Unit no 6 Sales, Marketing Management& Project Management

6.1 Sales Management

Sales - Definition

A sale is the pinnacle activity involved in selling products or services in return for money or other compensation. It is an act of completion of a commercial activity. - Sales is everything that you do to close the sale and get a signed agreement or contract.

• Sales management is attainment of an organization's sales goals in an effective & efficient manner through planning, staffing, training, leading & controlling organizational resources. Revenue, sales, and sources of funds fuel organizations and the management of that process is the most important function. Objectives of Sale

Objectives of Sales Function.

• To achieve Sales Targets

• To achieve Market share targets

• To manage dealer network

• To organize sales training

• To handle customer complaints

• To manage Sales promotion campaigns

• To effectively cover market

Sales Management…

• Managing Sales Force

• Offering Sales Training

• Managing Channel partners

• Managing Direct sales

• Managing Sales Promotion

• Managing Sales Territories

• Managing Sales Targets

Before, anything else you need to know what sales management is and how it works. There are two main parts to managing your sales team. The first is the person-management, making sure everyone knows what they are doing and what is expected of them. The second is keeping track of sales that have been made.

To keep everyone on track, you need to set goals and targets, that the team can aim for. In addition, a to-do list or diary should be used to make sure each team member does what is needed at the right time.

This might be making calls, sending messages, or attending meetings in person. Sales meetings are often one of the most difficult aspects to manage as they can take place at the customer's location. The salesperson must get there on time, have all the information they need with them, and potentially get away in time to get to their next meeting.

Comparatively, it is quite straightforward to keep track of sales. This is because sales will be recorded on a centralized system with the option of easily running reports. If the sales are too low in a particular period, you can offer encouragement and solutions as necessary.

Functions of sales management

There are various ways in which sales management helps a business to streamline their sales process and increase their ROI. You can refer to these ways as individual functions of sales management. Let us take a look at how this works.

Previous Performance and Setting Targets

One of the functions of sales management is to ensure that targets are reached, but targets that are set too high will never be reached. By running reports on sales figures over a period of time, especially those produced by current members of the sales team, you'll be able to calculate the most sensible and achievable target for individuals and the team as a whole.

Of course, previous performance does not always indicate how anyone will currently perform. There may have been changes in the products that are available or the locations that your sales team serves. You need to factor in those differences when you are setting targets.

Managing the Sales Process

At any given time, there could be a large number of potential customers working their way through your company's sales process. Another function of sales management is to make sure that each lead is dealt with promptly and correctly.

Identifying the best leads is a key factor in increasing the sales figures for the business. Converting those who are ready to buy into full paying customers is easier than getting the person who only has a passing interest to part with their cash.

Improving process efficiency

This leads to improving the efficiency of the sales process. Finding the best leads is a step that is near the end of the process. But, optimizing and improving the process as a whole will bring more good leads through more quickly.

The flow through the sales process should be constant. From newly interested people to fully qualified leads that are ready to buy, and the more you can automate it, the better.

Instead of having to worry about every little detail, using a software solution to automate particular tasks will make everything run much more smoothly. Say, a customer lands on your website and has shown an interest in a particular product. Ideally, you might have a whole team (or a certain salesperson) dedicated to that one product. By assigning the care of that customer to the right team or salesperson, their needs will be better met. And, the likelihood of a sale increases dramatically.

In the same way, sending out an automated email with similar or related products on will help build a relationship and create interest for the customer. To do this manually may take some time. But once configured, such a system does not need to be interacted with again by the sales team.

Monitor salespeople's performance

As mentioned earlier, the production of reports is essential to see how the business has progressed over time. An aspect of sales management that should not be overlooked is team leadership. Basing your actions on the cold hard facts presented by current and historical reports will enable you to get the best out of your team.

Congratulate those who deserve it and encourage and re-train those who are struggling. If there's still no hope for the underperformers after giving them a fair chance, it may be that sales is not the field they will excel in.

Sales Manager Responsibilities:

- Managing organizational sales by developing a business plan that covers sales, revenue, and expense controls.
- Meeting planned sales goals.
- Setting individual sales targets with the sales team.
- Tracking sales goals and reporting results as necessary.
- Overseeing the activities and performance of the sales team.

- Coordinating with marketing on lead generation.
- The ongoing training of your salespeople.
- Developing your sales team through motivation, counseling, and product knowledge education.
- Promoting the organization and products.
- Understand our ideal customers and how they relate to our products.

6.2 Marketing Management

The process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational goals

Marketing – Definition • Marketing is the process associated with promotion for sale goods or services. It is considered a "social and managerial process by which individuals and groups obtain what they need and want through creating and exchanging products and values with others." It is an integrated process through which companies create value for customers and build strong customer relationships in order to capture value from customers in return. • Marketing is used to create the customer, to keep the customer and to satisfy the customer. With the customer as the focus of its activities, it can be concluded that marketing management is one of the major components of business management. The evolution of marketing was caused due to mature markets and overcapacities in the last decades. Companies then shifted the focus from production more to the customer in order to stay profitable.

Sales	Marketing
• Sales starts with seller & is preoccupied all the time with the needs of the seller	• Marketing starts with the buyer and focuses constantly on the needs of the buyer
• Emphasizes on saleable surplus available with the company	• Emphasizes on identification of market opportunity
• Seeks to convert products in to cash	• Seeks to convert customer needs in to products
• Views business as – goods producing process	• Views business as – a customer satisfying process
• Sales views the customer as the last link in the business	• Marketing views the customer as the very purpose of business

The sales and marketing relationship

• Marketing and sales are very different, but have the same goal.

• Marketing improves the selling environment and plays a very important role in sales.

• The marketing department's goal is to increase the number of interactions between potential customers and company, which includes the sales team using promotional techniques such as advertising, sales promotion, publicity, and public relations, creating new sales channels, or creating new products (new product development), among other things.

