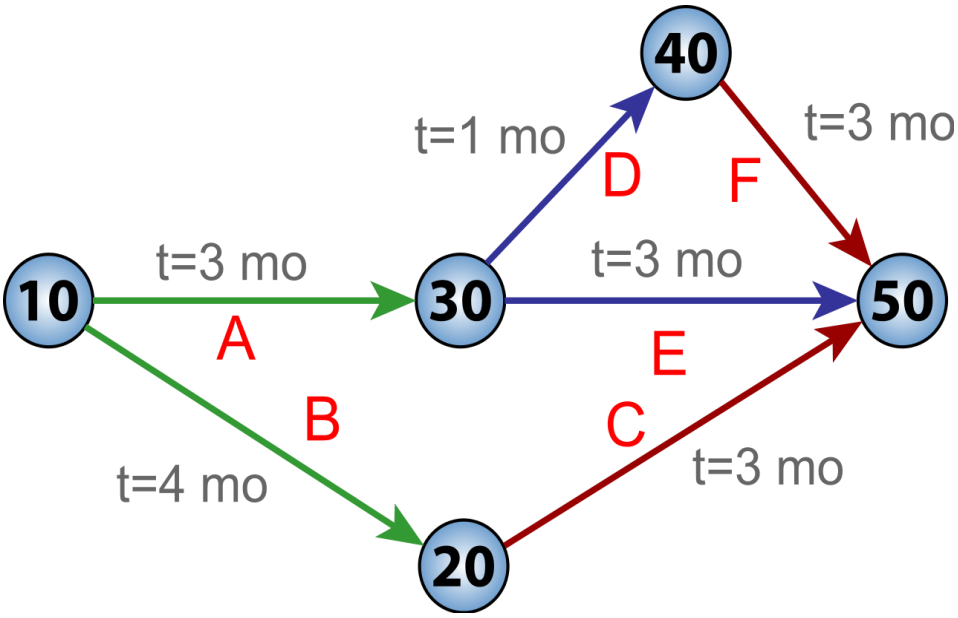
UNIT 3:

Project Scheduling and Risk Management

What is Project Evaluation Review Technique (PERT)?

In project management, the Project Evaluation Review Technique, or PERT, is used to identify the time it takes to finish a particular task or activity. It is a system that helps in the proper scheduling and coordination of all tasks throughout a project. It also helps in keeping track of the progress, or lack thereof, of the overall project. In the 1950s, the Project Evaluation Review Technique was developed by the US Navy to manage the Polaris submarine missile program of their Special Projects Office.



Knowing the time it should take to execute a project is crucial, as it helps project managers decide on other factors such as the budget and task delegation. No matter how big or small a project is, estimates can be too optimistic or pessimistic, but using a PERT chart will help determine realistic estimates.

Creating a PERT Chart

A flowchart is used to depict the Project Evaluation Review Technique. Nodes represent the events, indicating the start or end of activities or tasks. The directorial lines indicate the tasks that need to be completed, and the arrows show the sequence of the activities.

There are four definitions of time used to estimate project time requirements:

- Optimistic time – The least amount of time it can take to complete a task
- Pessimistic time – The maximum amount of time it should take to complete a task
- Most likely time – Assuming there are no problems, the best or most reasonable estimate of how long it should take to complete a task.
- Expected time – Assuming there are problems, the best estimate of how much time will be required to complete a task.

Here are several terms used in a PERT chart:

- Float/Slack – Refers to the amount of time a task can be delayed without resulting in an overall delay in completion of other tasks or the project

- Critical Path – Indicates the longest possible continuous path from the start to the end of a task or event
- Critical Path Activity – Refers to an activity without any slack
- Lead Time – Refers to the amount of time needed to finish a task without affecting subsequent tasks
- Lag Time – The earliest time by which a successor event/task can follow a prior event/task
- Fast Tracking – Refers to handling tasks or activities in parallel
- Crashing Critical Path – Shortening the amount of time to do a critical task

To implement a PERT chart:

- Identify the different tasks needed to complete a project. Make sure to add these in the right order and indicate the duration of each task.
- Create a network diagram. Use arrows to represent the activities and use nodes as milestones. Determine the critical path and possible slack.

