

ENGINEERING ECONOMICS & PROJECT MANAGEMENT

NOTE:

We have designed the complete ENGINEERING ECONOMICS & PROJECT MANAGEMENT course material in accordance with new and changed syllabus under WBSCTE. Hence we are providing some model questions & answers, so that students can get an idea about WBSCTE questions pattern.

Unit 1: Introduction, Theory of Demand & Supply

Unit at a glance:

The Theory of Demand and Supply is a central concept in the understanding of the Economic system and its function. The quantity demanded of a good or service is the amount that consumers plan to buy during a particular time period, and at a particular price. In the following section, we will see how the concept of supply and demand are related to each other and how they affect each other.

The theory of demand and supply is a vital tool that business owners and economic managers can utilize to calculate their profits. As the demand for a product increases, the business owner must raise his price to earn more profit. If a rise in supply occurs at the same time, the business owner can lower his price to attract more buyers. The above-mentioned was only an outline of how the theory of demand and supply can assist you in understanding its basics.

Short Answer Type Questions

A. Choose the correct answer from the given alternatives in each of the following:

1. Which of the following is an assumption made while drawing the demand curve?
[Model Question]
(a) The demand curve must be linear
(b) The price of substitutes should not change
(c) The quantity demanded should not change
(d) The price of the commodity should not change
Answer: (b)

2. Law of demand shows a relation between the _____.
[Model Question]
(a) Quantity demand and quantity supply of a commodity
(b) Income and quantity demand of a commodity
(c) Price and quantity of a commodity
(d) Income and price of a commodity
Answer: (c)

Answer:

Opportunity cost can be defined as the potential benefits that are lost when an individual, business or investor chooses a substitute over another. As the opportunity cost definition defines it to be hidden, the costs could go unnoticed very easily. To make a better decision it is important for a business to understand the possible missed opportunities whenever a business chooses one investment over another.

E. Pick up the correct answer:

32. Normally the demand curve will have a (Upward/Downward) sloping shape.

[Model Question]

Answer: Downward

33. The elasticity for the demand of durable goods is (less/ greater) than unity.

[Model Question]

Answer: greater

34. If the quantity demanded of a commodity is unresponsive to change in prices, then the demand of that commodity is perfectly (elastic/inelastic).

[Model Question]

Answer: inelastic

35. When the price of a product falls by 10% and its demand rises by 30%, then the elasticity of demand is (3/30).

[Model Question]

Answer: 3

36. When the elasticity of demand for a commodity is very low, it shows that the product is a (necessity/luxury).

[Model Question]

Answer: necessity

37. In May 2019, a firm was providing 5000 kg of sugar at a market price of Rs. 30 per kg. But in June 2019, the supply of sugar decreased to 4500 kg at a market price of Rs. 20 per kg. This change shows that the supply of sugar is (more/ less) elastic.

[Model Question]

Answer: Less

38. If indifference curve is L shaped then two goods will be Perfect (complementary/ substitute) goods.

[Model Question]

Answers: complementary

Long Answer Type Questions

- Q 1. Discuss the 7 Principles of Engineering Economics.

[Model Question]

Answers:

- **Principle 1 - Develop the Alternatives:** The choice (decision) is among alternatives. The alternatives need to be identified. A decision involves making a choice among

alternatives. Developing and defining alternatives depends upon engineer's creativity and innovation.

