UNIT-III

PROJECT EVALUATION AND PROJECT PLANNING

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT

Objectives of Activity planning

What Is an Activity in Project Management?

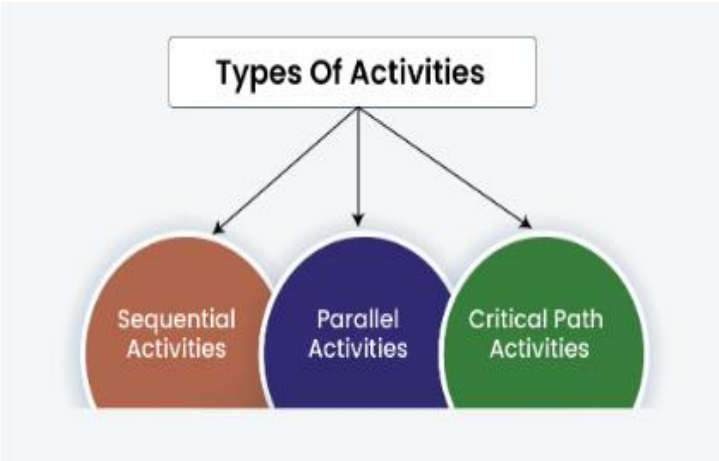
In project management, an "activity" is a specific job that needs to be done as part of a project. They also help plan when things should happen, who needs to do them, and what resources are needed. By keeping track of activities, managers can see how the project is progressing and catch any problems early. For example, activities could include things like doing research, designing, coding, testing, or having meetings.

Table of Content

What is an Activity in Project Management?

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



Types of Activities

1. **Sequential Activities:** These are tasks that must be completed in a specific order. For example, designing a product must precede manufacturing it.
2. **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.
3. **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

1. **Unique and Measurable:** Each activity should be distinct and clearly defined, with measurable outcomes or milestones.
2. **Time-Bound:** Activities have specific start and end dates or durations, contributing to the overall project timeline.
3. **Resource Consumption:** Activities consume various resources such as human resources, materials, equipment, and budget allocation.
4. **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?

1. **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.
2. **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.
3. **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.
4. **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.

5. **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.
6. **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.

What are Project Activities Examples?

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.

Example 2: Developing Software Modules

- **Activity Description:** Developing specific modules or features of a software application as per the project's scope and technical specifications.
- **Resources Required:** Software developers, coding tools/IDEs, and version control systems.
- **Timeframe:** Each module development may vary in duration, ranging from days to weeks, depending on complexity and dependencies.

Example 3: Conducting Market Research

- **Activity Description:** Gathering data and insights related to market trends, customer preferences, competitor analysis, and potential opportunities for a new product or service.
- **Resources Required:** Market research analysts, survey tools, and data analysis software.
- **Timeframe:** Market research activities can span several weeks to months, depending on the depth of analysis required and the size of the target market.

Project Activity vs Project Task

Basis	Project Activity	Project Task
Definition	A project activity is a bigger part of the project, like a section or phase.	A project task is a smaller job that needs to be done as part of an activity.
Scope	Activities involve lots of tasks and help achieve the project's big goals.	Tasks are smaller jobs that fit into activities and help finish them.
Duration	Activities can take a long time, sometimes weeks or even months.	Tasks usually don't take as long, often just a few hours or days.
Dependency	One activity might depend on another to finish before it can start.	Tasks often rely on other tasks in the same activity to be done first.

Basis	Project Activity	Project Task
Resource Allocation	Activities need certain resources, like people or tools, to get done.	Tasks also need resources, but they're usually assigned within activities.
Monitoring Progress	Managers keep track of how activities are going to see if the project is on track.	Tasks are monitored to make sure activities stay on schedule.
Completion Criteria	An activity is finished when all the tasks inside it are done.	Tasks are done one by one, helping finish the activity they're part of.

Conclusion: Activity in Project Management

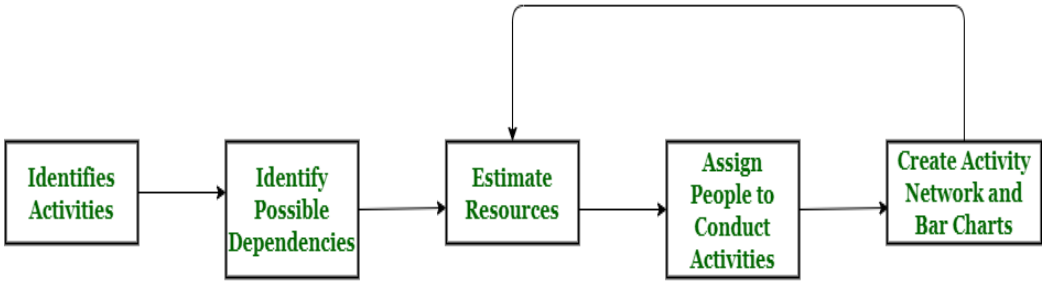
In conclusion, project activities are important parts of managing projects. They help to plan, track progress, and communicate with everyone involved. Breaking down big projects into smaller tasks, and activities makes it easier to manage and complete projects successfully. They help to avoid problems, meet deadlines, and achieve project goals. So, understanding and managing project activities well is key to making sure projects are done right and on time.

Project schedules

A schedule in your project's time table actually consists of sequenced activities and milestones that are needed to be delivered under a given period of time.

Project schedule

simply means a mechanism that is used to communicate and know about that tasks are needed and has to be done or performed and which organizational resources will be given or allocated to these tasks and in what time duration or time frame work is needed to be performed. Effective project scheduling leads to success of project, reduced cost, and increased customer satisfaction. Scheduling in project management means to list out activities, deliverables, and milestones within a project that are delivered. It contains more notes than your average weekly planner notes. The most common and important form of project schedule is Gantt chart.



Project Scheduling Process

Process

The manager needs to estimate time and resources of project while scheduling project. All activities in project must be arranged in a coherent sequence that means activities should be arranged in a logical and well-organized manner for easy to understand. Initial estimates of project can be made optimistically which means estimates can be made when all favorable things will happen and no threats or problems take place.

The total work is separated or divided into various small activities or tasks during project schedule. Then, Project manager will decide time required for each activity or task to get completed. Even some activities are conducted and performed in parallel for efficient performance. The project manager should be aware of fact that each stage of project is not problem-free.

Problems arise during Project Development Stage :

- People may leave or remain absent during particular stage of development.
- Hardware may get failed while performing.
- Software resource that is required may not be available at present, etc.

The project schedule is represented as set of chart in which work-breakdown structure and dependencies within various activities are represented. To accomplish and complete project within a given schedule, required resources must be available when they are needed. Therefore, resource estimation should be done before starting development.

Resources required for Development of Project :

- Human effort
- Sufficient disk space on server
- Specialized hardware
- Software technology
- Travel allowance required by project staff, etc.

AdvantagesofProjectScheduling

There are several advantages provided by project schedule in our project management:

- It simply ensures that everyone remains on same page as far as tasks get completed, dependencies, and deadlines.
- It helps in identifying issues early and concerns such as lack or unavailability of resources.
- It also helps to identify relationships and to monitor process.
- It provides effective budget management and risk mitigation.

Activities

Principles of Project Management Process Activities : Project management is the use of methods, tools and processes to effectively plan and execute projects. Successful project management uses teams and resources to complete project tasks within time, cost and scope. The purpose of a project is defined by the client or stakeholders, and the project manager uses project management methods to develop a plan that describes the allocation of resources, tasks, distances and releases required to meet the needs of the participants.
There are mainly 8 basic principles of the project management processes :

8 basic principles of the project management processes

1. Proposal Writing
2. Project Planning and Scheduling
3. Cost of Project
4. Project Monitoring and Review
5. Personal Selection and Evaluation
6. Report Writing and Presentations
7. Quality Management
8. Configuration Management

1. Proposal Writing :
Proposal Writing includes –
- A brief analysis of the vital objectives of the project.
- How the objectives will be achieved and fulfilled.
- Cost and schedule estimates.

2. Project Planning and Scheduling :
Project planning includes –
- Identification of activities.
- Causes (reports, manual) of management.
- Deliverables for the customer.

Project scheduling includes –

- The division of the project into separate activities.
- The judgement of time to complete each task.

3. Cost of Project :

Project cost represents the sum of all project-related outputs supported by long-term funding. It is important that Project Expenditure is accurately measured as under cost estimates will lead to a lack of funding. Cost of the project includes –

- Estimating the total cost of projects.