Advantages of PERT

Here are several benefits of using PERT in project management:

1. It helps maximize the use of resources.
2. It makes project planning more manageable.
3. It's useful even if there is little or no previous schedule data.
4. It enables project managers to better estimate or determine a more definite completion date. **Disadvantages of PERT**

Like any other method, PERT comes with its share of limitations:

1. In complex projects, many find PERT hard to interpret, so they may also use a Gantt Chart, another popular method for project management.
2. It can be tedious to update, modify, and maintain the PERT diagram.
3. It entails a subjective time analysis of activities and, for those who are less experienced or are biased, this may affect the project's schedule.

What is a Gantt chart?

A Gantt chart is a project management tool assisting in the planning and scheduling of projects of all sizes, although they are particularly useful for simplifying complex projects.
Project management timelines and tasks are converted into a horizontal bar chart, showing start and end dates, as well as dependencies, **scheduling** and deadlines, including how much of the task is completed per stage and who is the task owner.
This is useful to keep tasks on track when there is a large team and multiple **stakeholders** when the scope changes.

As it's in a bar chart format it is possible to check on progress with a quick glance. You can easily see:

- a visual display of the whole project,
- timelines and deadlines of all tasks,
- relationships and dependencies between the various activities, project phases

Project management solutions that integrate Gantt charts give managers visibility into team workloads, as well as current and future availability, which allows for more accurate scheduling. Gantt charts have been around for nearly a century, having been invented by Henry Gantt, an American mechanical engineer, around 1910.

How to use a Gantt chart

The underlying concept of a Gantt chart is to map out which tasks can be done in parallel and which need to be done sequentially. If we combine this with the project resources we can explore the trade-off between the scope (doing more or less work), cost (using more or less resources) and the time scales for the project. By adding more resources or reducing the scope the project manager can see the effect on the end date.

To create a chart you need to know all of the individual tasks required to complete the project, an estimate of how long each task will take and which tasks are dependent on others. The very process of pulling this information together helps a project manager focus on the essential parts of the project and begin to establish a realistic timeframe for completion.

In summary:

- When you set up a Gantt chart, you need to think through all of the tasks involved in your project and divide them into manageable components.
- Then decide who will be responsible for each task and delegate to the team.
- Identify task relationships and decide on the completion date sequence for each task, showing the expected time duration of the whole project and the sub tasks. A Gantt chart will show the tasks in a sequential order and display task dependencies (ie. how one task relates to another).
- Determine and allocate your resources.
- Anticipate the risks and problems you may encounter and create a contingency plan for potential problems.