- **Principle 2 - Focus on the Difference:** Only the differences in expected future outcomes among the alternatives are relevant to their comparison and should be considered in the decision. If all prospective outcomes of the feasible alternatives were exactly the same, obviously, only the differences in the future outcomes of the alternatives are important. Outcomes that are common to all alternatives can be disregarded in the comparison and decision. For example, if two apartments were with same purchase price or rental price, decision on selection of alternatives would depend on other factors such as location and annual operating and maintenance expenses.
- **Principle 3 - Use a Consistent Viewpoint:** The prospective outcomes of the alternatives, economic and other, should be consistently developed from a defined viewpoint (perspective). Often perspective of decision maker is owner's point of view. For the success of the engineering projects viewpoint may be looked upon from the various perspective e.g. donor, financer, beneficiary group & stakeholders. However, viewpoint must be consistent throughout the analysis.
- **Principle 4 - Use a Common Unit of Measure:** Using a common unit of measurement to enumerate as many of the prospective outcomes as possible will make easier the analysis and comparison of the alternatives. For economic consequences, a monetary units such as dollars or rupees is the common measure.
- **Principle 5 - Consider all Relevant Criteria:** Selection of preferred alternative (decision making) requires the use of a criterion (or several criteria). The decision process should consider both the outcomes enumerated in the monetary unit and those expressed in some other unit of measurement or made explicit in a descriptive manner. Apart from the long term financial interest of owner, needs of stakeholders should be considered.
- **Principle 6 - Make uncertainty Explicit:** Uncertainty is inherent in projecting (or estimating) the future outcomes of the alternatives ad should be recognized in their analysis and comparison. The magnitude & impact of future impact of any course of action are uncertain or probability of occurrence changes from the planned one. Thus dealing with uncertainty is important aspect of engineering economic analysis.
- **Principle 7 - Revisit your Decisions:** Improved decision making results from an adaptive process; to the extent practicable, the initial projected outcomes of the selected alternative should be subsequently compared with actual results achieved. If results significantly different from the initial estimates, appropriate feedback to the decision making process should occur.

2. Establish the relationship between Engineering and Economics.

Answer:

[Model Question]

Engineering and economics are two different fields, but they are closely related in many ways. Engineers are concerned with designing and building physical systems and products, while economists focus on studying the production, distribution, and

consumption of goods and services. However, the relationship between these two fields is important because economics plays a crucial role in shaping the decisions engineers make about what products to build, how to design them, and how to produce them.

Here are a few examples of the relationship between engineering and economics:

- **Cost-benefit analysis:** Engineers often use cost-benefit analysis to evaluate the feasibility of a project or product. This involves calculating the costs of designing, building, and operating a system or product, as well as the potential benefits it could provide. Economists can provide valuable insights into this process by analyzing market trends, estimating consumer demand, and forecasting future economic conditions.
- **Investment decisions:** Many engineering projects require significant upfront investments, and engineers often need to work closely with economists and financial analysts to determine the best way to finance these projects. This might involve analyzing the risks and returns associated with different funding options, such as debt financing, equity financing, or public-private partnerships.
- **Resource allocation:** Engineers are often tasked with optimizing the use of resources, such as labor, materials, and energy, in order to minimize costs and maximize efficiency. Economists can help inform these decisions by analyzing the economic value of different resources, as well as the environmental and social impacts of different production methods.
- **Innovation and entrepreneurship:** Many engineers are also entrepreneurs or innovators who create new products or technologies. Economics can play a key role in this process by providing insights into market trends, consumer behavior, and the regulatory landscape. Engineers who understand these economic factors can make more informed decisions about how to design and market their products, as well as how to navigate the business and legal aspects of entrepreneurship.

Overall, the relationship between engineering and economics is complex and multifaceted. Engineers who understand the economic factors that shape their work are better equipped to design products and systems that are efficient, sustainable, and economically viable. Similarly, economists who understand the technical aspects of engineering can provide valuable insights into the costs, benefits, and risks associated with different projects and products.

➲ 3. State the law of demand, explaining it with the help of demand schedule and related graph. Also, state the assumptions to the law of Demand. [Model Question]

Answer:

According to Alfred Marshall, the law of demand is defined as “Other things being equal, the quantity of a commodity demanded varies inversely with its price.”

Law of demand can be expressed as

$$D_{-}\{x\} = f(P_{-}\{x\})$$

Where,

D = demand for commodity X

X = commodity demanded

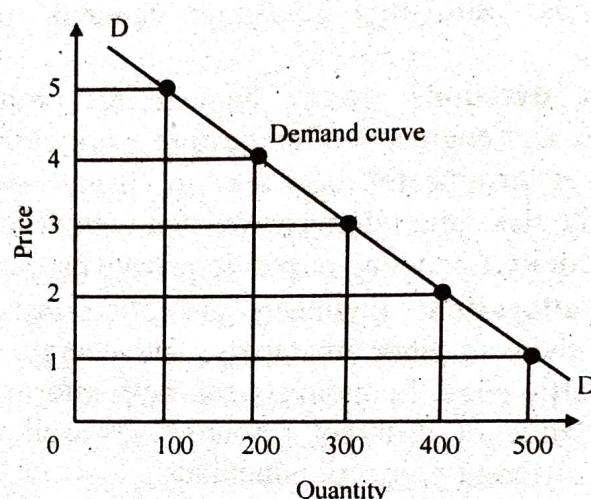
$F = \text{function of}$

$P_x = \text{price of the commodity } X$

In other words, Law of demand states that there is an inverse relation between the price of a commodity and its quantity demanded, assuming all other factors affecting demand remain constant. It means that when the price of a good falls, the demand for the good rises and when price rises, the demand falls.