Functions of Marketing

Gathering and Analyzing Market Information

Primary function to identify the needs of the customers
• Most important to take decisions for the successful marketing of goods and services
• Analyze opportunities and threats as well as strengths and weakness of the organisation
• With technological explosion, it has become easier to collect necessary information through interactive portals

Marketing planning

• Develop appropriate marketing plans covering various important aspects to achieve organizational objective
• Also to include level of production, promotion of products, specifying action Programmes

Product designing & development

• A good design makes the product attractive to the consumer
• It also improves performance of the product and gives a competitive edge in the market
• Hence decision regarding the design and development of the product is very crucial for a marketing manager

Standardisation & grading

• **Standardisation** refers to producing goods as per pre-determined specifications.
• Helps in achieving uniformity and consistency in the output.
• Reduces the need for inspection, testing and evaluation from the consumer's perspective
• **Grading** is the process of classification of products into different groups
• This is done where products are not produced as per pre-determined specifications eg; agricultural products
• It helps in realising higher price for higher quality products

Packaging & labelling

• Both are considered as pillars of modern day marketing tools
• **Packaging** wraps the product and **labelling** forms the information printed on he package.
• Packaging not only protects the product but also used as a promotional tool
• Quality of the product is also assessed by looking at the package and label

Branding

• Important decision area for marketing – to sell in the generic name (fan pen etc.) or specific brand name (usha, reynolds)
• Helps in creating product differentiation
• **Branding strategy** – each product a separate brand name (Lux, Surf etc.,) or same brand
name for all products of a company (philips, samsung etc.,)

Customer support services

• Includes after sales services, handling customer complaints, procuring credit Services, maintenance services, technical services & consumer information
• Aim at providing maximum customer satisfaction the key to marketing successes
• Effective in bringing repeated sales and developing brand loyalty

Pricing of product

• Amount of money a customer has to pay to obtain the product or service
• Most important factor deciding the success of failure
• Demand is directly related to the price of the product
• Important decisions marketer has to take are:- pricing objective, pricing strategy, determining and changing the price

Promotion

• Providing information to the customers regarding the product and its features; persuading them to buy the product
• Four important tools – personal selling, advertising, publicity and sales promotion
• Marketer has to decide on the combination of the promotional tools and budget thereon.

Physical distribution

• Two major areas – choice of marketing intermediaries and selection of physical movement of the product

• Marketer has to decide on – inventory levels, storage and warehousing & transportation of goods from the place of production to the end user

Transportation

• End users of products are wide spread and geographically separated
• Various factors to be considered before deciding the mode of transportation:- nature of the product, cost and location of target market

Storage and warehousing

• There is a time gap between production and procurement of goods due to irregular demand or supply
• To maintain smooth flow & supply of the products and also to protect against contingencies proper storage is needed
• Storage is performed by different intermediaries

Market research **Market research** is the process of determining the viability of a new service or product through **research** conducted directly with potential customers. **Market research** allows a company to discover the target **market** and get opinions and other feedback from consumers about their interest in the product or service.

Market research is defined as the process of evaluating the feasibility of a new product or service, through research conducted directly with potential consumers. This method allows organizations or businesses to discover their target market, collect and document opinions and make informed decisions.

Market research can be conducted directly by organizations or companies or can be outsourced to agencies which have expertise in this process.

The process of market research can be done through deploying surveys, interacting with a group of people also known as sample, conducting interviews and other similar processes.

Primary purpose of conducting **market research** is to understand or examine the market associated with a particular product or service, to decide how the audience will react to a product or service. The information obtained from conducting market research can be used to tailor marketing/ advertising activities or to determine what are the feature priorities/service requirement (if any) of consumers.

Three key objectives of market research

A market research project may usually have 3 different types of objectives.

1. **Administrative**: Help a company or business development, through proper planning, organization, and both human and material resources control, and thus satisfy all specific needs within the market, at the right time.
2. **Social**: Satisfy customer's specific needs through a required product or service. The product or service should comply with the requirements and preferences of a customer when it's consumed.
3. **Economical**: Determine the economical degree of success or failure a company can have while being new to the market, or otherwise introducing new products or services, and thus providing certainty to all actions to be implemented.

Why is market research important?

Conducting research is one of the best ways of achieving customer satisfaction, reducing customer churn and elevating business. Here are the reasons why market research is important and should be considered in any business:

- **Valuable information:** It provides information and opportunities about the value of existing and new products, thus, helping businesses plan and strategize accordingly.
- **Customer-centric:** It helps to determine what the customers need and want. Marketing is customer-centric and understanding the customers and their needs will help businesses design products or services that best suit them.
- **Forecasts:** By understanding the needs of customers, businesses can also forecast their production and sales. Market research also helps in determining optimum inventory stock.
- **Competitive advantage:** To stay ahead of competitors market research is a vital tool to carry out comparative studies. Businesses can devise business strategies that can help them stay ahead of their competitors.
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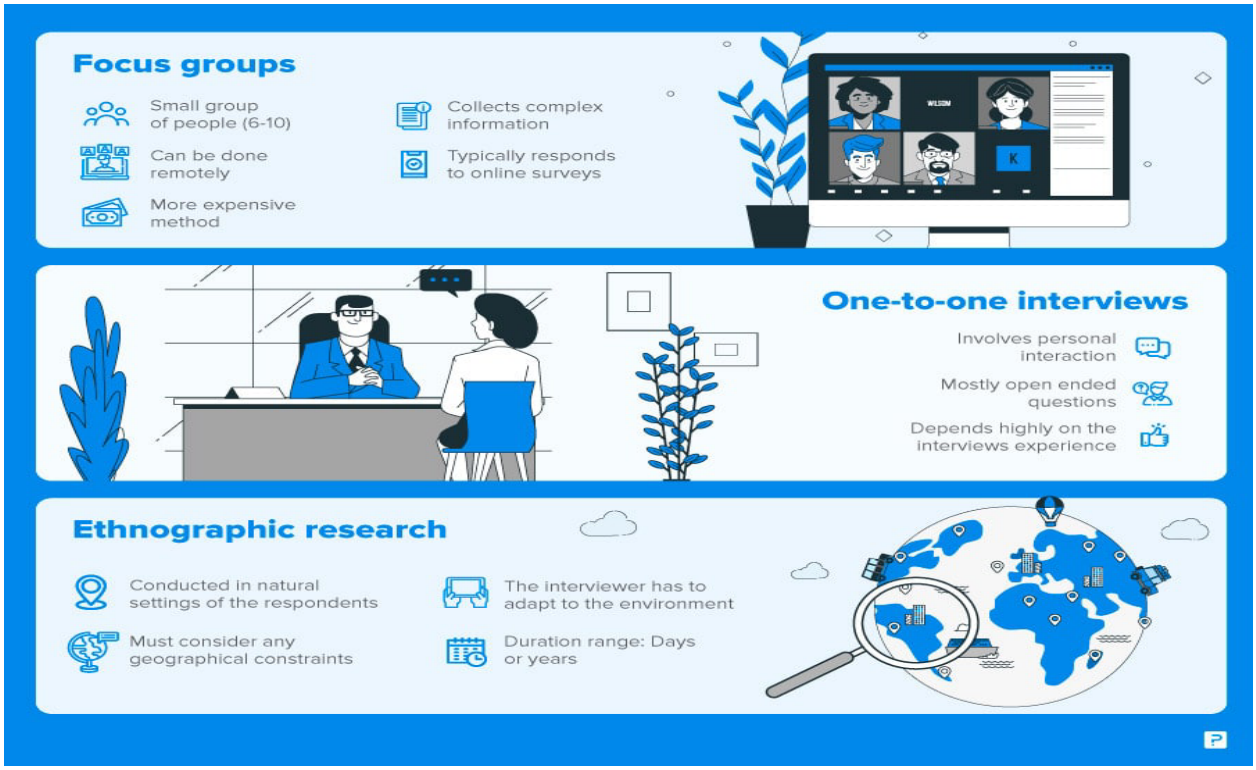
  Types of Market Research
  - **1. Primary Market Research** (A combination of both Qualitative and Quantitative Research): Primary market research is a process, where organizations or businesses get in touch with the end consumers or employ a third party to carry out relevant studies to collect data. The data collected can be qualitative data (non-numerical data) or quantitative data (numerical or statistical data).