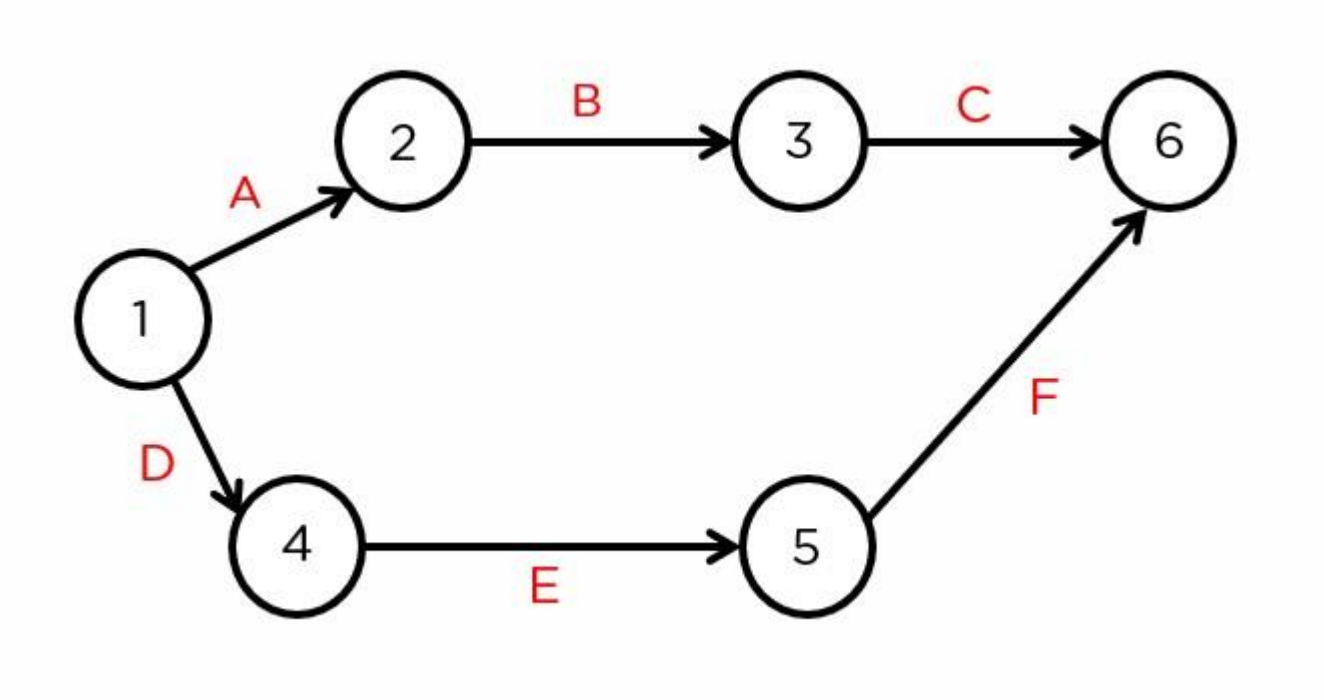
Critical Path Method

CPM or the Critical Path Method is an algorithm used in project management that is used to schedule project activities. The critical path refers to the longest stretch of the activities, and a measure of them from start to finish.

With the help of CPM, we'll be able to create a model that enables you to determine the following:

- Tasks required to complete the project
- Dependencies between tasks
- The duration required to complete an activity

Now, before we can get started with CPM or Critical Path Method, we'll have to understand two major concepts which are Events and Activities. To help understand them better, let's have a look at the network diagram (which is also the output) of the process.



This output represents some of the most important parts of the process: Events and Activities.

Event

Events are represented by a circle and will occur at the start and end of an activity. Event 1 is the tail event and Event 2 is the head event. In the case of our example, the events are 1, 2,3,4, 5, and 6. Taking into consideration, nodes 1 and 2, and the connection between them, 1 will be referred to as the tail event, and 2 will be referred to as the head event.