Law of demand may be explained with the help of the following demand schedule and demand curve:

Demand Schedule	
P_x	D_x
5	100
4	200
3	300
2	400
1	500



The above table and diagram show that as the price of the good reduces from Rs 5 to Rs 4, the demand for the good increases from 100 to 200 units.

Assumptions to the law of Demand

- There will be no introduction of any substitutes.
- There will be no change in prices of substitute goods.
- There will be no anticipation of price change in future.
- There will be no change in the income level of the consumer.
- There will be no change in the taxation policy of the government.
- There will be no change in consumer's taste, preference and habit.
- There will be no change in size, sex and age composition of the population.

4. Discuss the exceptions to the law of demand.

[Model Question]

Answers:

1. **Inferior goods/ Giffen goods:** Some special varieties of inferior goods are termed as Giffen goods. Cheaper varieties of goods like low priced rice, low priced bread, etc. are some examples of Giffen goods. This exception was pointed out by Robert Giffen who observed that when the price of bread increased, the low paid British workers purchased lesser quantity of bread, which is against the law of demand. Thus, in case of Giffen goods, there is indirect relationship between price and quantity demanded.
2. **Veblen Goods/Goods having prestige value:** This exception is associated with the name of the economist, T. Veblen and his doctrine of conspicuous consumption. Few goods like diamond can be purchased only by rich people. The prices of these goods

are so high that they are beyond the capacity of common people. The higher the price of the diamond the higher the prestige value of it. In this case, a consumer will buy less of the diamonds at a low price because with the fall in price, its prestige value goes down. On the other hand, when price of diamonds increase, the prestige value goes up and therefore, the quantity demanded of it will increase.

3. **Price expectation:** When the consumer expects that the price of the commodity is going to fall in the near future, they do not buy more even if the price is lower. On the other hand, when they expect further rise in price of the commodity, they will buy more even if the price is higher. Both of these conditions are against the law of demand.
4. **Fear of shortage:** When people feel that a commodity is going to be scarce in the near future, they buy more of it even if there is a current rise in price. For example: If the people feel that there will be shortage of L.P.G. gas in the near future, they will buy more of it, even if the price is high.
5. **Change in income:** The demand for goods and services is also affected by change in income of the consumers. If the consumers' income increases, they will demand more goods or services even at a higher price. On the other hand, they will demand less quantity of goods or services even at lower price if there is decrease in their income. It is against the law of demand.
6. **Change in fashion:** The law of demand is not applicable when the goods are considered to be out of fashion. If the commodity goes out of fashion, people do not buy more even if the price falls. For example: People do not purchase old fashioned shirts and pants nowadays even though they've become cheap. Similarly, people buy fashionable goods in spite of price rise.
7. **Basic necessities of life:** In case of basic necessities of life such as salt, rice, medicine, etc. the law of demand is not applicable as the demand for such necessary goods does not change with the rise or fall in price.

- ➲ 5. Explain the concept of price elasticity of demand and supply. Also state the different types of elasticities. [Model Question]

Answer:

The price elasticity of demand is the percentage change in the quantity demanded of a good or service divided by the percentage change in the price. The price elasticity of supply is the percentage change in quantity supplied divided by the percentage change in price.

Elasticities can be usefully divided into five broad categories: perfectly elastic, elastic, perfectly inelastic, inelastic, and unitary. An elastic demand or elastic supply is one in which the elasticity is greater than one, indicating a high responsiveness to changes in price. An inelastic demand or inelastic supply is one in which elasticity is less than one, indicating low responsiveness to price changes. Unitary elasticities indicate proportional responsiveness of either demand or supply.

Perfectly elastic and perfectly inelastic refer to the two extremes of elasticity. Perfectly elastic means the response to price is complete and infinite: a change in price results in

the quantity falling to zero. Perfectly inelastic means that there is no change in quantity at all when price changes.