4. Project Monitoring and Review :

Monitoring is an ongoing process and includes –

- Project progress is regularly compared to planned time and cost schedule can be done through informal daily conversations or formal meetings.

Reviews include –

- Review of all technological advances in the project is done regularly.

5. Personal Selection and Evaluation :

Personal selection and evaluation includes –

- Selection of skilled and experienced project staff.
- Regular monitoring of staff performance.
- Inexperienced employees can be trained.

6. Report Writing and Presentations :

The purpose of the presentation is not simply to convey details. After all, the audience at the show can read a written report for themselves. The purpose of the presentation is to 'sell' the ideas contained in this report by urging the audience to act on its recommendations.

- The project report is written briefly to present before the client & contractor.

7. Quality Management :

Quality management includes –

- Quality Assurance
- Quality Planning
- Quality Control

Quality is the intensity of the purpose or the degree of coherence of the results of the process or process itself. Quality control consists of evaluation, measurement and evaluation to ensure that project results meet the acceptance process defined during quality planning.

8. Configuration Management :

Configuration is a set of functions designed to control change by identifying work products that can change, establish relationships between them, defined management methods a different kind of these products, controls and set changes auditing and reporting on changes made. It Includes –

- Identifying work products.
- Product management and control, testing, change reporting.

Project Management Process Activities Advantages :

Whether you run a small business or an established organization, you may not be able to manage all kinds of projects from start to finish. Some projects are very difficult and have

strong deadlines or require special skills that your team may not have. A qualified project manager can help you plan and manage the most time-consuming tasks. An experienced project manager will motivate your team, manage resources, measure outcomes, provide feedback and find ways to increase quality and reduce costs or time. Other project management skills include enhanced planning strategies, responsiveness change, improved communication, quality control and risk management.

Project Management Process Activities Disadvantages :

If a project manager does not have the right information or knowledge, there are many problems that can arise. Loss of resources, planning problems, security issues and conflicts between people are major issues in project management. Additionally, your organization may incur higher costs by outsourcing or hiring new staff to complete the project. In some cases, project management may interfere with your day-to-day operations or may even go away from usual.

Conclusion: Project Management Process Activities

In conclusion, project management is about finishing up paperwork, learning from mistakes, freeing up resources, checking if the project did what it was supposed to, and having a celebration to mark success. It's like tying up loose ends and getting ready for what's next.

Sequencing and scheduling

Sequencing and Scheduling Activities Project and its activities must be clearly defined to achieve the target. An activity plan will

contain the following factors: A project is basically, composed of number of interrelated activities.

- The initiation of a project happens only if atleast 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 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 analysis the

various activities needed a0t 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 down into lower sets of tasks.

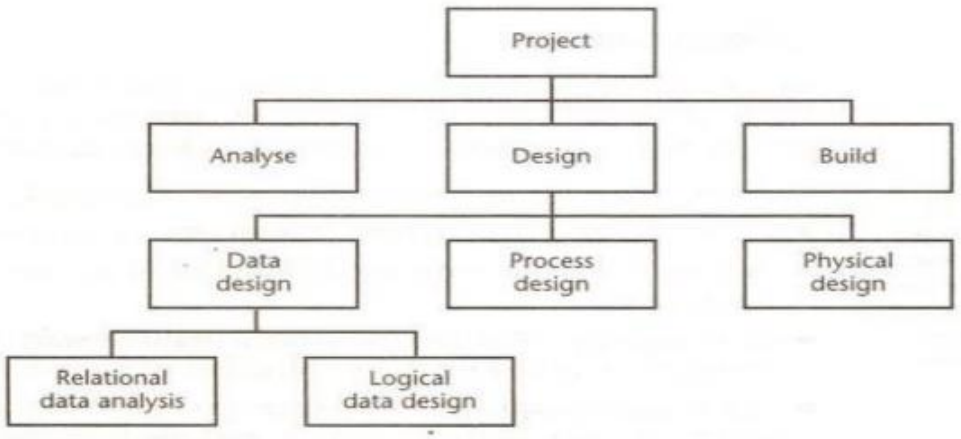


Figure - Activity-based approach Work Breakdown Structure

Task defined at lower level includes everything that is required to complete the task at the

¬ higher level. The work breakdown structure provides an 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 has to be achieved in

¬ accomplishing a specific task. The ordering of 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 do not leave out any activity from its ordered list and adopts a

¬ methodology which clearly specifies what are the products required and what are the activities required to produce the product.

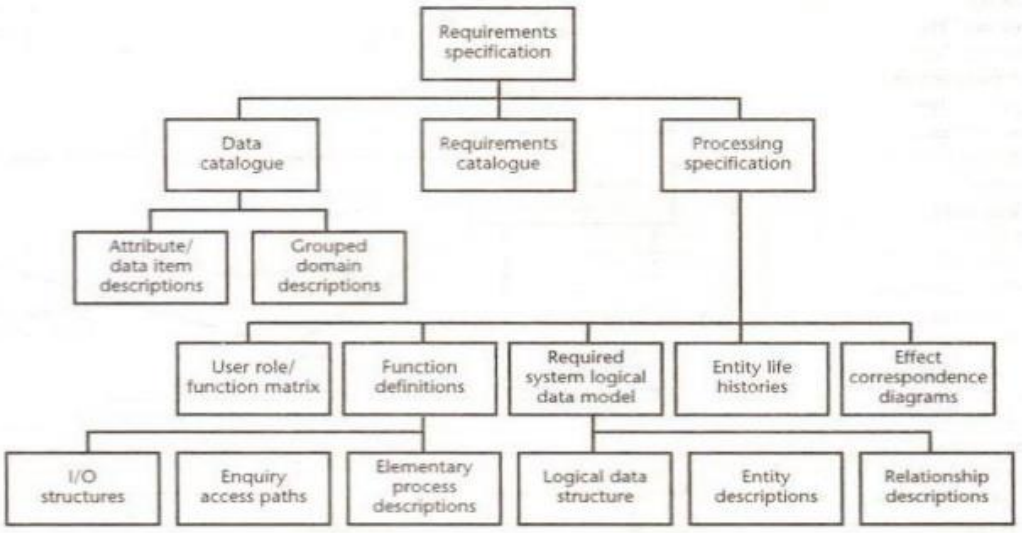


Figure - SSADM Product Breakdown Structure

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 activitynetwork.

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.

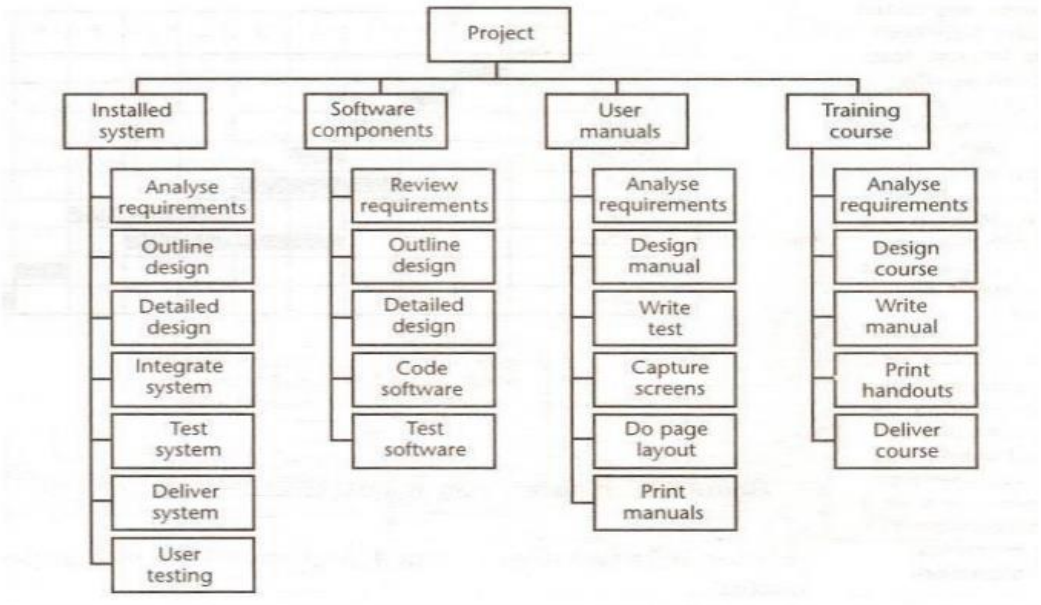


Figure - Hybrid Approach combining Activities and Products

Sequencing and scheduling activities Scheduling is required for every activity that is planned along with the resources and can