  - While conducting primary market research, one can gather two types of information: Exploratory and Specific. Exploratory research is open ended, where a problem is explored by asking open ended questions in a detailed interview format usually with a small group of people also known as sample. Here the sample size is restricted to 6-10 members. Specific research, on the other hand, is more pinpointed and is used to solve the problems that are identified by exploratory research.

  - As mentioned earlier primary market research is a combination of qualitative market research and quantitative market research. Qualitative market research study involves semi-structured or unstructured data collected through

some of the commonly used qualitative research methods like



Focus groups: Focus group is one of the commonly used qualitative research methods. Focus group is a small group of people (6-10) who typically respond to online surveys sent to them. The best part about focus group is the information can be collected remotely, can be done without personally interacting with the group members. However, this is a more expensive method as it is used to collect complex information.

One-to-one interview: As the name suggests this method involves personal interaction in the form of an interview, where the researcher asks a series of questions to collect information or data from the respondents. The questions are mostly open ended questions and asked in a way to facilitate responses. This method is heavily dependent on the ability and experience of the interviewer to ask questions that evoke responses.

Ethnographic research: This type of in-depth research is conducted in the natural settings of the respondents. This method requires the interviewer to adapt himself/herself to the natural environment of the respondents which could be a city or a remote village. Geographical constraints can be a hindering factor in conducting this kind of research. Ethnographic research can last from a few days to a few years.

2. Secondary Market Research: Secondary research uses information that is organized by outside source like government agencies, media, chambers of commerce etc. This information is published in newspaper, magazines, books, company website, free

government and nongovernment agencies and so on. Secondary source makes use of the following:

Public sources: Public sources like library are an awesome way of gathering free information. Government libraries usually offer services free of cost and a researcher can document available information.

Commercial sources: Commercial source although reliable are expensive. Local newspapers, magazines, journal, television media are great commercial sources to collect information.

Educational Institutions: Although not a very popular source of collecting information, most universities and educational institutions are a rich source of information as many research projects are carried out there than any business sector.

6.3 Advertising

Is a means of communication with the users of a product or service. Advertisements are messages paid for by those who send them and are intended to inform or influence people who receive them

Examples of above the line **advertising** are TV, radio, & newspaper **advertisements**. Below the line **advertising** include conversion focused activities which are directed towards a specific target group. **Examples** of below the line **advertising** are billboards, sponsorships, in-store **advertising**, etc.

Newspaper. Newspaper **advertising** can promote your business to a wide range of customers. ...
Magazine. **Advertising** in a specialist magazine can reach your target market quickly and easily. ...
Radio. ...
Television. ...
Directories. ...
Outdoor and transit. ...
Direct mail, catalogues and leaflets. ...
Online.

Concept

• Any paid form of non personal presentation & promotion of ideas, goods or services by an identified sponsor

Features:

• Paid form: marketer has to bear the cost of communication

• Impersonal method: no direct face to face contact with the prospective buyer

• Identified sponsor: advertising is done by an identified individual or company who bears the cost

Objective of advertising

To increase sales **To educate consumer** **Entry in new market**

Create new customers **To overcome competition**

Role of Advertising

Creates Demand	By making people aware of new products and new uses of existing products
Educates customer	• By providing useful information about the product • Also educates on the new product development and new features of the existing product
Enhances consumer confidence	• As consumers feel more assured and confident about the product advertised
Creates organizational image	• Through advertisement, people come to know about how organization stands for the society
Facilitates introduction of new products	• Communicating the positive features of the newly introduced product
Creates customer loyalty	• Through repeated communication, creates customer loyalty

Advertising agency types

- Full-service **advertising agency**. A full-service **advertising agency** is just what it sounds like: an **agency** that does anything and everything for their client. ...
- Digital **advertising agency**. ...
- Traditional **advertising agency**. ...
- Social media **advertising agency**. ...
- **Creative** boutique. ...

- Media buying **agencies**.