If....	It is called....
$\frac{\% \text{ change in quantity}}{\% \text{ change in price}} = \infty$	Perfect elastic
$\frac{\% \text{ change in quantity}}{\% \text{ change in price}} > 1$	Elastic
$\frac{\% \text{ change in quantity}}{\% \text{ change in price}} = 1$	Unitary
$\frac{\% \text{ change in quantity}}{\% \text{ change in price}} < 1$	Inelastic
$\frac{\% \text{ change in quantity}}{\% \text{ change in price}} = 0$	Perfect inelastic

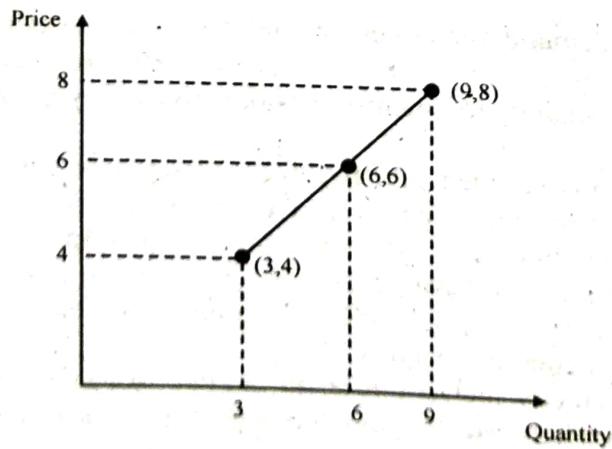
6. State and explain the Law of Supply.

[Model Question]

Answer:

Law of supply states that other factors remaining constant, price and quantity supplied of a good are directly related to each other. In other words, when the price paid by buyers for a good rises, then suppliers increase the supply of that good in the market. The law of supply graph (or, the supply curve) is upward sloping, reflecting the direct relationship between price and supply. Let us look at the example below to gain more clarity on this.

Price	Quantity Supplied
\$4	3
\$6	6
\$8	9



Q 7. Explain the concept of market equilibrium.**[Model Question]****Answer:**

A market is in equilibrium if at the market price the quantity demanded is equal to the quantity supplied. The price at which the quantity demanded is equal to the quantity supplied is called the equilibrium price or market clearing price, and the corresponding quantity is the equilibrium quantity.

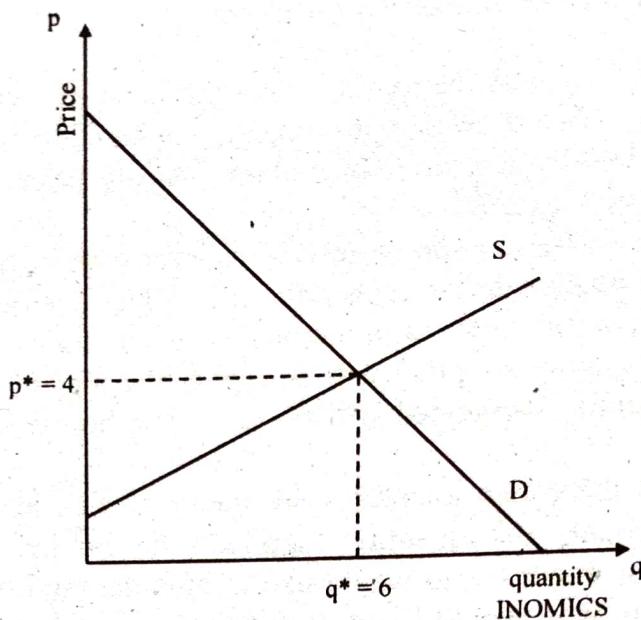
In a market, sellers who offer a good or service interact with buyers who do not possess the good and want to acquire it. At each price the sellers decide how many units they want to offer or supply at this price, and the buyers decide how many units they want to buy or demand. The quantity supplied will be higher the higher the market price of the good, whereas the quantity demanded will be lower the higher the market price of the good.

At the price at which these two quantities are identical, i.e., at the price at which the quantity demanded equals the quantity supplied, the market is in equilibrium. In equilibrium there are no buyers who would like to buy the good but cannot find a seller, and there are no sellers who would like to sell the good but are unable to find a buyer. This means that at the equilibrium price, the sellers are able to sell exactly the quantity they want to sell at this price and the buyers are able to buy exactly the quantity that they want to buy at this price.

