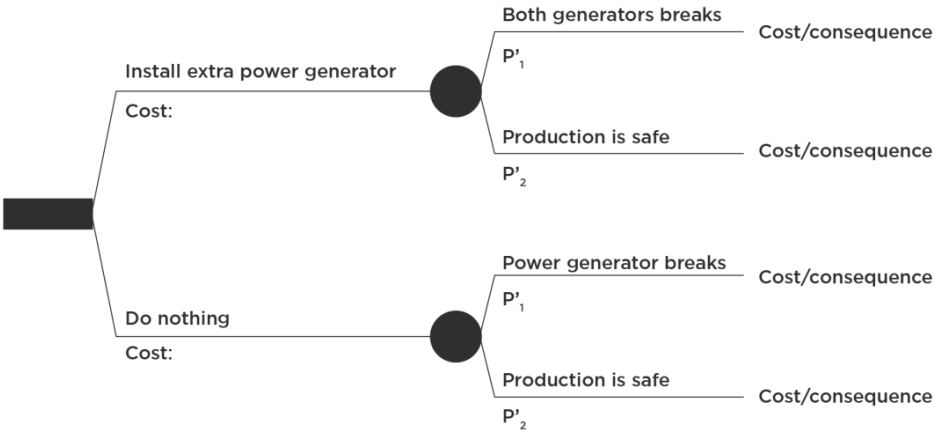
- work decomposition;
- costs and estimates.

Interview

Interviewing both internal stakeholders and external experts is a good idea to get a full-scale overview of the current state of affairs within the organization. You can have a prepared list of questions or have an unstructured discussion.

Decision tree

Construct multiple decision trees for each stage of the analysis. This tool is flexible enough to go deeper with calculations of the exact costs or losses for each possible decision. Each tree is designed with the decision, event, and cost nodes.



How to manage risks

Negative vs. positive risks- As we mentioned above, not all risks are negative, and some of them can turn into real possibilities for an organization's growth and prosperity. Negative risks, or threats, can be avoided, mitigated, accepted, or transferred. Positive risks, or opportunities, can be exploited, enhanced, accepted, or shared.

Risk Breakdown Structure (RBS) in Project Management?

A risk breakdown structure (RBS) is like a chart that arranges project risks from most serious to least serious and from most likely to least likely. These risks are grouped based on their type, which helps make sure we think about all the different possibilities. It presents written documentation of all risks in a structured manner. Similar to Work Breakdown Structure, Risk Breakdown Structure in project management gives a medium to the project manager to organize potential risks that must be tracked and addressed. RBS comprises different levels from 0 to 4, each representing

- Level 0: The Project Name
- Level 1: The Category of the Risk
- Level 2: The risk
- Level 3: The actual risk
- Level 4: The detailed risk description

For instance, for a bike purchase, the different levels of risk breakdown structure will be as follows:

Level 0	Level 1	Level 2	Level 3	Level 4
Bike Purchase	Financial	Application	Loan Denial	The loan application can be denied due to a low credit score.
Mechanical	Performance	Reliability	Buying an old bike may not be reliable as it may require frequent repair.	
Cosmetics	Paint Damage	An old bike may have paint damage.		

Risk Breakdown Structure in Project Management: Risk Scoring

Initially, you begin by categorizing project risks. For instance, we have four categories: technical, organizational, external, and project management. Next, we will subcategorize each of these categories.

Once we have identified and categorized all possible risks, it's time to prioritize them in a sequence so that allocating resources toward risk mitigation gets easier.

PMI has proposed a P-I risk-scoring method that relies on probability (P) and impact (I).

- P denotes the probability of risk occurrence:
    - High probability ($80\% \leq x \leq 100\%$)
    - Medium-high probability ($60\% \leq x$)
    - Medium-low probability ($30\% \leq x$)
    - Low probability (0%)
- 'I' denotes the impact of the risk:

- High: catastrophic (rating A - 100)
- Medium: critical (rating B - 50)
- Low: marginal (rating C - 10)

This P-I method calculates the risk score by multiplying Probability and Impact. The following risk breakdown structure example grid represents the risk scoring method as suggested by PMI.