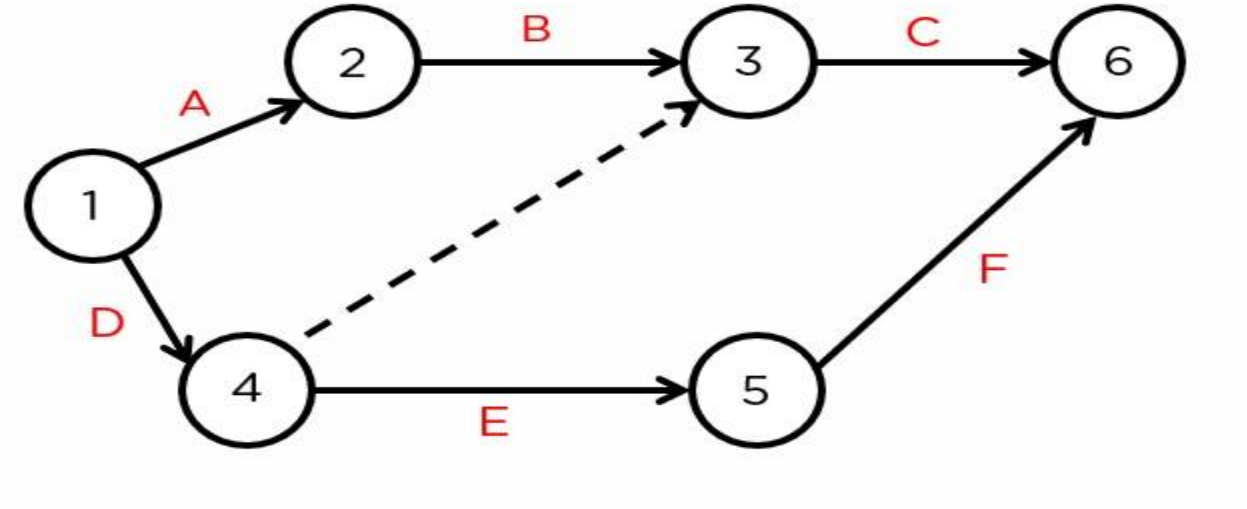
Similarly, for 2 and 3, 2 is the tail event, and 3 is the head event.

Activity

Activities represent action and consumption of resources like time, money, and energy required to complete the project. In the case of our example, A, B, C, D, E, and F represent the activities taking place between their respective events.

Dummy Activity

A dummy activity represents a relationship between two events. In the case of the example below us, the dotted line represents a relationship between nodes 4 and 3.
The activity between these nodes will not have any value.



Other rules to consider

- The network should have a unique starting and ending node. In the case of our example, event 1 represents a unique starting point and 6 represents the unique completion node
- No activity can be represented by more than a single arc (the line with an arrow connecting the events) in the network
- No two activities can have the same starting and ending node.

Now, let's talk about the process of the Critical Path Method with an example.

The Critical Path Method

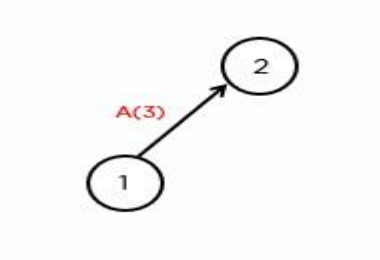
The objective of the question below is to determine the critical path, based on the information available, like activity, immediate predecessor, and duration (which in this case, we'll take as months)

Activity	Immediate Predecessor	Duration (Mon)
A	-	3
B	-	4
C	-	6
D	B	3
E	A	9
F	A	1
G	B	4
H	C, D	5
I	C, D	4
J	E	3
K	F, G, H	6
L	F, G, H	3
M	I	6
N	J, K	9

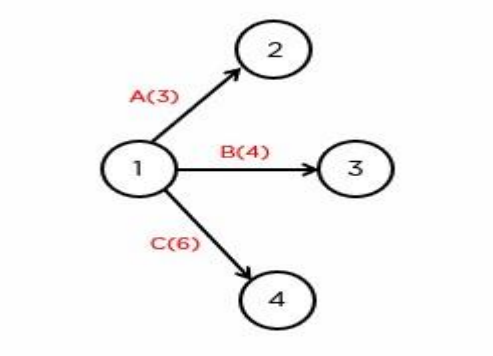
First, let's analyze the activities and their immediate predecessors.

Activities A, B, and C don't have any immediate predecessors. This means that each of them will have individual arcs connecting to them. First, we'll

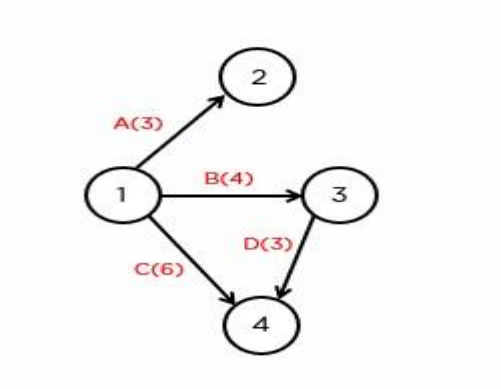
draw nodes 1 (which is the starting point) and 2. We'll add the activity on the arc, along with the duration.