6.4 Project management

Project management is the process of leading the work of a team to achieve goals and meet success criteria at a specified time. The primary challenge of **project management** is to achieve all of the **project** goals within the given constraints.
Project management is the process of leading the work of a team to achieve all **project** goals within the given constraints. This information is usually described in **project** documentation, created at the beginning of the development process. The primary constraints are scope, time, and budget.
Developed by the **Project Management** Institute (PMI), the **five phases of project management** include conception and initiation, planning, execution, performance/monitoring, and **project** close.
KEY TAKEAWAYS

- On a very basic level, project management includes the planning, initiation, execution, monitoring, and closing of a project.
- Many different types of project management methodologies and techniques exist, including traditional, waterfall, agile, and lean.
- Project management is used across industries and is an important part of the success of construction, engineering, and IT companies.

Network Analysis

Network technique is a technique for planning, scheduling (programming) and controlling the progress of projects. This is very useful for projects which are complex in nature or where activities are subject to considerable degree of uncertainty in performance time.

This technique provides an effective management, determines the project duration more accurately, identifies the activities which are critical at different stages of project completion to enable to pay more attention on these activities, analyze the scheduling at regular interval for taking corrective action well in advance, facilitates in optimistic resources utilization, helps management for taking timely and better decisions for effective monitoring and control during execution of the project.

List of network analysis techniques

- **Method** CPM (Critical Path **Method**)
- CCM (Critical Chain **Method**)

- PERT **Method** (Program Evaluation and Review **Technique**)
- GERT **Method** (Graphical Evaluation and Review **Technique**)
- P.E.P Programme Evaluation Procedure.
- M.A.P Manpower Allocation Procedure.

Objective Network Analysis

1. Powerful tool of planning, scheduling and control.

2. Shows the inter-relationships of the activities of a project or a programme.

3. Minimizes total cost where the cost of delays and cost of resources required to carry out the tasks can be measured.

4. Minimize total time where required e.g. in maintenance of production-line machinery in a factory.

5. Minimization of idle resources.

6. Minimize production delays.

7. To provide systematic approach in planning and scheduling.

8. Follow an integrated approach and bring about better coordination between the de¬partments.

9. Focuses attention on critical activities of the project.

10. Provides up-to-date status information.

Advantages of Network Technique:

1. Detailed and thoughtful planning provides better analysis and logical thinking.

2. Identifies the critical activities and focus them to provide greater managerial atten¬tion.

3. Network technique enables to forecast project duration more accurately.

4. It is a powerful tool for optimization of resources by using the concept of slack.

5. It provides a scientific basis for monitoring, review and control, to evaluate effect of slippages.

6. It helps in taking decision;

(i) To over-come delays,

(ii) To crashing programme,

(iii) Optimising resources, and

(iv) On other corrective actions.

7. It helps in getting better co-ordination amongst related fields.

8. It is an effective management tool through a common and simple language, providing common understanding.

Limitations of Network Techniques:

(i) Network technique is simply a tool to help the management; hence its effectiveness depends on how well it is used by the management.

(ii) Its accuracy depends on the estimation of the data used in the network.

(iii) It is useful only if it is updated regularly and decisions for corrective actions are taken timely.

Terminology in network analysis

Network: A Network is symbolic representation of essential characteristics of the project.

Activity

Any individual operation, which utilizes resources and has a beginning and an end is called an activity. An arrow is used to depict an activity with its head indicating the direction of progress in the project. It is of four types:

a) **Predecessor activity:** activity that must be completed immediately prior to the start of another activity.
b) **Successor activity:** activity which cannot be started until one or more of other activities are completed but immediately succeed them are called successor

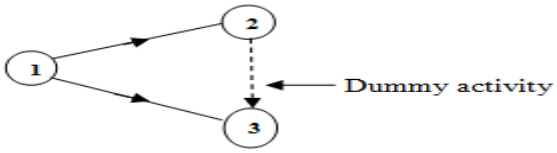
activity.

c) **Concurrent:** Activity which can be accomplished concurrently is known as concurrent activity. An activity can be predecessor or successor to an event or it may be concurrent with the one or more of the other activities.

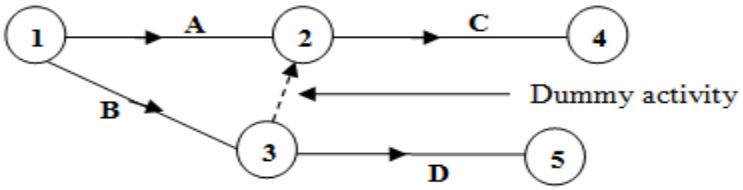
d) **Dummy activity:** An activity which does not consume any kind of resources but merely depicts the technological dependence is called a dummy activity. Dummy activity is inserted in a network to classify the activity pattern in the following situations:

   i) To make activities with common starting and finishing points distinguishable.

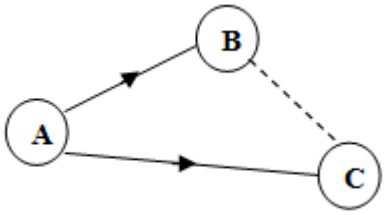
   ii) To identify and maintain the proper precedence relationship between activities those are not connected by events.



Let's consider a situation where A and B are concurrent activities and activity D is dependent on B and C is dependent on both A and B. Such a situation can be handled by use of dummy activity.



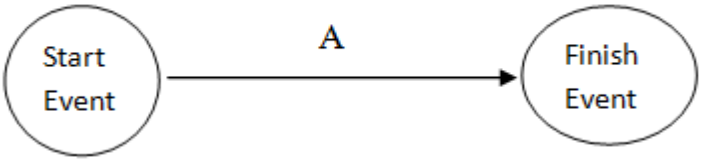
When two or more activities are exactly parallel such that they would start at the same node (event) and finish at the same node. A dummy would be inserted between the end of one of the activities and the common finishing node.



This is to ensure that each activity has a unique description when refer to by its start and finish node number. Dummy are often used to improve the layout of network. When they may not strictly necessary to represents the logic involved. This often happens at the start or finish of a network where a number of activities either start from a certain point or converge to particular point.