	Probability				
Impact		1=High (80%<=x<=100%)	2 = Medium High (60%<=x<=80%)	3 = Medium Low (30%<=x<=60%)	4 = Low (0%<x<30%)
A = High (Rating 100)	Exposure - Very High (Score 100)	Exposure - Very High (Score 80)	Exposure - High (Score 80)	Exposure - Moderate (Score 30)	
B = Medium (Rating 50)	Exposure - High (Score 50)	Exposure - Moderate (Score 40)	Exposure - Moderate (Score 30)	Exposure - Low (Score 15)	
C = Low (Rating 10)	Exposure - Low (Score 10)	Exposure - Low (Score 8)	Exposure - Low (Score 6)	Exposure - Low (Score 3)	

Monte Carlo simulation

- A manufacturing company keeps stock of a special product Previous experience indicates the daily demand as given below

Daily demand	5	10	15	20	25	30
probability	0.01	0.20	0.15	0.50	0.12	0.02

Simulate the demand for the next 10 days. Also find the daily average demand for that product on the basis of simulated data. Consider the following random numbers:
82,96,18,96,20,84,56,11,52,03

- **Solution:** Step 1:Generate tag values

Daily demands	Probability	Cumulative probability	Tag values(Random num range)
5	0.01	0.01	00-00
10	0.20	0.21	01-20
15	0.15	0.36	21-35
20	0.50	0.86	36-85
25	0.12	0.98	86-97
30	0.02	1.00	98-99

Step 2: Simulate for 10 days

Days	Random num	Daily demand
1	82	20
2	96	25
3	18	10
4	96	25
5	20	10
6	84	20
7	56	20
8	11	10
9	52	20
10	03	10

Average demand=(20+25+10+25+10+20+20+10+20+10)/10
=170/10=17 units/day

- 2)A tourist car operator finds that during the past few months the cars use has varied so much that the cost of maintaining the car varied considerably. During the past 200 days the demand for the car fluctuated as below

Trips per week	Frequency
0	16
1	24
2	30
3	60
4	40
5	30

Using random numbers 82,96,18,96,20,84,56,11,52,03, simulate the demand for 10 week period

- Solution: Step 1:Generate tag values

Trips/week	frequency	Probability	Cumulative probability	Tag values
0	16	16/200=0.08	0.08	00-07
1	24	24/200=0.12	0.20	08-19
2	30	30/200=0.15	0.35	20-34
3	60	60/200=0.30	0.65	35-64
4	40	40/200=0.20	0.85	65-84
5	30	30/200=0.15	1.00	85-99

Frequency-Number of occurrences, Total num of occurrences(16+24+30+60+40+30)=200
Step 2: Simulation for next 10 week

Weeks	Random Num	Trips/week
1	82	4
2	96	5
3	18	1
4	96	5
5	20	2
6	84	4
7	56	3
8	11	1
9	52	3
10	03	0

Avg trips/week=28/10=2.8≈3 trips/week

Resource Allocation

Resource allocation is the process of assigning and scheduling available resources in the most effective and economical way possible. Projects will always need resources but they can often be scarce. The task, therefore, lies with the project manager to determine the proper timing and allocation of those resources within the project schedule.
In project management, resources are often in high demand but low in availability. This reality puts project managers in a position where they must strategize the best ways to use what they have. They need to determine who does what, when, and with what tools or support. It's a balancing act that requires keen insight into the project's needs and the capabilities of the resources at hand.
This guide will discuss the positive impacts of good resource allocation, such as enhanced team performance and better project outcomes. We'll address potential challenges, including resource scarcity and the complexities of people management. We'll also cover the best practices for resource assignment and provide insights on how to effectively manage and deploy resources throughout a project's life cycle. Finally, we'll show you why Wrike is the best software to help with resource allocation, including the specific features that will make your life as a project manager easier.

Most common types of resources to allocate
Resource allocation is an integral part of project management and it often revolves around four primary types of resources. These resources are essential to consider, irrespective of the industry or project scope.

- **Financial** This includes the project's budget and funding. Financial resources help acquire other resources and ensure sufficient funds to cover all project aspects, from initial planning to execution and completion.
- **Physical** This involves tangible assets used in the project, such as equipment, materials, and workspaces. Physical resources are necessary for the project's actual construction or development phase.
- **People** This category includes the people involved in the project, such as team members, contractors, and consultants. Human resources carry out the tasks and responsibilities outlined in the project plan.
- **Technological** This includes software tools for planning and monitoring, communication systems, and other technological aids that make project processes run more smoothly.

What impacts resource allocation in project management?
Resource allocation in project management is an ongoing process, not just a one-off task at the outset. It involves strategically assigning and managing various resources throughout the entire project life cycle.
Proper resource allocation leads to numerous positive outcomes. It enhances efficiency, keeps the project within budget, and ensures that every team member has clarity about their roles and responsibilities. Effective resource allocation also means making the most of what you have and avoiding wasting time and resources.
However, resource allocation isn't without its challenges. For one, it requires continuous monitoring and adjustment. The dynamic nature of projects means that resource needs can change, sometimes unpredictably. The responsibility of resource allocation typically falls on the project manager, who must keep a vigilant eye on the project's resource needs, adjusting and reallocating as necessary to steer the project toward its goals.