We'll have to also keep in mind that A acts as the immediate predecessor for both nodes E and F. Similarly, let's draw the arcs for nodes B and C.

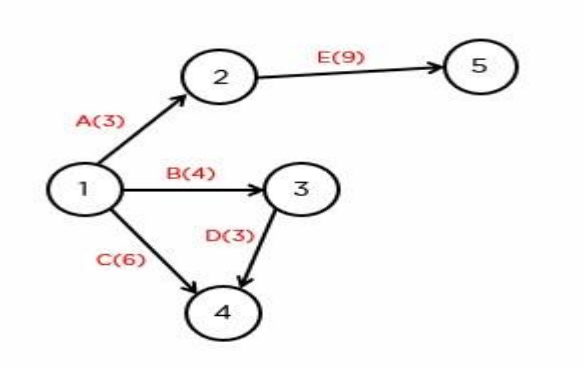


Before we can draw the nodes for activity D, a quick look at the table will tell us that it is preceded by activity B and that a combination of activities C and D act as immediate predecessors for activities H and
J. This means that both activities C and D have to connect at some point. That's why we'll be drawing an arc from events 3 and 4.

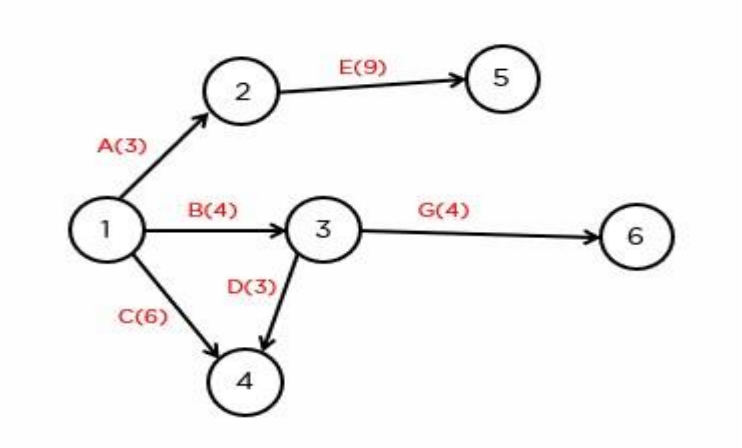


So now, we've completed activities A, B, C, and D of the critical path method. Next, let's take a look at activity E.

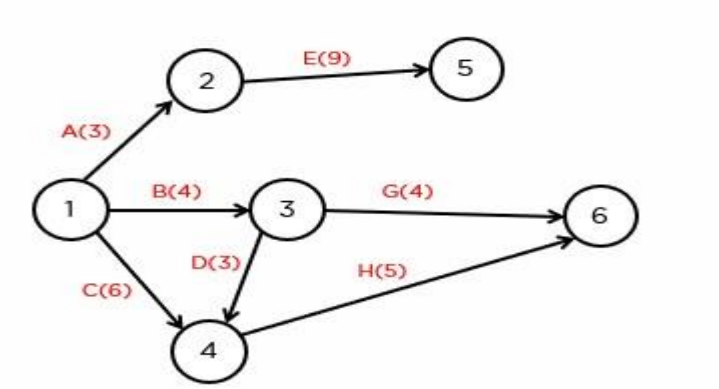
Activity E is preceded by activity A and acts as the immediate predecessor for activity J. Since this is an independent activity, we'll be able to draw an arc like this.