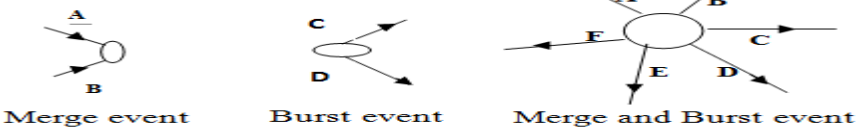
Event

The beginning and end points of an activity are called events or nodes or connector. This is usually represented by circle in a network.



Here, A is known as the activity.
The events can be further classified into three categories:

a) **Merge Event**: When two or more activities come from an event it is known as merge event.
b) **Burst Event:** When more than one activity leaves an event is known as burst event.
c) **Merge & Burst Event:** An activity may be merged and burst at the same time.



Difference between event and activity

An event is that particular instant of time at which some specific part of project is to be achieved while an activity is the actual performance of a task. An activity requires time and resources for its completion. Events are generally described by such words as complete, start, issue, approves, taste etc. while the word like design, process, test, develop, prepare etc. shows that a work is being accomplished and thus represent activity. While drawing networks, it is assumed that

a) The movement is from left to right and
b) Head event has a number higher than the tail event.

Thus the activity (i-j) always means that job which begins at event (i) is completed at event (j).

Network representation is based on the following two axioms.

a) An event is not said to be complete until all the activities flowing into it are completed.
b) No subsequent activities can begin until its tail event is reached or completed.

Earliest Event Time (ETi): is the earliest time at which the event corresponding to node (i) can occur.

Latest Event Time (LTi): is the latest time at which the event corresponding to node (i) can occur without delaying the completion of the project.

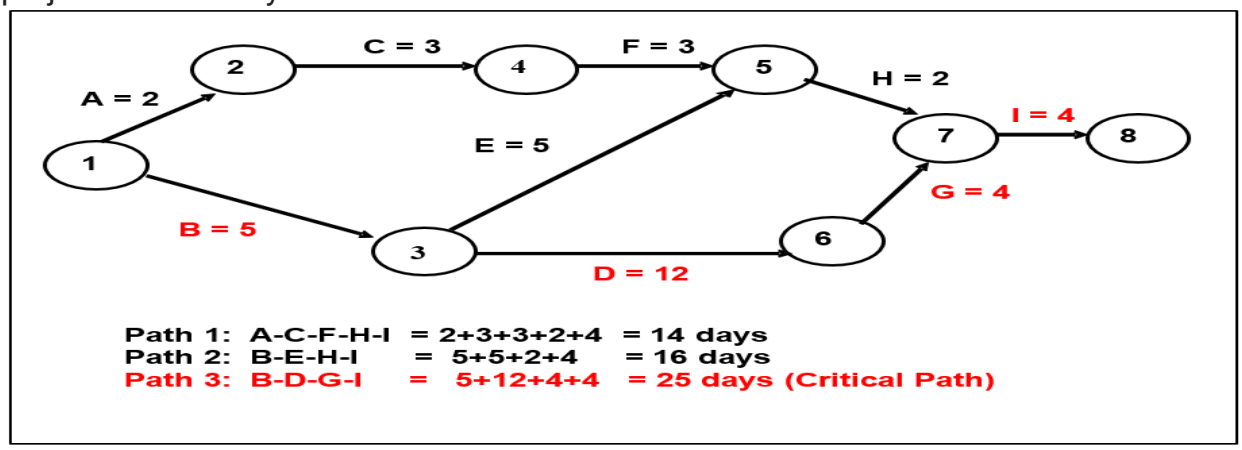
Total Float (TFij) of activity (i, j): (i < j) is the amount by which the starting time of activity (i, j) can be delayed beyond its possible starting time without delaying the completion of the project.

The critical path is computed in two parts: For the starting event, we set the time at zero,
ESo = 0. Let the duration of activity (i, j) be denoted by dij (i < j).
Earliest time formula: max [ETi, ETi + dij] For the terminal node we set the latest event time equal to the earliest time,
i.e. LTT = ETT, and compute Latest time formula: min [LTi, LTi − dij]
The final calculation is the total float (TFij) for activity (i, j) FLOAT =|ET − LT|

Duration Duration is the estimated or actual time required to complete a task or an activity.

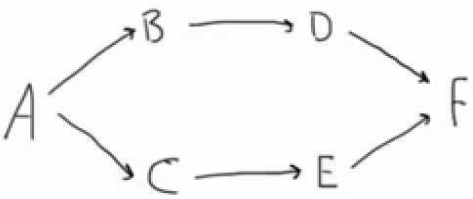
Critical Path

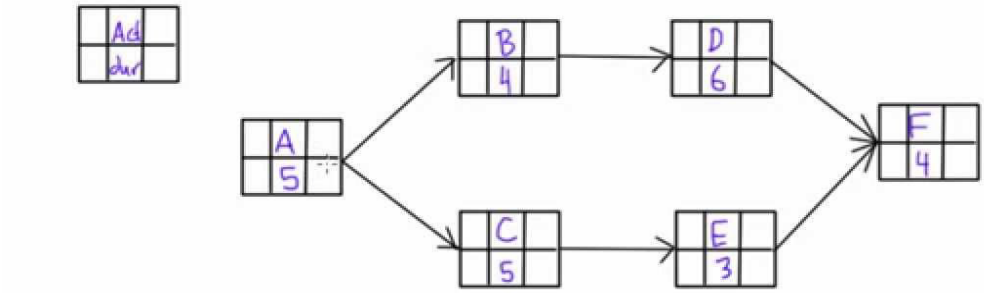
In project management, the **critical path** is the longest sequence of tasks that must be completed to successfully conclude a project, from start to finish. The tasks on the **critical path** are known as **critical** activities because if they're delayed, the whole project will be delayed.



Network diagram

Activity	Predecessor	Duration
A	-	5
B	A	4
C	A	5
D	B	6
E	C	3
F	D,E	4





Critical Path Method

In project management, the critical path is the longest sequence of tasks that must be completed to successfully conclude a project, from start to finish. The tasks on the critical path are known as critical activities because if they're delayed, the whole project will be delayed. By identifying the critical path, you can determine the total duration of a project.