¬ be represented using a bar chart. The chart describes the nature of the development process and the resources available for completing the specified activities

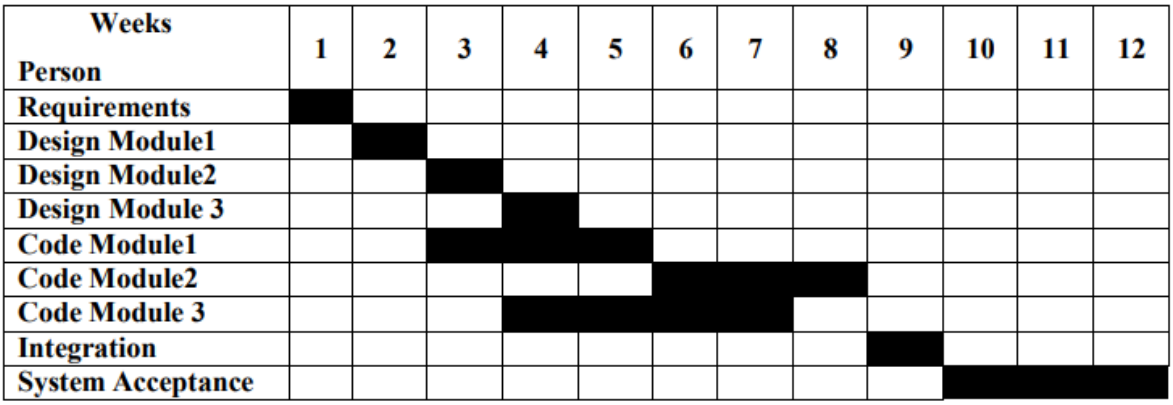


Figure - Bar chart representing Scheduling

The chart defines two factors: sequencing of tasks and the schedule of thetask. Scheduling

¬ includes the staff availability and the activities allocated to them. Combining sequencing – scheduling approach is suitable only for smaller projects and

¬ needs to be separated for complex projects as individual process. In case of larger projects, the logical relationship between the activities are grouped

¬ together and then scheduled for resources.

Network Planning models

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

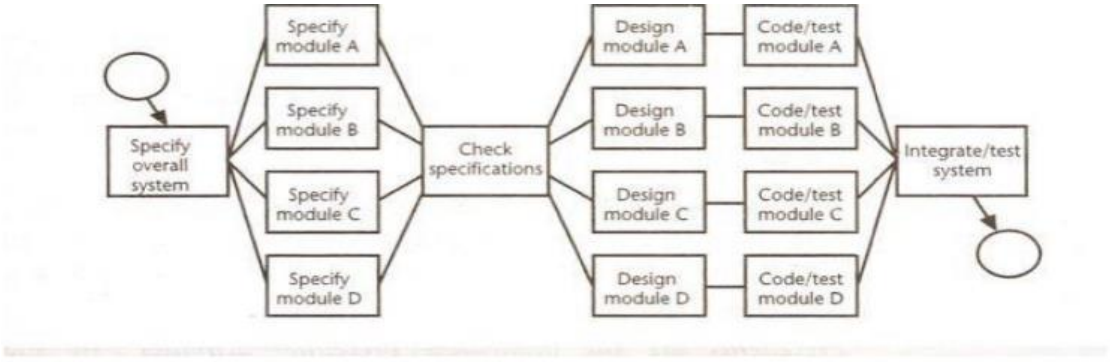


Fig: The IOE maintenance group accounts project activity network fragment with a check point activity added

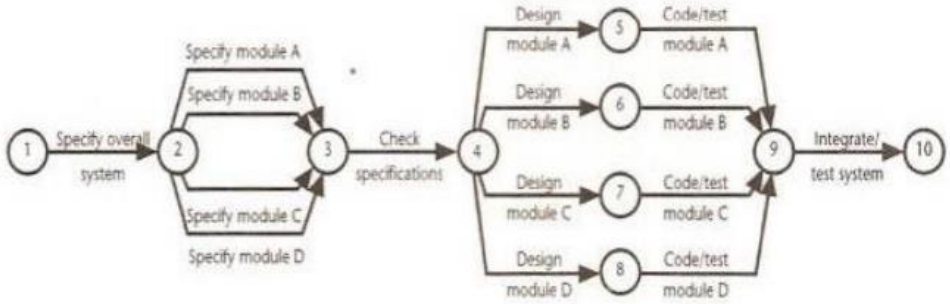


Fig: The IOE maintenance group accounts project activity network fragment represented as a CPM network

:

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 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

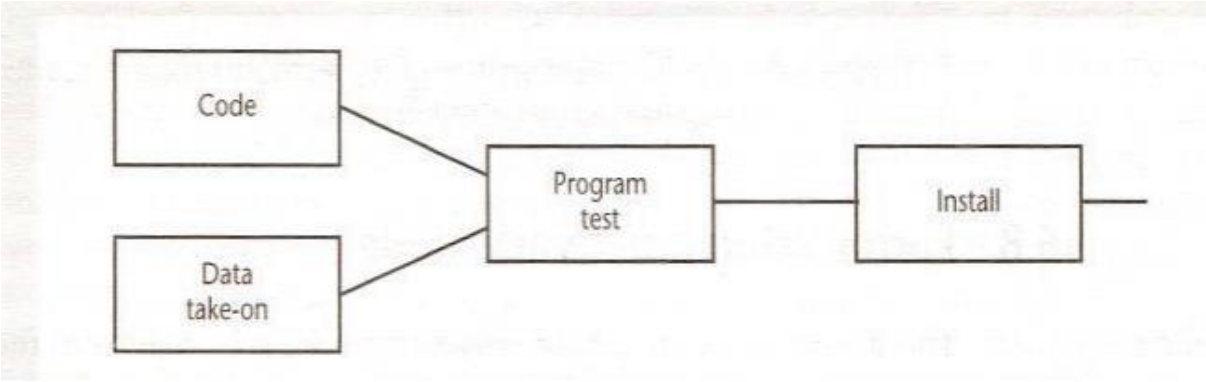


Fig : Fragment of a precedence network

• 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 of iteration, may occur in practice, they cannot be directly represented in a project network.

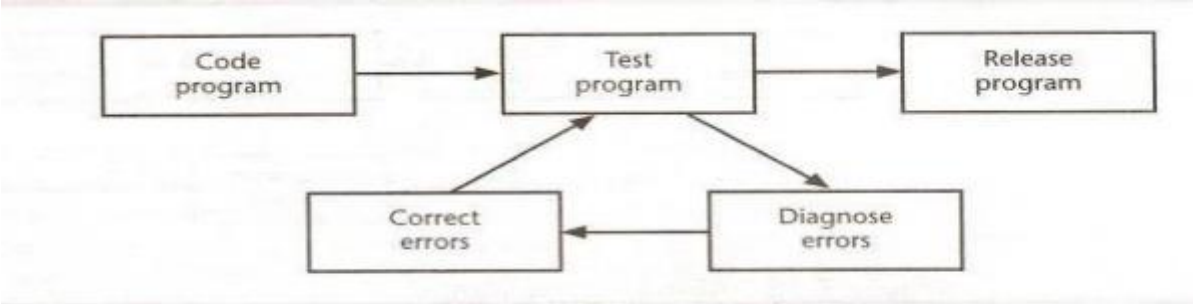


Fig: A Loop representing an impossible sequence

• 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

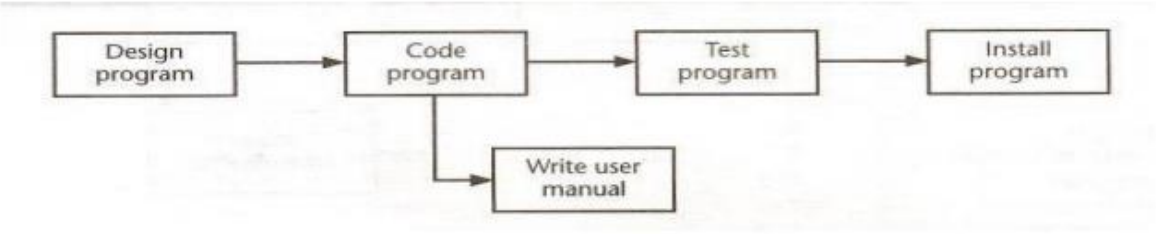


Fig: A Dangle

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.