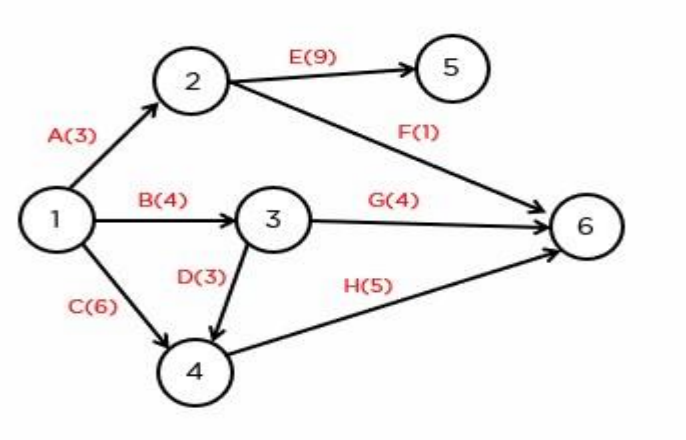
If we have a look at activity F, it's preceded by activity A, and a combination of F, G, and H act as immediate predecessors for the activities K and L. So let's wait before we take it up. Instead, let's shift our attention to activity G. It's preceded by B. So, we'll draw it like so.



Now, let's take a look at activity H. It is preceded by both C and D and will act as the immediate predecessor for K and L, along with F and G. So, we can connect node 4 to 6.



Now that we've done that, let's go back to activity F. Now that we know where activities G and H connect to, we can combine nodes 2 and 6, fulfilling the conditions required for activities K and L.



Following this, we have an activity I. The activity I is preceded by activities C and D. It also acts as an immediate predecessor to activity M. Since it's an independent activity, we can draw it like so.

Automated Tools

Business automation is transforming the way brands operate, allowing them to do more with less and scale in ways never before possible. In theory, this means business size doesn't matter so much and automation can actually give the advantage to smaller brands that are often able to react to new trends faster than their larger rivals.

The only problem is most of the automation tools on the market are still geared toward medium and larger businesses – but not all of them.

In this article, we've got a selection of some of the best business automation tools designed with smaller brands in mind and helping you take your venture to the next level.

What is Risk Management?

Risk management encompasses the identification, analysis, and response to risk factors that form part of the life of a business. Effective risk management means attempting to control, as much as possible, future outcomes by acting proactively rather than reactively. Therefore, effective risk management offers the potential to reduce both the possibility of a risk occurring and its potential impact.

Risk Management Structures

Risk management structures are tailored to do more than just point out existing risks. A good risk management structure should also calculate the uncertainties and predict their influence on a business. Consequently, the result is a choice between accepting risks or rejecting them. Acceptance or rejection of risks is dependent on the tolerance levels that a business has already defined for itself.

If a business sets up risk management as a disciplined and continuous process for the purpose of identifying and resolving risks, then the risk management structures can be used to support other risk mitigation systems. They include planning, organization, cost control, and budgeting. In such a case, the business will not usually experience many surprises, because the focus is on proactive risk management.

Risk Management Activities

Risk management consists of three main activities, as shown in fig:

Risk Assessment

The objective of risk assessment is to division the risks in the condition of their loss, causing potential. For risk assessment, first, every risk should be rated in two methods: ○ The possibility of a risk coming true (denoted as r). ○ The consequence of the issues relates to that risk (denoted as s).

Based on these two methods, the priority of each risk can be estimated:

$$p = r * s$$

Where p is the priority with which the risk must be controlled, r is the probability of the risk becoming true, and s is the severity of loss caused due to the risk becoming true. If all identified risks are set up, then the most likely and damaging risks can be controlled first, and more comprehensive risk abatement methods can be designed for these risks.

1. Risk Identification: The project organizer needs to anticipate the risk in the project as early as possible so that the impact of risk can be reduced by making effective risk management planning.

A project can be of use by a large variety of risk. To identify the significant risk, this might affect a project. It is necessary to categories into the different risk of classes.