Calculating the critical path is key during the planning phase because the critical path identifies important deadlines and the activities which must be completed on time. Once a critical path is determined, you'll have a clear picture of the project's actual schedule.

The critical path method (CPM) is used in project management to create project schedules and helps project managers create a timeline for the project. The critical path method includes:

- Identifying every task necessary to complete the project and the dependencies between them
- Estimating the duration of the project tasks
- Calculating the critical path based on the tasks' duration and dependencies to identify the critical activities
- Focusing on planning, scheduling and controlling critical activities

- Setting project milestones and deliverables

- Setting stakeholder expectations related to deadlines

Characteristics of Critical Path Method (CPM)

CPM uses activity oriented network.
Duration of activity may be estimated with a fair degree of accuracy.
It is used extensively in construction projects.
CPM is the management of repetitive projects.
The deterministic concept is used.
CPM can control both time and cost when planning.
Identifies the critical and non-critical activities of the project so that we can focus more on the critical activities and complete the project on time.
Crashing is a compression technique applied to CPM, to shorten the project duration, along with least additional cost.
CPM is used to compute the earliest and latest possible start time for each activity.
In CPM, cost optimization is given prime importance. The time for the completion of the project depends upon cost optimization. The cost is not directly proportioned to time. Thus, the cost is the controlling factor.

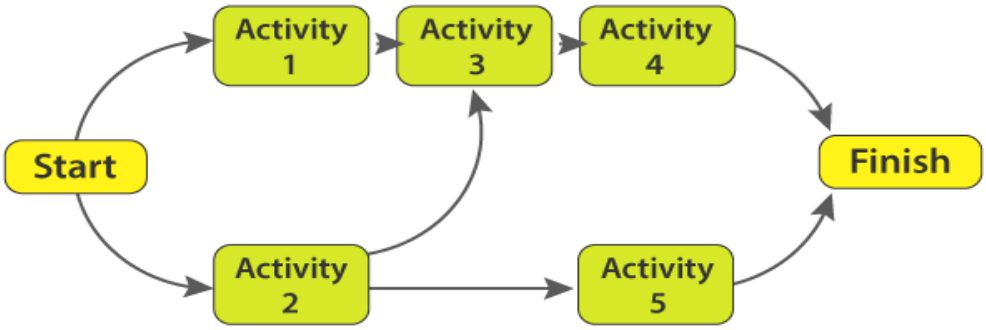
Advantages of CPM

- Provides an outline for long term coordination and planning of a project
- Recognizes critical activities
- Easy to plan, schedule and control project
- It improves productivity
- Manages the resource needed

Disadvantages of CPM

- For beginners its difficult to understand
- Software too expensive
- Sometimes, to structure CPM is too time-consuming
- It cannot control and form the schedule of a person involved in the project
- Allocation of resources cannot be monitored properly

CPM Example



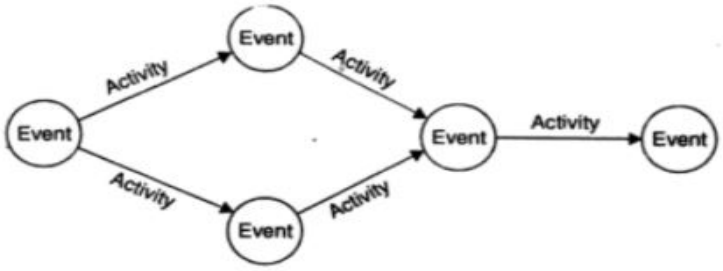
Program (Project) Evaluation and Review Technique (PERT)

Program (Project) Evaluation and Review Technique (PERT) is an activity to understand the planning, arranging, scheduling, coordinating and governing of a project. This program helps to understand the technique of a study taken to complete a project, identify the least and minimum time taken to complete the whole project. PERT was developed in the 1950s, with the aim of the cost and time of a project.

This is called programmable Evaluation and review techniques.

This deals with problem of uncertain activities. The statistical analysis to apply in order to estimate or determine time of each activity concerning the project used

PERT (Program Evaluation Review Technique) and CPM (Critical Path Method) are one of the modern network tools of project management. An entire project can be broken down to distinct and well-defined jobs or tasks or activities.



An event constitutes the beginning or the end of such an activity. A network is defined as the flow diagram that constitutes activities and events, that are controlled logically and sequentially. In the network diagram, an activity is represented by arrows and an event is represented using circles.

3-time estimates. Namely are:

to: The most optimistic time

tp: The most pessimistic time

tl: The most likely time

Optimistic estimate: the time the activity would take if things did go well.

Pessimistic estimate: the time the activity would take if things did not go well.

Most likely estimate: the consensus best estimate of the activity's duration

PERT (Program Evaluation Review Technique) network diagram is used to model a project's activities and their relationships as a network. It was developed to take account of the uncertainty surrounding estimates of task durations. The difference between the CPM and the PERT methods is that the CPM uses a single estimate for the duration of each task, whereas the PERT method uses 3 estimates. These 3 estimates include:

- **Optimistic (a)**
- **Most Likely (m)**
- **Pessimistic (b)**

These 3 estimates are combined to calculate the t_e values. The formula is depicted below:

$$te = \frac{a + 4m + b}{6}$$

After the t_e values are calculated, the standard deviation (s) can be calculated using the following formula:

$$s = \frac{b - a}{6}$$

The next step is to calculate the **z - value**. The formula to calculate the z value is depicted below:

$$z = \frac{T - te}{s}$$

Remember that the **T value is the target date** of the specific project and the **z value is calculated on the last activity.**

The PERT event labelling convention adopted here indicates event number and its target date along with the calculated values for expected time and standard deviation.

Methodology of PERT:

The PERT involves following steps:

1. The project is broken down into different activities systematically.

2. Activities are arranged in logical sequence.

3. The network diagram is drawn.

4. Events and activities are numbered in the network diagram.

5. Using optimistic, pessimistic and normal time, the expected time is calculated.

6. Standard deviation and variance for each activity is calculated.

7. Earliest starting time (EST) and latest finishing time (LFT) are calculated.

8. Expected time, EST and LFT are marked on the net¬work diagram.

9. Slack is calculated.

10. Critical paths are identified and marked on the network diagram.

11. Length of critical path or the total project duration is found out.

Advantages of PERT:

1. PERT forces the management to plan carefully and study how the various parts fit into the whole project.

2. PERT enables the business managers to predict time and cost of the project in advance.

3. PERT is a forward-looking control device for manage¬ment. PERT calls attention on the timely completion of the project and avoids delay.