If we know the demand and supply in a particular market, we can easily find the market equilibrium by looking for the price at which the quantity demanded is equal to the quantity supplied. For example, suppose that in the market for pencils the market demand is given by the linear demand function $q_p = 10 - p$ and the market supply is equal to $q_s = 2p - 2$. In equilibrium the number of pencils that the sellers want to sell has to be equal to the number of pencils that the buyers want to buy, i.e., quantity supplied has to be equal to the quantity demanded, or $q_p = q_s$. For the demand and supply function of our example this means $10 - p = 2p - 2$.

Now we only have to solve p to find the equilibrium price which is equal to $p^* = 4$. To find the corresponding quantity, we plug the equilibrium price p^* back into the supply or the demand function and obtain $q^* = 6$. Thus, in our market for pencils the equilibrium price is equal to 4, and at this price the quantity exchanged is equal to 6 units.

This result is also shown in the graph below. The market equilibrium in a perfectly competitive market corresponds to the point of intersection of the supply curve and the demand curve. On the x-axis we have the quantity q of the good or service (in our case pencils) and on the y-axis the price p of the good. The green line represents the demand curve and shows the quantity demanded at each price (for the graph below the demand function is the same as in the example $q_p = 10 - p$). The blue line represents the supply curve (also taken from the example above $q_s = 2p - 2$) and shows the quantity supplied at each price. At the equilibrium price $p^* = 4$, the quantity demanded is equal to the quantity supplied ($q_p = q_s = q^* = 6$)



The market equilibrium is also called the competitive equilibrium, because it describes the allocation of goods and services in a perfectly competitive market (see the term for Perfect Competition). In a competitive market where buyers and sellers are price takers, the equilibrium price (and thus marginal revenue) will be equal to marginal costs and each firm makes a profit of zero.

The intuition behind this result is that in a perfectly competitive market without barriers to entry, firms will enter as long as they can make a positive profit. As the number of firms increases the market price decreases because new firms introduce excessive supply that cannot be sold at the original market price. Then they must lower prices to sell their stock. This decreases profits until they reach zero and firms have no incentive to enter the market anymore.

Unit 2: Theory of Production & Costs

Unit at a glance:

The theory of production and cost states that the cost of a product is determined by the sum total of the cost of all the resources that went into making it. There are multiple factors to be considered when determining the cost of a product.

The theory of production and cost is very important for pricing. It is the base for a company's demand for production factors about their supply. This relation decides the prices of products and services. The theory of production and cost further helps in maximizing profit. Every organization must consider the marginal and average cost of production to define the relationship between input and output.

Short Answer Type Questions

A. Choose the correct answer from the given alternatives in each of the following:

Answer: (a)

2. Which of the following is an assumption associated with the definition of a production function? [Model Question]

 - (a) Technology remains constant
 - (b) Both inputs and outputs are measured in monetary units
 - (c) The function shows the maximum level of output possible with a given combination of inputs
 - (d) All units of the inputs are homogeneous

Answer: (b)

3. A production function refers to [Model Question]

 - (a) Relationship between output and utility
 - (b) Relationship between input and output
 - (c) Relationship between inputs and price of output
 - (d) Relationship between inputs and cost of production

Answer: (b)

44. Economies of scale means increasing production with (Decrease/Increase) in average cost per unit. [Model Question]

Answer: Decrease

45. When the total product curve is falling, the marginal product of labor is (negative/Falling). [Model Question]

Answer: Negative

Long Answer Type Questions

Q 1. What is Law of Variable Proportions? Explain the assumptions of the Law. Elaborate the different stages of the Law of variable Proportions.

[Model Question]

Answer:

The Law of Variable Proportions states that as the quantity of a factor is increased while keeping other factors constant, the Total Product (TP) first rises at an incremental rate, then at a decremental rate and lastly the total production begins to fall. In other words, as one of the factors in production makes some variation in its quantity, keeping all the other factors constant, the ratio between all the factors starts varying, which further influence the level of output.