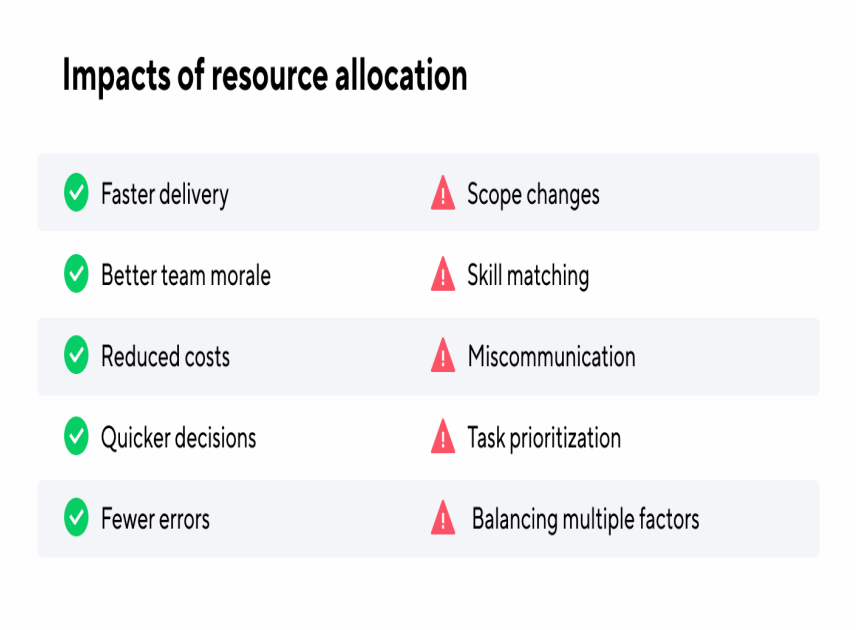
Positive impacts of resource allocation
When done right, resource management can offer a variety of positive impacts:

- Properly allocated resources lead to enhanced productivity, meaning goals and milestones are achieved on time.
- When resources are managed well, team members feel adequately supported and valued as they have clear guidelines and sufficient tools to execute their tasks.
- Strategic resource allocation helps avoid wastage and ensures that the project stays within budget, making it financially efficient.
- With a clear overview of resource distribution, team members can make quicker and more informed decisions, leading to better project outcomes.
- A well-structured resource plan reduces the likelihood of errors and lowers stress levels among team members.

Difficulties in project resource allocation
While resource allocation is important to the success of any project, it's not without its challenges. Understanding these obstacles can help you brainstorm ways to overcome them. Here are some common difficulties encountered in resource allocation:

- Projects often evolve, leading to changes in scope. This can affect the original resource plan, requiring adjustments and re-evaluations to align with the new direction.
- Finding the right match between the project's needs and the skills of team members can be challenging. Ensure that the right people are working on tasks that suit their expertise.
- Miscommunication can lead to resource mismanagement, affecting the project's progress. Wrike enhances communication with real-time updates and automated notifications, ensuring all team members are on the same page.
- Tracking multiple tasks and prioritizing them according to the project's needs can be difficult. It requires a clear understanding of the project's objectives and the ability to adapt to changing circumstances. With Wrike's intuitive dashboards, however, project managers can easily monitor tasks and prioritize them based on urgency and importance.

- Assigning tasks based on cost, skills, and availability is complex. It involves balancing various factors to maximize resource use while managing team members. Wrike's advanced analytics allow for a more informed task assignment process, considering cost, availability, and skill level.



Who is responsible for resource allocation during a project?
The responsibility of resource allocation typically falls on the shoulders of the project manager. They are the central figure who understands the intricacies of the project, making them best positioned to oversee the distribution and management of resources. From the initial planning stages to the final execution, the project manager must ensure that resources are utilized effectively and efficiently. A project manager's responsibilities include identifying resource needs, aligning skills with project requirements, and adjusting resources in response to project dynamics. They are also tasked with maintaining communication with team members and stakeholders, ensuring everyone is informed about resource availability and project progress.