There are different types of risks which can affect a software project:

1. **Technology risks:** Risks that assume from the software or hardware technologies that are used to develop the system.
2. **People risks:** Risks that are connected with the person in the development team.
3. **Organizational risks:** Risks that assume from the organizational environment where the software is being developed.
4. **Tools risks:** Risks that assume from the software tools and other support software used to create the system.
5. **Requirement risks:** Risks that assume from the changes to the customer requirement and the process of managing the requirements change.
6. **Estimation risks:** Risks that assume from the management estimates of the resources required to build the system

2. Risk Analysis: During the risk analysis process, you have to consider every identified risk and make a perception of the probability and seriousness of that risk.

There is no simple way to do this. You have to rely on your perception and experience of previous projects and the problems that arise in them.

It is not possible to make an exact, the numerical estimate of the probability and seriousness of each risk. Instead, you should authorize the risk to one of several bands:

1. The probability of the risk might be determined as very low (0-10%), low (10-25%), moderate (25-50%), high (50-75%) or very high (+75%).
2. The effect of the risk might be determined as catastrophic (threaten the survival of the plan), serious (would cause significant delays), tolerable (delays are within allowed contingency), or insignificant.

Risk Control

It is the process of managing risks to achieve desired outcomes. After all, the identified risks of a plan are determined; the project must be made to include the most harmful and the most likely risks. Different risks need different containment methods. In fact, most risks need ingenuity on the part of the project manager in tackling the risk.

There are three main methods to plan for risk management:

1. **Avoid the risk:** This may take several ways such as discussing with the client to change the requirements to decrease the scope of the work, giving incentives to the engineers to avoid the risk of human resources turnover, etc.
2. **Transfer the risk:** This method involves getting the risky element developed by a third party, buying insurance cover, etc.
3. **Risk reduction:** This means planning method to include the loss due to risk. For instance, if there is a risk that some key personnel might leave, new recruitment can be planned.

Risk Leverage: To choose between the various methods of handling risk, the project plan must consider the amount of controlling the risk and the corresponding reduction of risk. For this, the risk leverage of the various risks can be estimated.

Risk leverage is the variation in risk exposure divided by the amount of reducing the risk.

Risk leverage = (risk exposure before reduction - risk exposure after reduction) / (cost of reduction)

1. Risk planning: The risk planning method considers each of the key risks that have been identified and develop ways to maintain these risks.

Risk Categories Definition

Risk categories can be defined as the classification of risks as per the business activities of the organization and provides a structured overview of the underlying and potential risks faced by them. Most commonly used risk classifications include strategic, financial, operational, people, regulatory and finance.
The following are the categories of risk –

#1 – Operational Risk

Operational risks can be defined as the risks of loss arising from improper implementation of processes, external issues (weather problems, government regulations, political and environmental pressures, and so on), etc. Operational risks can be better understood as a type of risk due to inefficiencies in business operations carried out by an organization. Examples of operational risks are insufficient resources, failure in resolving conflicts, etc.

#2 – Budget Risk

Budget risk can be defined as a risk that arises from an improper estimation of a budget allocated to a particular project or process. Budget risk is also regarded as cost risk, and the implications of such a risk are delay in the completion of a specific project, premature handover of the project, failure to deliver the quality project or compromise in the quality of the project in comparison to what was committed to the client, etc.

#3 – Schedule Risk

When the release or completion of the project is not assessed and addressed correctly, the schedule risk takes place. Such a risk can impact a project and

might even be the reason behind the failure of the same and, thus, can result in losses for the company.

#4 – Technical Environment Risk

Technical environment risk can be regarded as the risk concerning the environment in which both the customers and the clients operate. This risk can take place due to the testing environment, regular fluctuations in production, etc.

#5 – Business Risk

Business risks can occur due to the unavailability of a purchase order, contracts in the initial stage of a particular project, delay in the attainment of inputs from clients and customers, etc. ***#6 – Programmatic Risk***

These are the risks that are not within the control of a program or outside the purview of the operational limits. Changes in product strategy or government regulations are examples of programmatic risks.