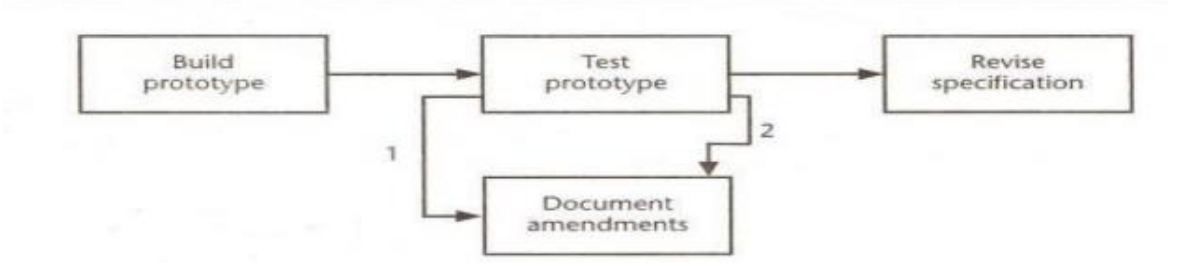


Fig: Indicating lags

Forward Pass & Backward Pass techniques

Activity-on-node network:

Critical path method uses activity-on-node networks where activities are represented as nodes and the links between nodes represent precedence (or sequencing) requirements. Labeling conventions

• There are a number of differing conventions that have been adopted for entering information on an activity-on-node network. One of the more common conventions for labelling nodes, and the one adopted here, is shown on the left.

• The activity label is usually a code developed to uniquely identify the activity and may incorporate a project code

• The activity description will normally be a brief activity name such as 'Test take-on module'.

Earliest start	Duration	Earliest finish
Activity label, activity description		
Latest start	Float	Latest finish

Adding the time dimension

• Having created the logical network model indicating what needs to be done and the interrelationships between those activities, we are now ready to start thinking about wheneach activity should be undertaken.

• The critical path approach is concerned with two primary objectives: planning the project in such a way that it is completed as quickly as possible: and identifying those activities where a delay in their execution is likely to affect the overall end date of the project or later activities' start dates.

• The method requires that for each activity we have an estimate of its duration. The network is then analyzed by carrying out a forward pass, to calculate the earliest dates at which activities may commence and the project be completed, and a backward pass, to calculate the latest start dates for activities and the critical path.

• In practice we would use a software application to carry out these calculations for anything but the smallest of projects. It is important, though, that we understand how the calculations are carried out in order to interpret the results correctly and understand the limitations of the method.

• The description and example that follow use the small example project outlined in Table — a project composed of eight activities whose durations have been estimated as shown in the table

Activity		Duration (weeks)	Precedents
A	Hardware selection	6	
B	Software design	4	
C	Install hardware	3	A
D	Code & test software	4	B
E	File take-on	3	B
F	Write user manuals	10	
G	User training	3	E, F
H	Install & test system	2	C, D

Table: An Example project specification with estimated activity durations and precedence requirements

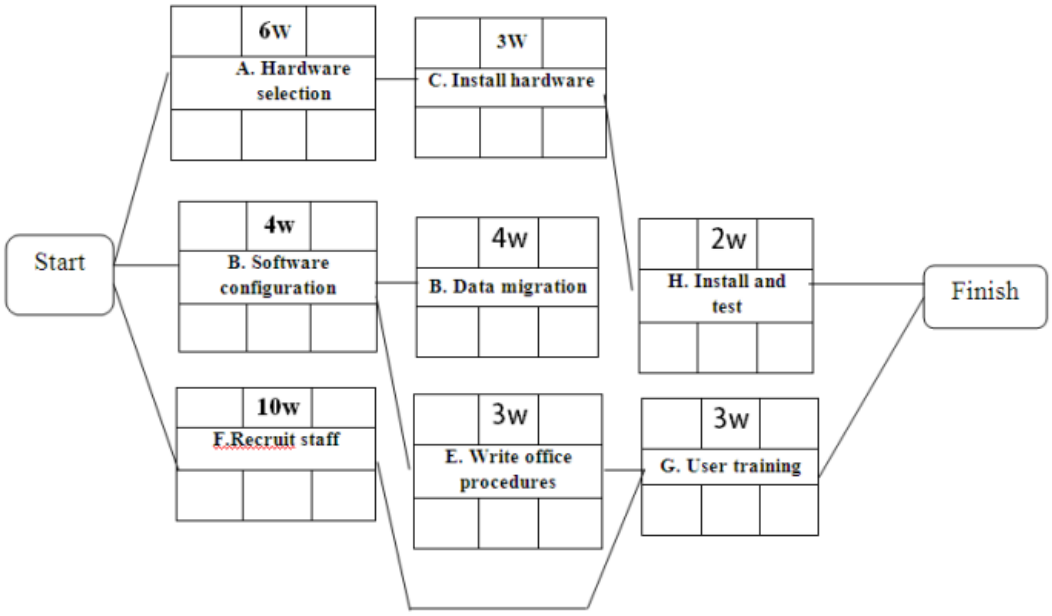


Figure: The precedence network for the example project

The forward pass

• The forward pass is carried out to calculate the earliest dates on which each activity may be started and completed.

• Where an actual start date is known, the calculations may be carried out using actual dates. Alternatively we can use day or week numbers and that is the approach we shall adopt here. By convention, dates indicate the end of a period and the project is therefore shown as starting at the end of week zero (or the beginning of week 1).

• The forward pass and the calculation of earliest start dates is calculated according to the following reasoning.

• Activities A, B and F may start immediately, so the earliest date for their start is zero.

• Activity A will take 6 weeks, so the earliest it can finish is week 6.

• Activity B will take 4 weeks, so the earliest it can finish is week 4.

• Activity F will take 10 weeks, so the earliest it can finish is week 10.

• Activity C can start as soon as A has finished so its earliest start date is week 6. It will take 3 weeks so the earliest it can finish is week 9.

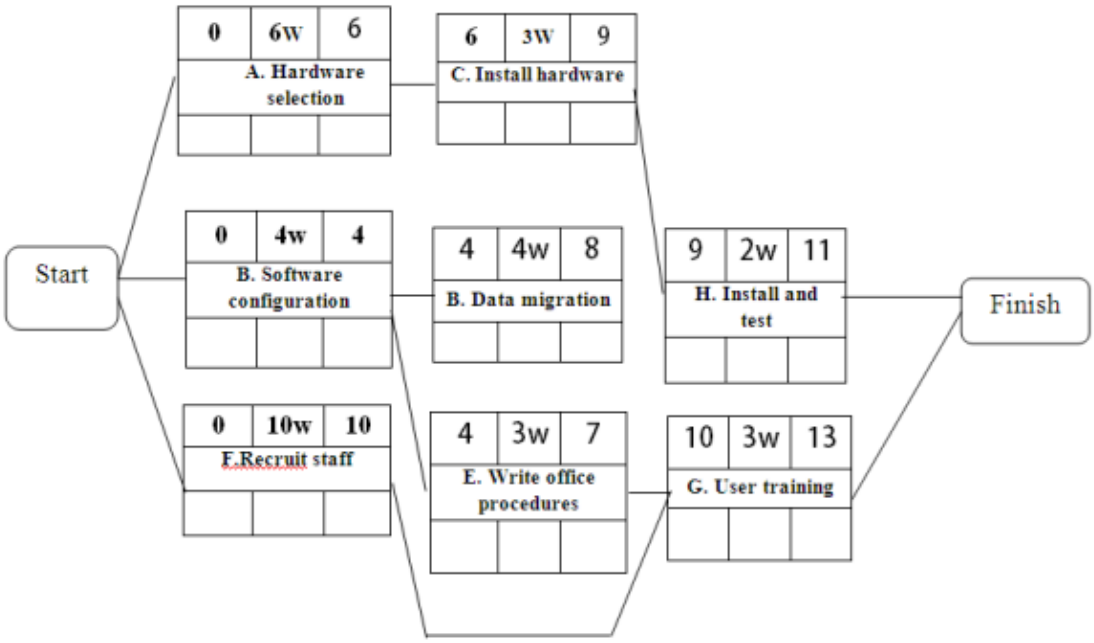


Figure: The network after the forward pass

• Activities D and E can start as soon as B is complete so the earliest they can each start is week 4. Activity D, which will take 4 weeks, can therefore finish by week 8 and activity E, which will take 3 weeks, can therefore finish by week 7.