5 steps to allocate resources for any project
Allocating resources effectively involves a careful balance of planning, analysis, and adaptation. Here's a roadmap outlining **five foundational steps** that can guide you through the process of allocating resources for your project:

1. Assess resource needs
The first resource allocation step is understanding the project's objectives and needs. Ask yourself questions like: What are the main goals of the project? What tasks need to be done? Then, move on to identifying the types of resources your project requires. This varies depending on your industry and the project's nature. Are we talking about the skills and expertise your people bring to the table? Or about the equipment or budget needed for different project aspects?
Determine the necessary resources for each task outlined in your project scope. Consider the number of team members needed, their specific skills, any special equipment required, and the budget for each task. By thoroughly assessing your resource needs, you're setting your project up for success, avoiding last-minute chaos, and ensuring you have everything you need right from the start.
2. Prioritize resource requirements
With a clear picture of your project's resource needs, the next step is **prioritization**. This is where you weigh the importance of each resource and determine which ones are non-negotiable and which ones you can be flexible with.
You can think of this as a hierarchy of needs for your project. At the top are the resources essential to the project's success. These could be specialized team members whose skills are important for certain tasks or specific equipment without which the project can't progress. These are your deal-breakers — the ones you can't do without.
Then, consider the resources that, while important, offer some wiggle room. Maybe there's software that would be nice to have but isn't essential, or maybe you could manage with fewer people on specific tasks. These are your negotiable resources, where you can explore alternatives or adjustments without derailing your project. By prioritizing your resources, you create a roadmap for decision making throughout the project.
3. Strategically allocate resources for the project
Good strategy means matching your resources smartly to your identified needs. This step requires careful consideration of availability, skills, and budget constraints to ensure a perfect fit for each aspect of your project. For instance, you should assign the most skilled team members to the most demanding tasks or ensure that essential equipment is available when needed.

It's important to strike a balance here. Allocating too many resources to one area might cause bottlenecks elsewhere, while too few resources can lead to delays and quality issues. The goal here is to distribute your resources evenly and logically, ensuring each project phase has what it needs to succeed without overextending your available resources.

4. Monitor and adjust resources throughout the project

Allocating resources is just the beginning. The real challenge lies in continuously monitoring and adjusting these resources throughout the life of your project. Just as your project grows and changes, so too will its needs. What seemed like a perfect initial allocation might need tweaking as the project evolves.

Regular monitoring ensures resources aren't being overused or underused. You might find that some team members are swamped with tasks while others have plenty of capacity, or maybe certain equipment is lying idle. These imbalances can lead to budget overruns, delays, and even burnout among your team.

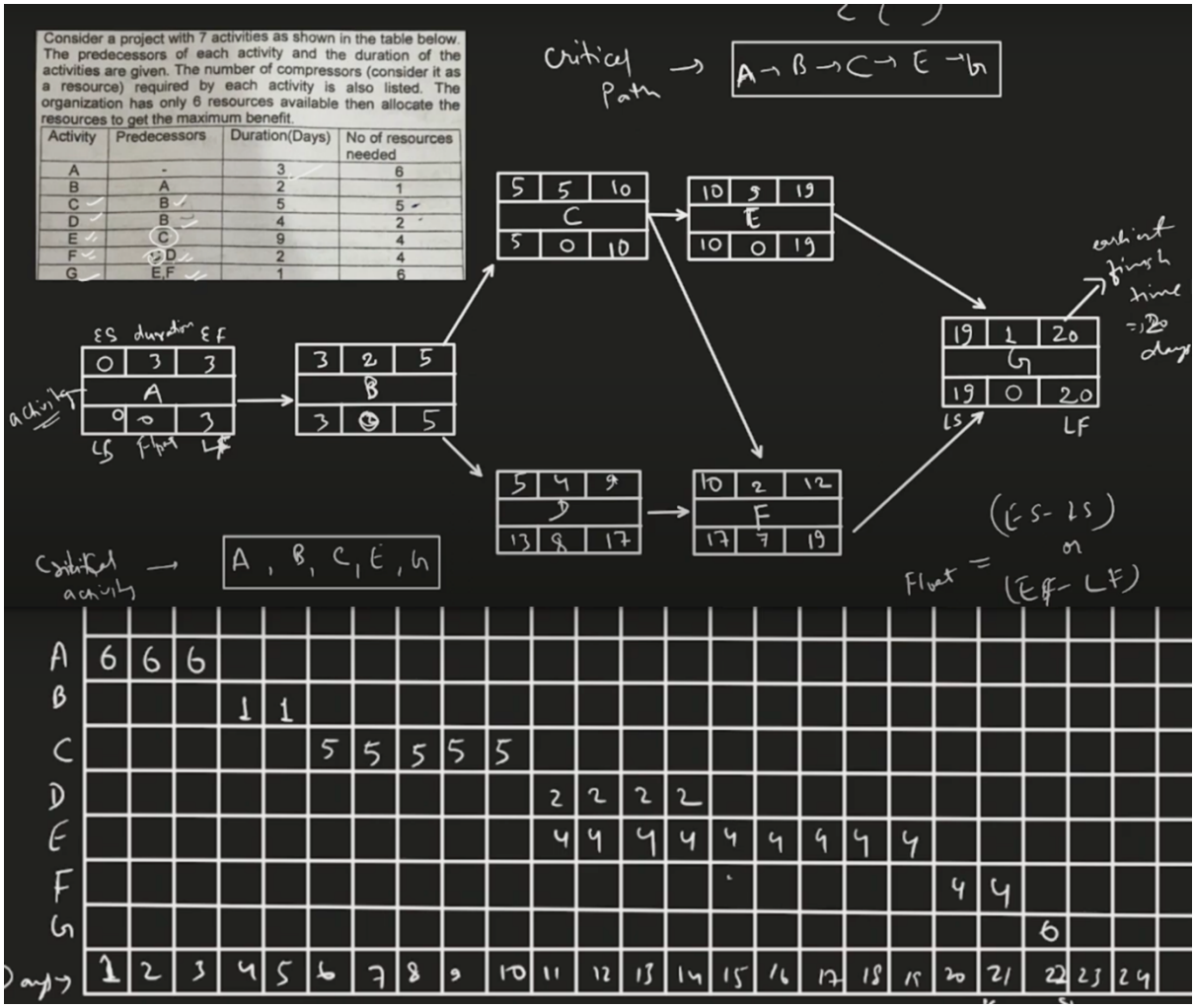
5. Evaluate and optimize your resource allocation process