Assumptions

The law of variable proportion works under the following situations:

Constant State of Technology

The first assumption is that the state of technology given for the situation remains unchanged. In case, the technology gets improved, then the marginal product may rise rather than diminish.

Other Factors also remain fixed

This means that there should some inputs or factors given in a certain situation which should remain fixed in terms of their quantity. By changing the factor proportions, we can understand the effects on the output. However, the law would not work if all the factors are altered in proportions.

Possibility of Varying the Proportions of Factors

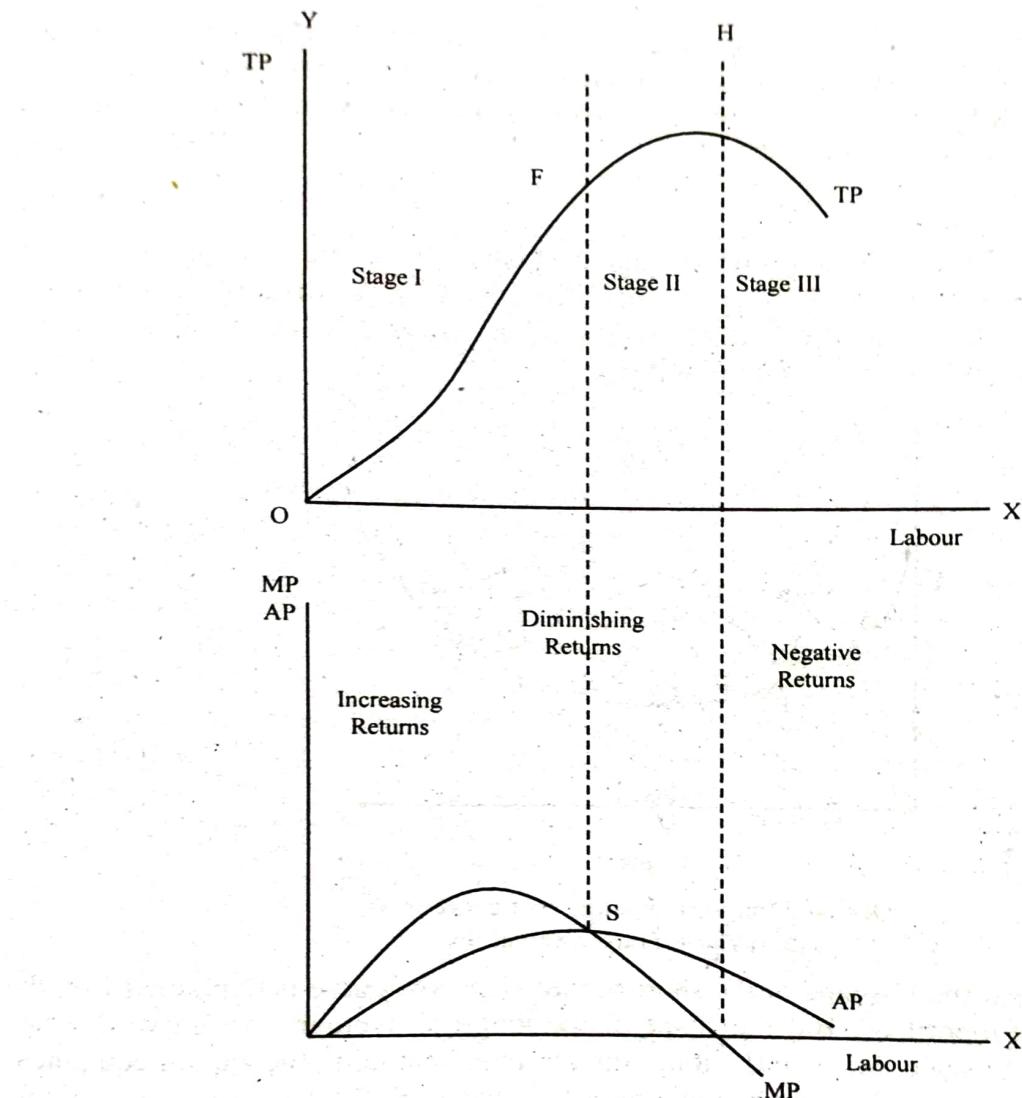
The third assumption is that the law can only work if there is the scope for varying proportions of factors as fixed proportions might not yield effective results.