• Activity G cannot start until both E and F have been completed. It cannot therefore start until week 10 — the later of weeks 7 (for activity E) and 10 (for activity F). It takes 3 weeks and finishes in week 13.

• Similarly, Activity H cannot start until week 9 — the later of the two earliest finished dates for the preceding activities C and a The project will be complete when both activities H and G have been completed. Thus the

earliest project completion date will be the later of weeks 11 and 13— that is, week 13. The results of the forward pass are shown in Figure. The backward pass

• The second stage in the analysis of a critical path network is to carry out a backward pass to calculate the latest date at which each activity may be started and finished without delaying the end date of the project. In calculating the latest dates, we assume that the latest finish date for the project is the same as the earliest finish date — that is, we wish to complete the project as early as possible.

• Figure 6.16 illustrates our network alter carrying out the backward pass.

• The latest activity dates are calculated as follows.

• The latest completion date for activities G and 1-1 is assumed to be week 13.

• Activity H must therefore start at week 11 at the latest (13-2) and the lateststart date for activity G is week 10 (13-3).

• The latest completion date for activities C and D is the latest date at which

• activity H must start — that is. week 11. They therefore have latest start dates of week 8 (11- 3) and week 7 (11-4) respectively.

• Activities E and F must be completed by week 10 so their earliest start dates are weeks 7 (10-3) and 0 (10-10 respectively.

• Activity B must be completed by week 7 the latest start date for both activities D and El soits latest start is week 3 (7-4).

• Activity A must be completed by week 8 (the latest start date for activity C) so its latest startis week 2 (8-6).

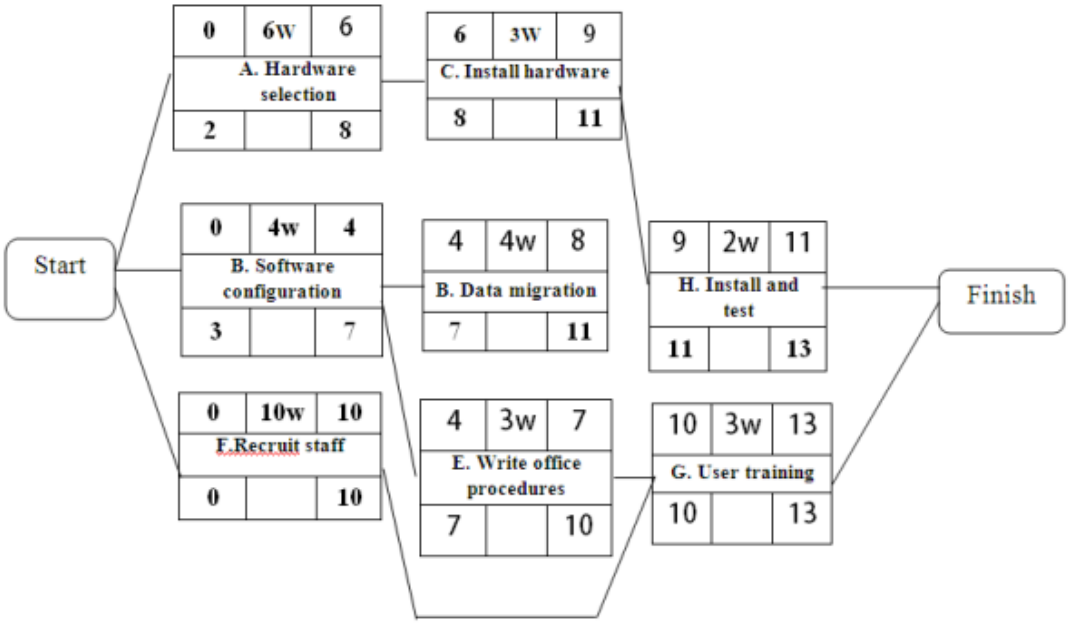


Figure: The network after the backward pass

The latest start date for the project start is the earliest of the latest start dates for activities A. B and F. This is week zero. This is, of course, not very surprising since it tells us that if the project does not start on time it won't finish on time.

critical path (crm) method

Critical Path Method (CPM) is a method used in project planning, generally for project scheduling for the on-time completion of the project. It helps in the determination of the earliest time by which the whole project can be completed. There are two main concepts in this method namely critical task and critical path.

What is a Critical task in project management?

It is the task/activity that can't be delayed otherwise the completion of the entire project will be delayed. It must be completed on time before starting the other dependent tasks.

What is the Critical path in project management?

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:

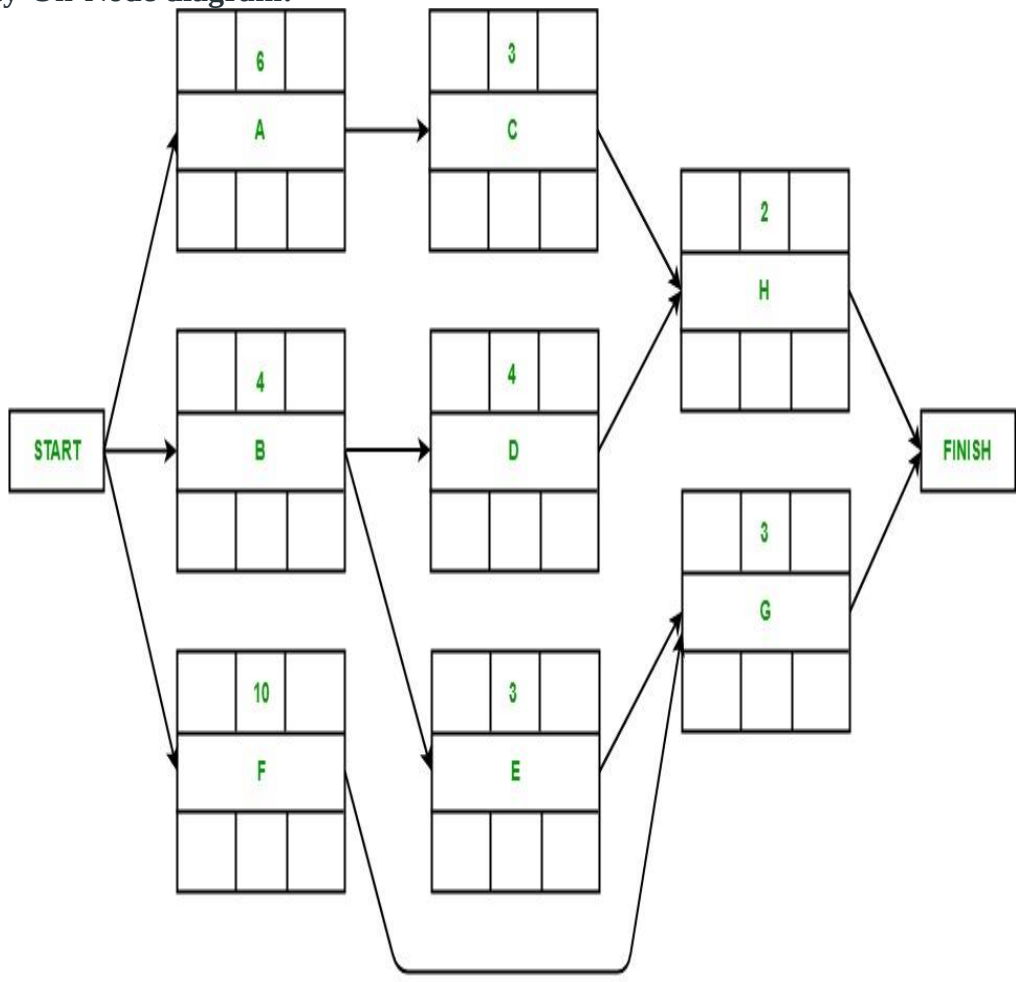
- A project network should have only one start node
- A project network should have only one end node

- 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:

- **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.