After the curtain falls on your project, it's time for introspection. Evaluating and optimizing your resource allocation process dissects what happened during the project, understanding what worked well and pinpointing areas for improvement.

Did you allocate too many resources to one area while neglecting another? Were there bottlenecks that could've been avoided with better planning? This reflective practice is not about finger-pointing or dwelling on mistakes. Instead, it's an opportunity to learn and grow.

At the same time, your team members may have excelled in instances where they nailed resource allocation. Recognizing these successes is just as important as identifying the missteps. Examining both the highs and lows of your project gives you invaluable insights to guide your approach in future ones.

Now, imagine having a platform like Wrike by your side throughout this process. Wrike makes the evaluation phase a breeze. With its comprehensive tracking and reporting features, Wrike can provide clear insights into how resources were used throughout your project. This data is gold when optimizing your approach for future projects.



Cost schedules

In project management, the cost schedule refers to the process of planning, estimating, budgeting, and controlling expenses while ensuring projects are completed on time and within budget. It involves integrating cost tracking and scheduling to monitor progress and make informed adjustments. Here's a more detailed explanation:

Key Aspects of Cost Schedule in Project Management:

Cost Planning:
Budgeting: Allocating costs to different project activities and phases.
Estimating: Determining the expected costs of resources, materials, and labor.
Resource Allocation: Assigning resources (people, equipment, etc.) to tasks and estimating their costs.
Cost Breakdown Structure (CBS): A hierarchical chart that details the individual costs of a project.

Schedule Planning:
Timeline: Establishing a realistic timeline for project activities and milestones.
Resource Optimization: Ensuring resources are used efficiently to minimize costs and delays.
Dependency Management: Identifying dependencies between tasks and activities to optimize the schedule.

Cost Control:
Monitoring: Tracking actual costs against planned costs and identifying variances.
Contingency Planning: Allocating funds for unexpected costs or delays.
Change Management: Managing changes to the project scope, schedule, or budget.

Tools and Techniques:
Earned Value Management (EVM): A methodology for measuring project performance by comparing planned costs and schedule with actual costs and schedule.
Cost Performance Index (CPI): A metric that measures the efficiency of a project's cost performance.
Schedule Performance Index (SPI): A metric that measures the efficiency of a project's schedule performance.
Cost Schedule Performance Index (CSI): A metric that combines CPI and SPI to assess the overall project performance.

Importance of Cost Schedule Integration:
Ensuring Project Success: Effective cost and schedule management are crucial for delivering projects on time and within budget.
Resource Optimization: Efficient resource allocation and utilization can lead to cost savings and improved project performance.
Stakeholder Communication: Clear cost and schedule information helps stakeholders understand project progress and potential risks.