The Stages of Law of Variable Proportion

In order to understand this in detail, let us take an example. Imagine you own a land wherein you produce rice by employing more and more labour (variable factors). The table given below explains the situation further:

Theory of Production & Costs

EPM.25



In the above graph of the Law of Variable Proportions, you would notice that:

Up to 3 units of labour employed, the TP is rising at an increasing rate (2,6,12). This constitutes Stage 1 of the law, which is the Stage of Increasing Returns. Therefore, during the first stage, the TP curve increases significantly.

Beyond the 3rd unit of labour, the TP starts rising at a diminishing rate (12,16,18), which means the TP curve rises at a slower rate. This eventually makes the marginal product (MP) starting to fall. Constituting the second stage of the Law of Variable Proportion which is called the Stage of Diminishing Returns.

After the employment of 6 units of labour, the TP starts to fall, indicating the 3rd stage which is the Stage of Negative Returns. Even after employing 6 units of labour, it fails to yield the marginal product, that is when the MP comes to zero. Eventually, the TP curve starts sloping down and the marginal product goes to negative in the x-axis.

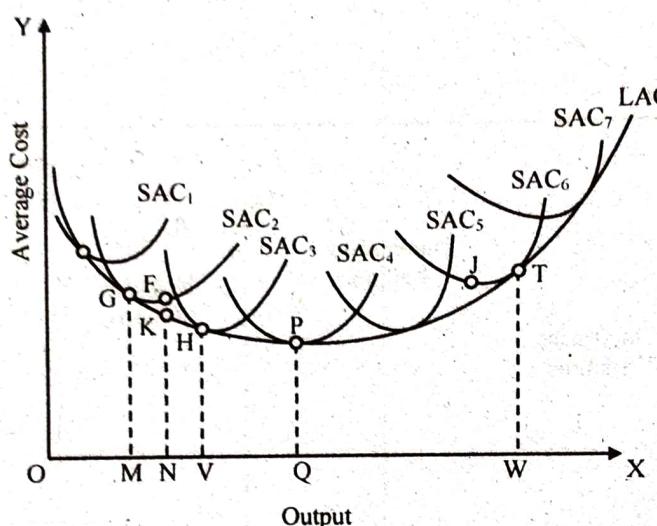
Q 2. Why is the Long Run Average Cost curve "U-shaped"? If a firm's Long Run Average Cost (LRAC) curve is U-shaped, show that except at the minimum point, the LRAC curve does not pass through the minimum points of the short run Average Cost curves.

[Model Question]

Answer:

1st part:

In Fig. 1, we have drawn the long-run average cost curve as having an approximately U-shape. It is generally believed by economists that the long-run average cost curve is normally U shaped, that is, the long-run average cost curve first declines as output is increased and then beyond a certain point it rises.



Deriving long-run average cost curve from
short-run average cost curves

We saw above that the U-shape of the short-run average cost curve is explained with the law of variable proportions. But the shape of the long-run average cost curve depends upon the returns to scale. Since in the long run all inputs including the capital equipment can be altered, the relevant concept governing the shape of this long-run average cost curve is that of returns to scale. Returns to scale increase with the initial increases in output and after remaining constant for a while, the returns to scale decrease. It is because of the increasing returns to scale in the beginning that the long-run average cost of production falls as output is increased and, likewise, it is because of the decreasing returns to scale that the long-run average cost of production rises beyond a certain point.

2nd part:

As in the short run, costs in the long run depend on the firm's level of output, the costs of factors, and the quantities of factors needed for each level of output. The chief difference between long- and short-run costs is there are no fixed factors in the long run. There are thus no fixed costs. All costs are variable, so we do not distinguish between total variable cost and total cost in the long run: total cost is total variable cost. The Long-Run Average Cost (LRAC) curve shows the firm's lowest cost per unit at each level of output, assuming that all factors of production are variable. The LRAC curve assumes that the