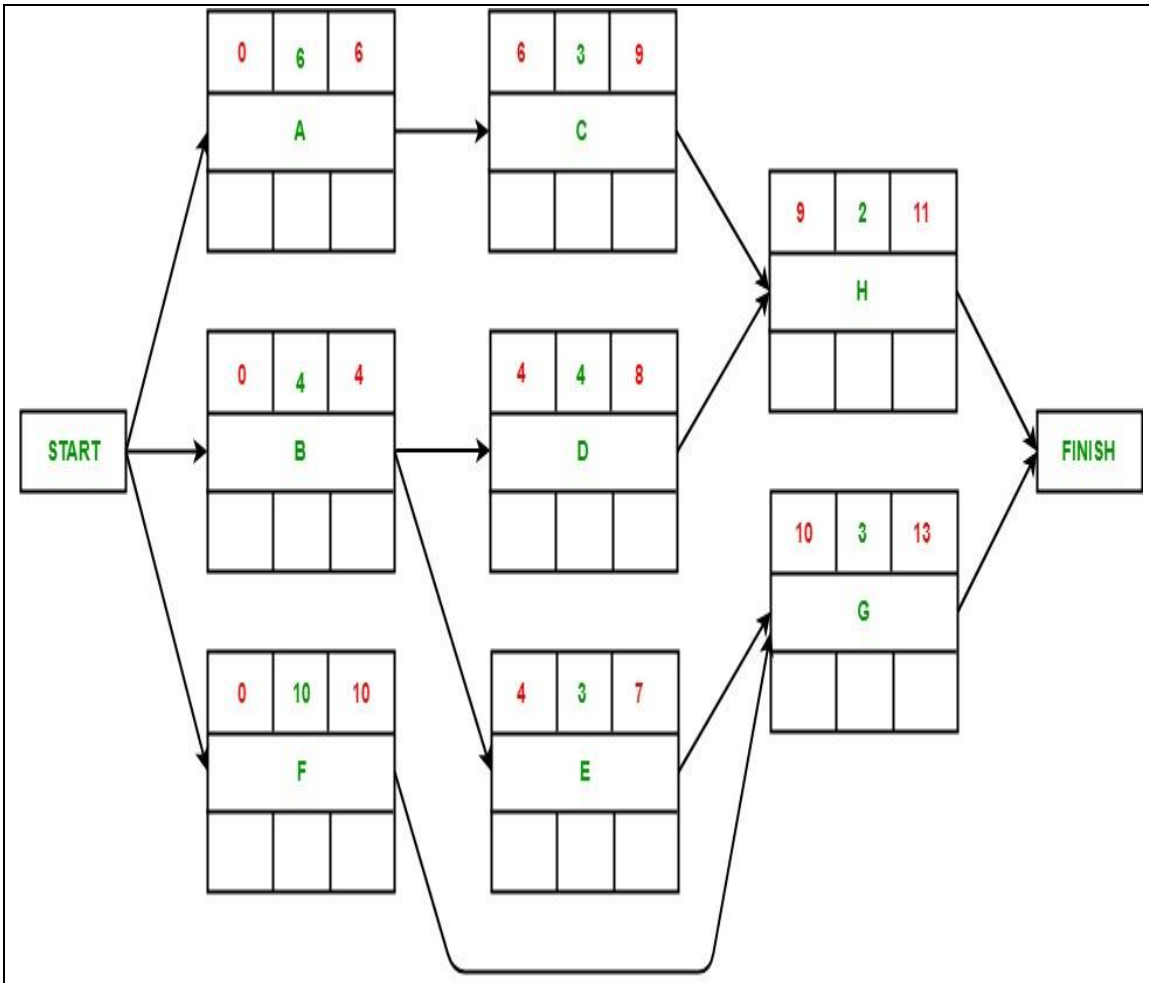
Activity-On-Node diagram:



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.

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
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.
8. 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.

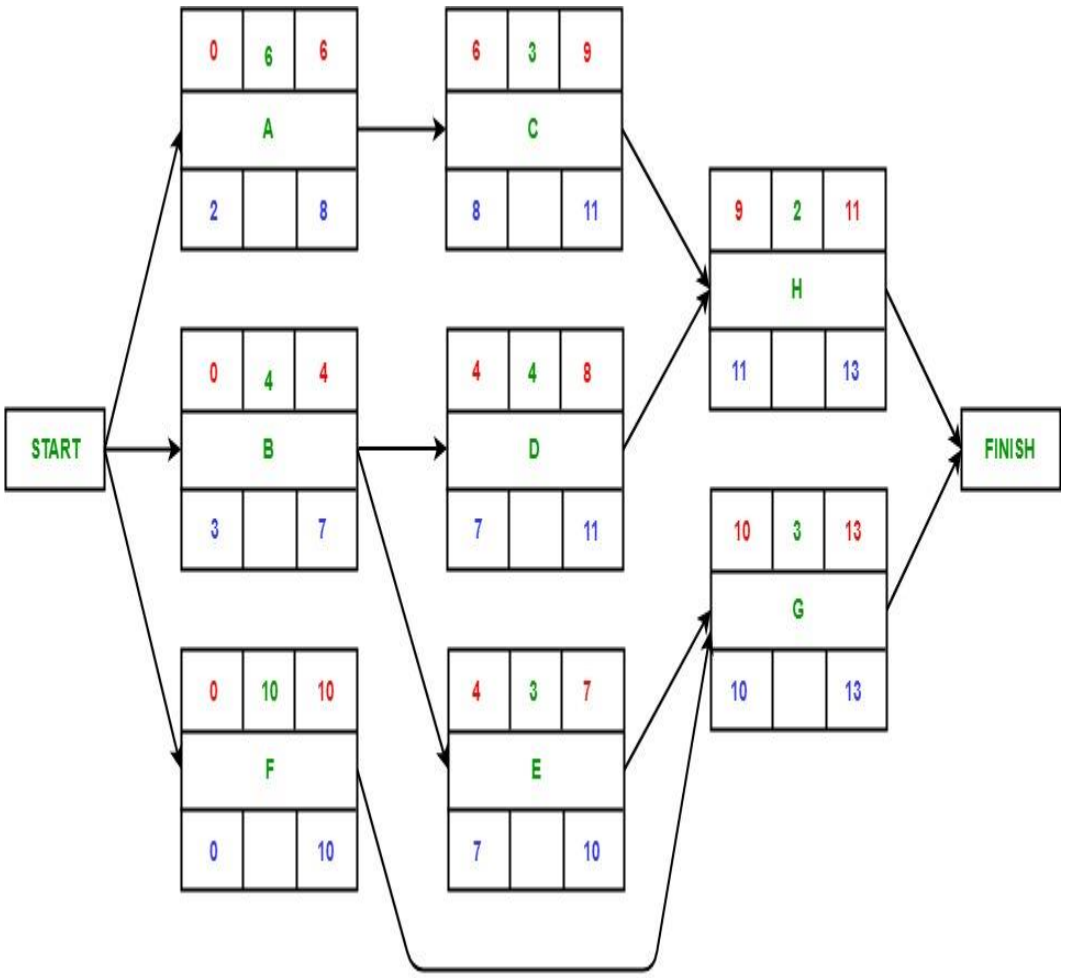


Backward Pass in Critical path in project management:

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.