4. PERT enables the determination of the probabilities concerning the time by which activity and project would be completed.

5. PERT suggests areas for increasing efficiency and reducing cost.

6. It provides up-to-date information of the project pro¬gramme so that the necessary steps may be taken to minimize the delays and interruptions.

7. PERT assists in coordinating the different parts of the total projects.

Limitations of PERT:

1. In PERT, it is assumed that all the activities involved in the project are known in advance. In projects like research and development (R and D), it is not possible to list out all the activities in advance.

2. The assumption that a project can be sub-divided into a set of predictable and independent, activities may not hold true always.

3. PERT emphasizes only on time and not the costs.

4. PERT is based on time estimates and there may be error in estimating time.

5. For active control of a project, PERT requires frequent updating and revising of calculations. It is an expansive and time consuming exercise, which requires highly trained personnel.

	PERT	CPM
Abbreviation	PERT – Project Evaluation and Review Technique	CPM – Critical Path Method
What does It Mean?	PERT – PERT is a popular project management technique that is applicable when the time required to finish a project is not certain	CPM – CPM is a statistical algorithm which has a certain start and end time for a project
Model Type	PERT – PERT is a probabilistic model	CPM – CPM is a deterministic model
Focus	PERT – The main focus of PERT is to minimize the time required for completion of the project	CPM – The main focus of CPM is on a trade-off between cost and time, with a major emphasis on cost-cutting.
Orientation type	PERT – PERT is an event-oriented technique	CPM – CPM is an activity-oriented technique

Simple numerical on CPM

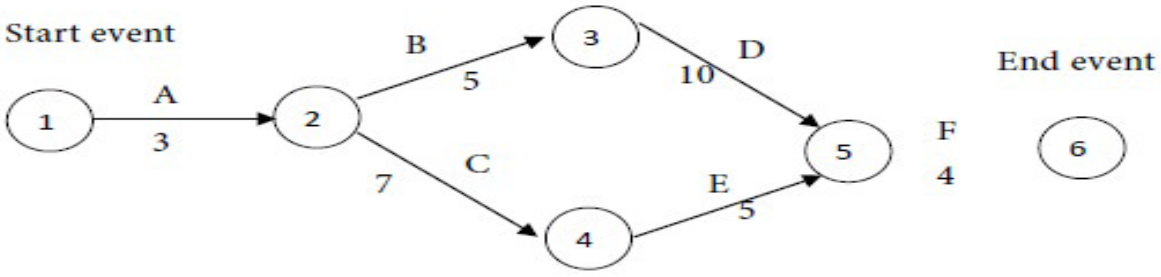
1) The following details are available regarding a project:

Activity	Predecessor Activity	Duration (Weeks)
A	-	3
B	A	5
C	A	7
D	B	10
E	C	5
F	D,E	4

Determine the critical path, the critical activities and the project completion time.

Solution

first let us construct the network diagram for the given project. We mark the time estimates along the arrows representing the activities. We obtain the following diagram:

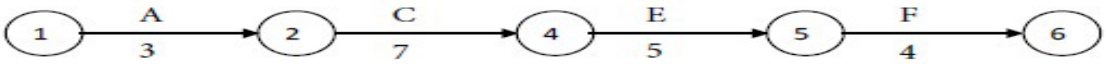


Consider the paths, beginning with the start node and stopping with the end node. There are two such paths for the given project. They are as follows:

Path I

with a time of $3 + 5 + 10 + 4 = 22$ weeks.

Path II



with a time of $3 + 7 + 5 + 4 = 19$ weeks.

Compare the times for the two paths. Maximum of {22,19} = 22. We see that path I has the maximum time of 22 weeks. Therefore, path I is the critical path. The critical activities are A, B, D and F. The project completion time is 22 weeks.
We notice that C and E are non- critical activities.

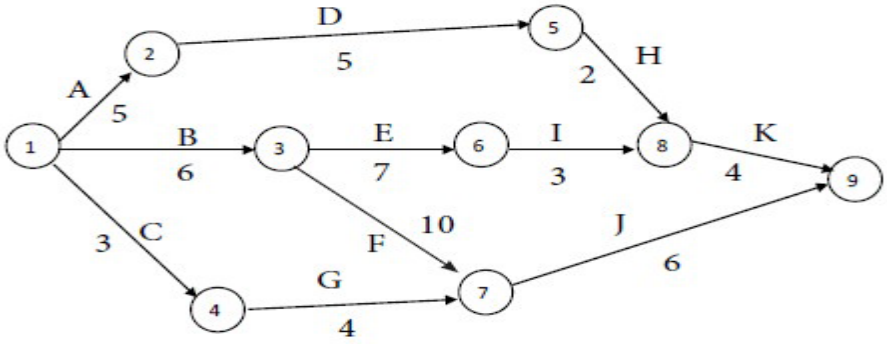
Time for path I - Time for path II = 22- 19 = 3 weeks.

Therefore, together the non- critical activities can be delayed upto a maximum of 3 weeks, without delaying the completion of the whole project.