#7 – Information Security Risk

Information security risks are concerned with the breach of the confidentiality of a company's or clients' sensitive data. The violation of such data can be a huge risk for an organization, and it might not just cause financial losses but also result in loss of **goodwill**. ***#8 – Technology Risk***

Technology risks occur due to sudden or complete change concerning technology or even the installation of new technology.

#9 – Supplier Risk

Supplier risks take place in a scenario where there is third-party supplier interference in the development of a particular project owing to his association in the same.

#10 – Resource Risk

Resource risk occurs due to improper management of a company's resources such as its staff, budget, etc. ***#11 – Infrastructure Risk***

Infrastructure risk takes place as a result of inefficient planning concerning infrastructure or resources, and that is why it is always essential to have appropriate planning of infrastructure so that the project does not get impacted.

#12 – Technical and Architectural Risk

Technical and architectural risk are such types of risk that fail the overall functioning and performance of an organization. These risks arise out of the failure of software and hardware tools and equipment that are taken into use in a particular project.

#13 – Quality and Process Risk

Quality and process risk occurs due to improper application of customizing a process and hiring of staff to the process that is not well trained and as a result of which the outcome of a process gets compromised.

#14 – Project Planning

Project planning risks are such risks that arise out of lack of proper planning concerning a project. This lack of project planning can cost the project to sink and fail to meet the expectations of the clients as well.

#15 – Project Organization

Project organization is another risk associated with the improper organization of a particular project. This lack of project organizing can cost the project to sink and fail to meet the expectations of the clients as well.

A) Aids for Risk Identification

For any project, any condition, situation or event that can occur would jeopardize the success of the project constitutes a risk. Identifying a risk is therefore an exercise in envisioning that can go wrong. The methods that can aid for risk identifications include,

1. Check list of possible risks.

2. Surveys

3. Meetings 4. Brainstorming

5. Review plans.

Check list of most commonly occurring risks are probably the most common tool for risk identification. Check list details are as follows: Risk identification checklist,

- Product size.
- Risks associated with the overall size of the software to be built or modified.
- Business impact.
- Risks associated with constraints imposed by the management.
- Process identification
- Risks associated with the degree with which software process has been defined and is followed by the development organization.
- Technology to be used.
- Risks associated with the complexity of the system to be built and the newness of the technology that is packaged by the system
- Project managers use their past experience and past project database to identify potential risks.

B) Risk Components and drivers

Risk components are defined as follows:

- Performance risk: The degree of uncertainty that the product will meet its requirements and be fit for its intended use.
- Cost risks: The degree of uncertainty that the project budget will be maintained.

· Support risks: The degree of uncertainty that the result software will be easy to correct, adapt and enhance.

· Schedule risks: The degree of uncertainty that the project schedule will be maintained and that the product will be delivered on time.

C) Risk Prioritization

The identified risks for a project merely give the possible events that can hinder it from meeting the goal. The consequences of various risks, however, may differ. So before we proceed with management risks, project mangers prioritize them so that management energies can be focused on high risks. Prioritizatation requires analyzing the possible side effects of the risk event in case it actually occurs. Based on the possible consequences and the probability of the risks event occurring, you can compute the risk exposure, which you can then use for prioritizing risks. In risk prioritization, each identified risk is evaluated and assigned values for the following elements:

· The probability that the risk condition will actually occur

· The impact if the risk condition does occur

· The risk exposure

Multiplying the risk probability by the impact would yield risk exposure, which is then compared against all other risk exposures to determine which risk will be given priority for risk mitigation. Since exposure is a relative measurement based on the numeric value assigned to risk probability and impact, consistency in assigning the probability and impact values is critical. A prioritized risks list that ranks risks by their exposure value determines the order in which risks will be addressed in risk mitigation and contingency planning.