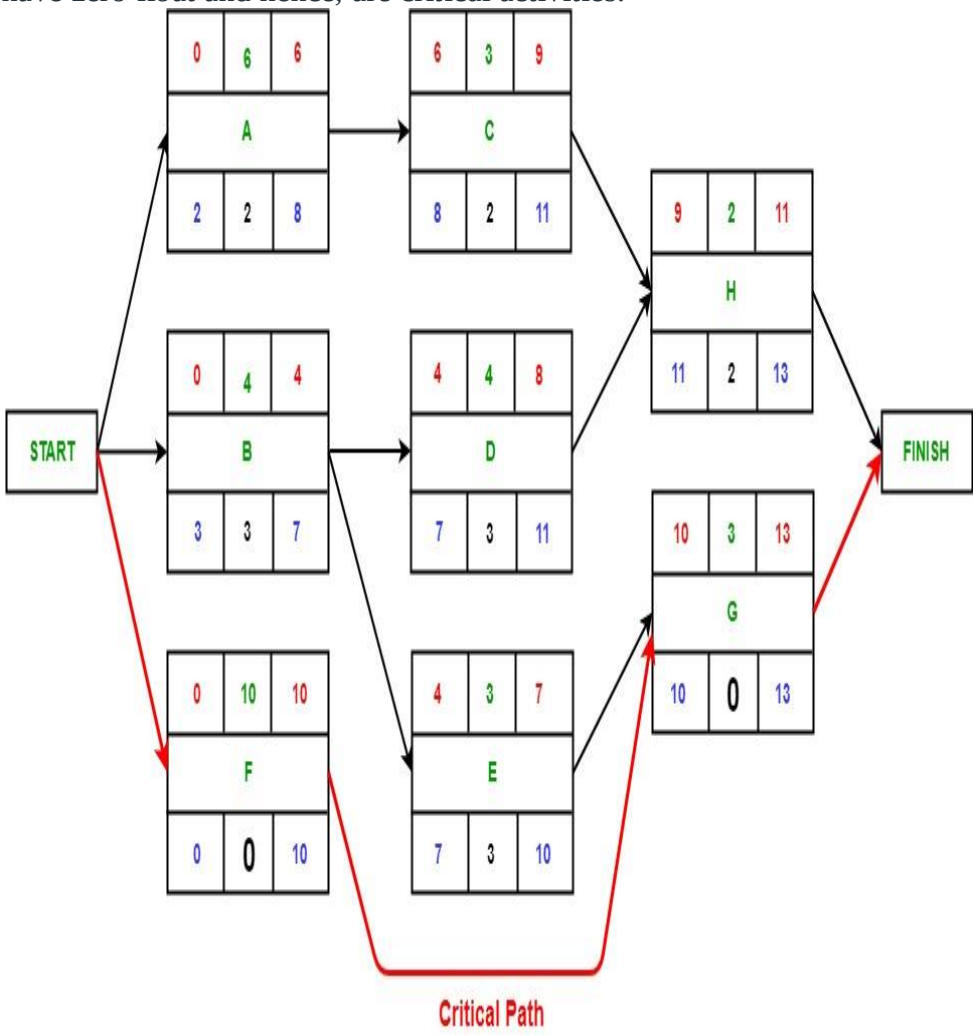
- The latest end date for activity F would be the latest start date of G i.e. LF(G) = 10. It takes 10 weeks to complete its execution. Hence, the latest it can start is week 0 i.e. LS(F) = 0.
- The latest end date for activity A would be the latest start date of C i.e. LF(A) = 8. It takes 6 weeks to 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.



Risk identification

Identifying risk is one of most important or essential and initial steps in risk management process. By chance, if failure occurs in identifying any specific or particular risk, then all other steps that are involved in risk management will not be implemented for that particular risk. For identifying risk, project team should review scope of program, estimate cost, schedule, technical maturity, parameters of key performance, etc. To manage risk, project team or organization are needed to know about what risks it faces, and then to evaluate them. Generally, identification of risk is an iterative process. It basically includes generating or creating comprehensive list of threats and opportunities that are based on events that can enhance, prevent, degrade, accelerate, or might delay successful achievement of objectives. In simple words, if you don't find or identify risk, you won't be able to manage it.

The organizer of project needs to expect some of the risk in the project as early as possible so that the performance of risk may be reduced. This could be only possible by making effective risk management planning.

A project may contain large variety of risk. To know the specific amount of risk, there may be chance of affecting a project. So, this is necessary to make categories into different class of risk.

There are many different types of risks which affects the software project:

1. Technology risks
2. Tools risks
3. Estimation risks
4. People risks
5. Requirement risks
6. Organizational risks

Methods for Identifying Risks : Earlier, there were no easy methods available that will surely identify all risks. But nowadays, there are some additional approaches available for identifying risks. Some of approaches for risk identification are given below:

1. Checklist Analysis – Checklist Analysis is type of technique generally used to identify or find risks and manage it. The checklist is basically developed by listing items, steps, or even tasks and is then further analyzed against criteria to just identify and determine if procedure is completed correctly or not. It is list of risk that is just found to occur regularly in development of software project. Below is the list of software development risk by Barry Boehm- modified version.

Risk	Risk Reduction Technique
Personnel Shortfalls	**Various techniques include training and career development, job-matching, teambuilding, etc.**
Unrealistic time and cost estimates	**Various techniques include incremental development, standardization of methods, recording, and analysis of the past project, etc.**
Development of wrong software functions	**Various techniques include formal specification methods, user surveys, etc.**
Development of the wrong user interface	**Various techniques include user involvement, prototyping, etc.**

2. Brainstorming – This technique provides and gives free and open approach that usually encourages each and everyone on project team to participate. It also results in greater sense of ownership of project risk, and team generally committed to managing risk for given time period of project. It is creative and unique technique to gather risks spontaneously by team members. The team members identify and determine risks in 'no wrong answer' environment. This technique also provides opportunity for team members to always develop on each other's ideas. This technique is also used to determine best possible solution to problems and issue that arises and emerge.

3. Casual Mapping – Causal mapping is method that builds or develops on reflection and review of failure factors in cause and effect of the diagrams. It is very useful for facilitating learning with an organization or system simply as method of project-post evaluation. It is also key tool for risk assessment.

4. SWOT Analysis – Strengths-Weaknesses-Opportunities-Threat (SWOT) is very technique and helpful for identifying risks within greater organization context. It is generally used as planning tool for analyzing business, its resources, and also its environment simply by looking at internal strengths and weaknesses and opportunities and threats in external environment. It is technique often used in formulation of strategy. The appropriate time and effort should be spent on thinking seriously about weaknesses and threats of organization for SWOT analysis to more effective and successful in risk identification.

5. Flowchart Method – This method allows for dynamic process to be diagrammatically represented in paper. This method is generally used to represent activities of process graphically and sequentially to simply identify the risk.

Assessment

Software Process Assessment is a disciplined and organized examination of the software process which is being used by any organization bases the on the process model. The Software Process Assessment includes many fields and parts like identification and characterization of current practices, the ability of current practices to control or avoid significant causes of poor (software) quality, cost, schedule and identifying areas of strengths and weaknesses of the software.

Types of Software Assessment :

- **Self Assessment :** This is conducted internally by the people of their own organisation.
- **Second Party assessment:** This is conducted by an external team or people of the own organisation are supervised by an external team.
- **Third Party assessment:**

In an ideal case Software Process Assessment should be performed in a transparent, open and collaborative environment. This is very important for the improvement of the software and the development of the product. The results of the Software Process Assessment are confidential and are only accessible to the company. The assessment team must contain at least one person from the organization that is being assessed.

Software Process Maturity Assessment:
The scope of Software Process Assessment includes many components like it should cover all the processes in the organisation, a selected subset of the software process or a specific project. The idea of process maturity serves as the foundation for the majority of standard-based process evaluation methodologies.

Though an organisation is the assessment objective, even when the same approach is applied again, the outcomes of a process evaluation may vary. The different results are mainly due to two reasons. The reasons are that the organization that is being investigated must be determined. When the company is very large it is possible for the company to have different definitions due to which the actual scope of appraisal may be different in successive assessments. Even if it is the same organization the sample of projects selected to represent the organization may affect the scope and result. Process maturity is important when the organisation intended to embark on an long term improvement strategy.

Software Process Cycle:
Generally there are six different steps in the complete cycle:

- Selecting a team: The first step is to select all the team members. Everyone must be software professionals with sound knowledge in software engineering.
- The standard process maturity questionnaire is filled out by the representatives of the site that will be evaluated.
- In accordance with the CMM core process areas, the assessment team analyses the questionnaire results to determine the areas that call for additional investigation.
- The evaluation team visits the location to learn more about the software procedures used there.
- The evaluation team compiles a set of results outlining the organization's software process's advantages and disadvantages.
- In order to deliver the findings to the right audience, the assessment team creates a Key Process Area (KPA) profile analysis.

SCAMPI;

SCAMPI stands for Standard CMMI Assessment Method for Process Improvement. To fulfil the demands of the CMMI paradigm, the Standard CMMI Assessment Method for Process Improvement (SCAMPI) was created (Software Engineering Institute, 2000). Moreover, it is based on the CBA IPI. The CBA IPI and SCAMPI both have three steps.

1. Plan and become ready
2. Carry out the evaluation on-site
3. Report findings

The planning and preparation phase includes the following activities:

- Describe the scope of the evaluation.
- Create the assessment strategy.
- Get the evaluation crew ready and trained.
- Make a quick evaluation of the participants.
- CMMI Appraisal Questionnaire distribution
- Look at the survey results.
- Perform a preliminary document evaluation.

The onsite evaluation phase includes the following activities:

- Display the results.
- Execute the findings.
- Complete / end the assessment.

Risk Planning –Risk Management

A risk is a probable problem; it might happen, or it might not. There are main two characteristics of risk.

- **Uncertainty:** the risk may or may not happen which means there are no 100% risks.
- **Loss:** If the risk occurs in reality, undesirable results or losses will occur.

In this Article we will understand Risk Management in detail.