2) Draw the network diagram and determine the critical path for the following project:

Activity	Time estimate (Weeks)
1 - 2	5
1 - 3	6
1 - 4	3
2 -5	5
3 -6	7
3 -7	10
4 -7	4
5 -8	2
6 -8	5
7 -9	6
8 -9	4

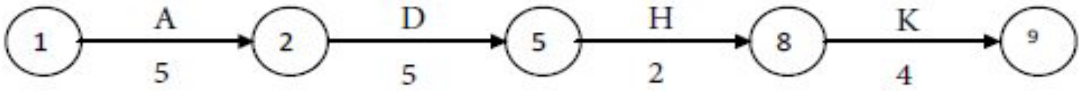
We have the following network diagram for the project:



Solution

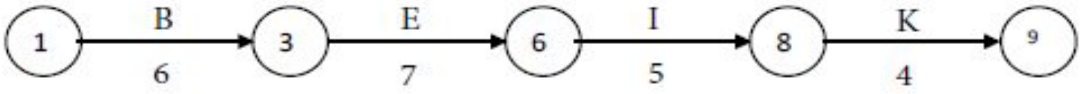
we assert that there are 4 paths, beginning with the start node of 1 and terminating at the end node of 9. They are as follows:

Path I



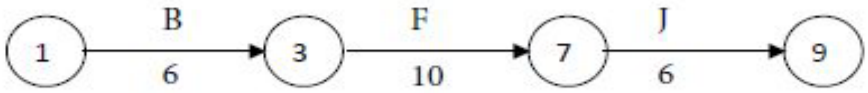
Time for the path = 5 + 5 + 2 + 4 = 16 weeks.

Path II



Time for the path = 6 + 7 + 5 + 4 = 22 weeks.

Path III

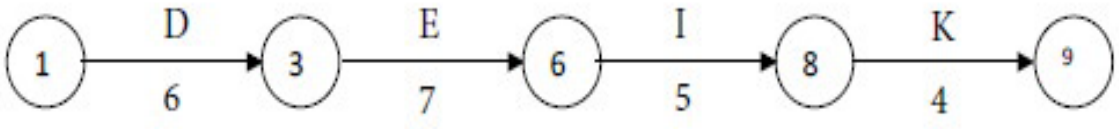


Time for the path = 6 + 10 + 6 = 16 weeks.

Path IV

Time for the path = 3 + 4 + 6 = 13 weeks.

Compare the times for the four paths. Maximum of {16, 22, 16, 13} = 22. We see that the following path has the maximum time and so it is the critical pa



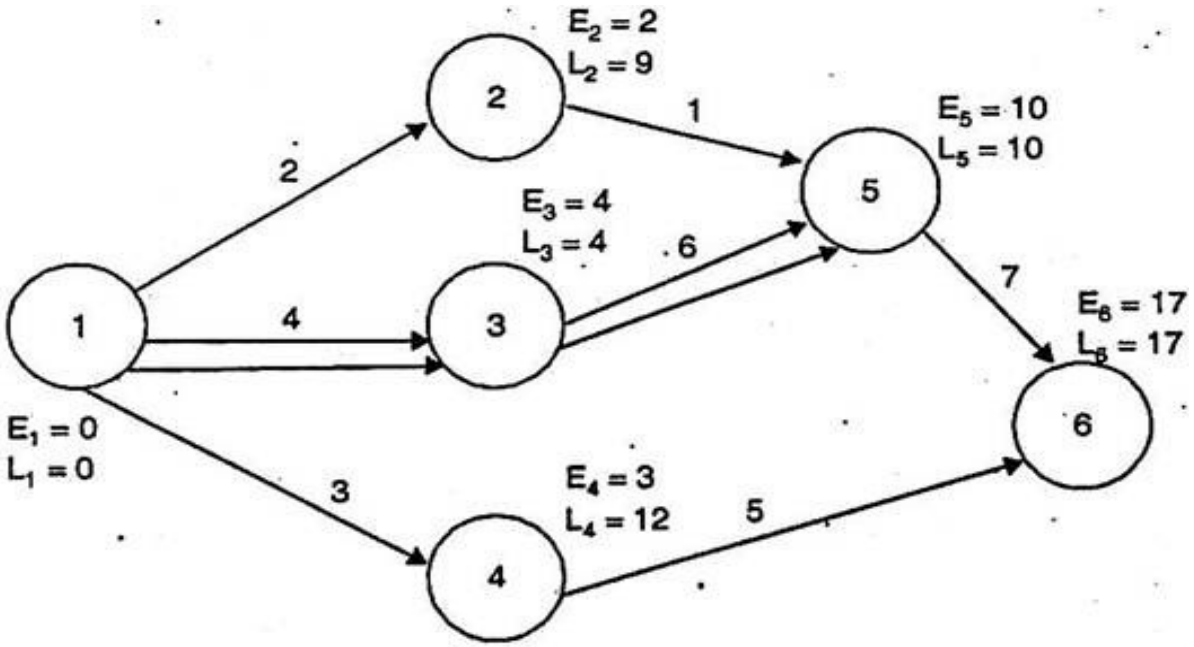
The critical activities are B, E, I and K. The non-critical activities are A, C, D, F, G, H and J. The project completion time is 22 weeks.

Simple numerical on PERT

Activity		*Estimated duration in weeks*		
i	*j*	*Optimistic*	*Most likely*	*Pessimestic*
1	2	1	1	7
1	3	1	4	7
1	4	2	2	8
2	5	1	1	1
3	5	2	5	14
4	6	2	5	8
5	6	3	6	15

E- Values and L- values are calculated on the basis of expected time are as follows:

Forward pass method	*Backward pass method*
$E_1 = 0$	$L_6 = E_6 = 0$
$E_2 = E_1 + t_{1-2} = 0+2 = 2$	$L_5 = L_6 - t_{5-6} = 17-7 = 10$
$E_3 = E_1 + t_{1-3} = 0+4 = 4$	$L_4 = L_6 - t_{4-6} = 17-5 = 12$
$E_4 = E_1 + t_{1-4} = 0+3 = 3$	$L_3 = L_5 - t_{3-5} = 10-6 = 4$
$E_5 = \max[E_2 + t_{2-5}; E_3 + t_{3-5}]$	$L_2 = L_5 - t_{2-5} - 10 - 1 = 9$
$= \max[2+1; 4+6] = 10$	$L_1 = \min[L_2 - t_{1-2}; L_3 - t_{1-3}; L_4 - t_{1-4}]$
$E_6 = \max[E_5 + t_{5-6}, E_4 + t_{4-6}]$	$= \min[9-2; 4-4; 12-3] = 0$
$= \max(10+7; 3+5) = 17$	



Critical path for the above network 1-3-5-6 shown by double lines; along with E- values and L-values are same.
Expect project length will be = 4 + 6+ 7 = 17 weeks.