What is Risk Management?

Risk Management is a systematic process of recognizing, evaluating, and handling threats or risks that have an effect on the finances, capital, and overall operations of an

organization. These risks can come from different areas, such as financial instability, legal issues, errors in strategic planning, accidents, and natural disasters.
The main goal of risk management is to predict possible risks and find solutions to deal with them successfully.

Why is risk management important?
Risk management is important because it helps organizations to prepare for unexpected circumstances that can vary from small issues to major crises. By actively understanding, evaluating, and planning for potential risks, organizations can protect their financial health, continued operation, and overall survival.
Let's Understand why risk management important with an example.
Suppose In a software development project, one of the key developers unexpectedly falls ill and is unable to contribute to the product for an extended period.
One of the solution that organization may have , The team uses collaborative tools and procedures, such as shared work boards or project management software, to make sure that each member of the team is aware of all tasks and responsibilities, including those of their teammates.
An organization must focus on providing resources to minimize the negative effects of possible events and maximize positive results in order to reduce risk effectively.
Organizations can more effectively identify, assess, and mitigate major risks by implementing a consistent, systematic, and integrated approach to risk management.
The risk management process
Risk management is a sequence of steps that help a software team to understand, analyze, and manage uncertainty. Risk management process consists of

- Risks Identification.
- Risk Assessment.
- Risks Planning.
- Risk Monitoring

Risk Management Process

Risk Identification

Risk identification refers to the systematic process of recognizing and evaluating potential threats or hazards that could negatively impact an organization, its operations, or its workforce. This involves identifying various types of risks, ranging from IT security threats like viruses and phishing attacks to unforeseen events such as equipment failures and extreme weather conditions.

Risk analysis

Risk analysis is the process of evaluating and understanding the potential impact and likelihood of identified risks on an organization. It helps determine how serious a risk is and how to best manage or mitigate it. Risk Analysis involves evaluating each risk's probability and potential consequences to prioritize and manage them effectively.

Risk Planning

Risk planning involves developing strategies and actions to manage and mitigate identified risks effectively. It outlines how to respond to potential risks, including prevention, mitigation, and contingency measures, to protect the organization's objectives and assets.

Risk Monitoring

Risk monitoring involves continuously tracking and overseeing identified risks to assess their status, changes, and effectiveness of mitigation strategies. It ensures that risks are regularly reviewed and managed to maintain alignment with organizational objectives and adapt to new developments or challenges.

Understanding Risks in Software Projects

A computer code project may be laid low with an outsized sort of risk. To be ready to consistently establish the necessary risks that could affect a computer code project, it's necessary to group risks into completely different categories. The project manager will then examine the risks from every category square measure relevant to the project.

There are mainly 3 classes of risks that may affect a computer code project:

1. **Project Risks:**
   Project risks concern various sorts of monetary funds, schedules, personnel, resources, and customer-related issues. A vital project risk is schedule slippage. Since computer code is intangible, it's tough to observe and manage a computer code project. It's tough to manage one thing that can not be seen. For any producing project, like producing cars, the project manager will see the merchandise taking form.
   For example, see that the engine is fitted, at the moment the area of the door unit is fitted, the automotive is being painted, etc. so he will simply assess the progress of the work and manage it. The physical property of the merchandise being developed is a vital reason why several computer codes come to suffer from the danger of schedule slippage.
2. **Technical Risks:**
   Technical risks concern potential style, implementation, interfacing, testing, and maintenance issues. Technical risks conjointly embody ambiguous specifications, incomplete specifications, dynamic specifications, technical uncertainty, and technical degeneration. Most technical risks occur thanks to the event team's lean information concerning the project.
3. **Business Risks:**
   This type of risk embodies the risks of building a superb product that nobody needs, losing monetary funds or personal commitments, etc.

Classification of Risk in a project

Example: Let us consider a satellite-based mobile communication project. The project manager can identify many risks in this project. Let us classify them appropriately.

- What if the project cost escalates and overshoots what was estimated? – **Project Risk**

- What if the mobile phones that are developed become too bulky to conveniently carry? **Business Risk**
- What if call hand-off between satellites becomes too difficult to implement? **Technical Risk**

Risk management standards and frameworks

Risk management standards and frameworks give organizations guidelines on how to find, evaluate, and handle risks effectively. They provide a structured way to manage risks, making sure that everyone follows consistent and reliable practices. Here are some well-known risk management standards and frameworks:

1. COSO ERM Framework:

COSO ERM Framework was introduce in 2004 and updated in 2017. Its main purpose is to addresses the growing complexity of Enterprise Risk Management (ERM).

- **Key Features**:
    - 20 principles grouped into five components: Governance and culture, Strategy and objective-setting, Performance, Review and revision, Information, communication, and reporting.
    - It promote integrating risk into business strategies and operations.

2. **ISO 31000**:

ISO 31000 was introduce in 2009, revised in 2018. It provides principles and a framework for ERM.

- **Key Features**:
    - It offers guidance on applying risk management to operations.
    - It focuses on identifying, evaluating, and mitigating risks.
    - It promote senior management's role and integrating risk management across the organization.

3. **BS 31100**:

This framework is British Standard for Risk Management and latest version issued in 2001. It offers a structured approach to applying the principles outlined in ISO 31000:2018, covering tasks like identifying, evaluating, and addressing risks, followed by reporting and reviewing risk management efforts.

Benefits of risk management

Here are some benefits of risk management:

- Helps protect against potential losses.
- Improves decision-making by considering risks.
- Reduces unexpected expenses.
- Ensures adherence to laws and regulations.
- Builds resilience against unexpected challenges.
- Safeguards company reputation.

Limitation of Risk Management

Here are Some Limitation of Risk Management

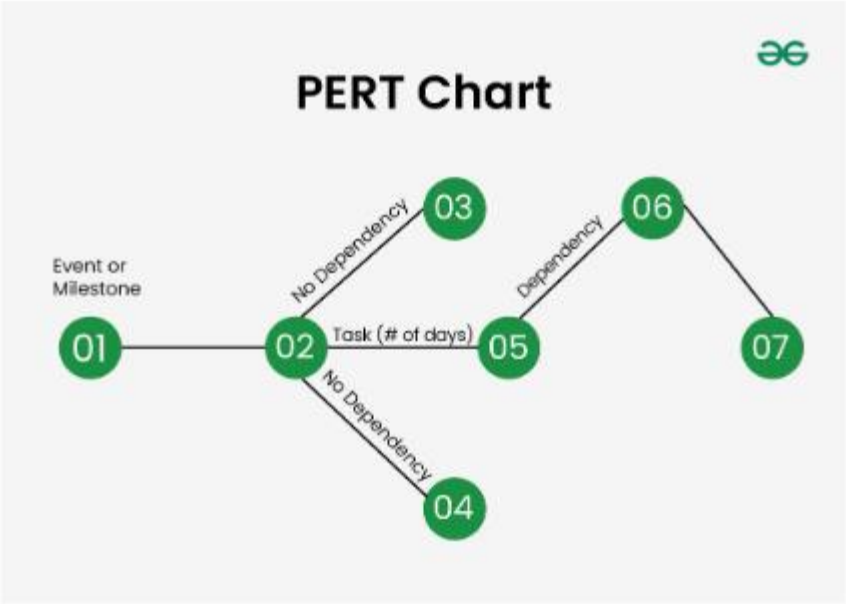
- Too much focus on risk can lead to missed opportunities.
- Implementing risk management can be expensive.
- Risk models can be overly complex and hard to understand.
- Having risk controls might make people feel too safe.
- Relies on accurate human judgment and can be prone to mistakes.
- Some risks are hard to predict or quantify.
- Managing risks can take a lot of time and resources.

Conclusion

Risk management is important for protecting businesses from potential problems and helping them make better decisions. While it has many advantages, like saving money and keeping things running smoothly, it also has challenges, such as cost and complexity. Overall, using risk management wisely can help businesses succeed by preparing for the unexpected and making the most of opportunities.

PERT

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).



PERT chart

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

Feature	PERT Chart	Gantt Chart
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.

Aspect	PERT	CPM
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.

Conclusion

In conclusion, the **Project Evaluation and Review Technique (PERT)** is a valuable tool for effective project management. It helps teams visualize the sequence of tasks, understand dependencies, and identify the critical path for timely project completion. By using PERT, organizations can improve planning, resource allocation, and overall project success, ensuring that goals are met efficiently and effectively.