firm has chosen the optimal factor mix, as described in the previous section, for producing any level of output. The costs it shows are therefore the lowest costs possible for each level of output. It is important to note, however, that this does not mean that the minimum points of each short-run ATC curves lie on the LRAC curve. This critical point is explained in the next paragraph and expanded upon even further in the next section. Figure 8.9 "Relationship Between Short-Run and Long-Run Average Total Costs" shows how a firm's LRAC curve is derived. Suppose Lifetime Disc Co. produces compact discs (CDs) using capital and labor. We have already seen how a firm's average total cost curve can be drawn in the short run for a given quantity of a particular factor of production, such as capital. In the short run, Lifetime Disc might be limited to operating with a given amount of capital; it would face one of the short-run average total cost curves shown in Fig. 2 "Relationship Between Short-Run and Long-Run Average Total Costs." If it has 30 units of capital, for example, its average total cost curve is ATC₃₀. In the long run the firm can examine the average total cost curves associated with varying levels of capital. Four possible short-run average total cost curves for Lifetime Disc are shown in Figure 8.9 "Relationship Between Short-Run and Long-Run Average Total Costs" for quantities of capital of 20, 30, 40, and 50 units. The relevant curves are labeled ATC₂₀, ATC₃₀, ATC₄₀, and ATC₅₀ respectively. The LRAC curve is derived from this set of short-run curves by finding the lowest average total cost associated with each level of output. Again, notice that the U-shaped LRAC curve is an envelope curve that surrounds the various short-run ATC curves. With the exception of ATC₄₀, in this example, the lowest cost per unit for a particular level of output in the long run is not the minimum point of the relevant short-run curve.

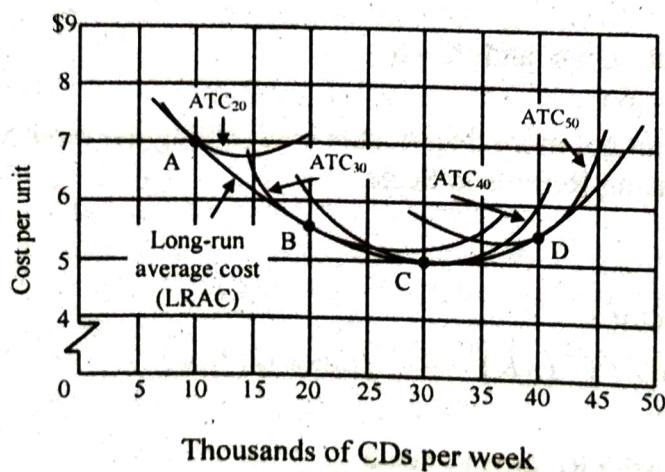


Fig. 2 Relationship between Short-Run and Long-Run Average Total Costs. The LRAC curve is found by taking the lowest average total cost curve at each level of output. Here, average total cost curves for quantities of capital of 20, 30, 40, and 50 units are shown for the Lifetime Disc Co. At a production level of 10,000 CDs per week, Lifetime minimizes its cost per CD by producing with 20 units of capital (point A). At 20,000 CDs per week, an expansion to a plant size associated with 30 units of capital minimizes cost per unit (point B). The lowest cost per unit is achieved with production of 30,000 CDs per week

using 40 units of capital (point C). If Lifetime chooses to produce 40,000 CDs per week, it will do so most cheaply with 50 units of capital (point D).

- Q 3. For each of the following production functions, determine whether returns to scale are decreasing, constant, or increasing. [Model Question]

- $Q = 2K + 3L + KL$
- $Q = 20K^{0.6}L^{0.5}$
- $Q = 100 + 3K + 2L$
- $Q = 5K^a L^b$, Where $a + b = 1$
- $Q = K/L$

Answer:

Production function: $Y = F(K, L)$

We augment the T to the factor t

$$f(tL, tK) = t^{\alpha+\beta} f(L, K)$$

if $\alpha + \beta = 1$, the $f(L, K)$ exhibit Constant Returns to Scale

if $\alpha + \beta > 1$, the $f(L, K)$ exhibit Increasing Returns to Scale

if $\alpha + \beta < 1$, the $f(L, K)$ exhibit Decreasing Returns to Scale

i) $Q = 2K + 3L + KL$

Let $K = 3$ and $L = 3$

$$Q = 6 + 9 + 9 = 24$$

Let's double the input, $L = 6$ and $K = 6$

$$Q = 12 + 18 + 36 = 66$$

We observe that output got more than double by doubling the input values.

So, Q exhibits Increasing Returns to Scale.

ii) $Q = 20K^{0.6}L^{0.5}$

Augmenting Q by factor λ

$$Q(\lambda K, \lambda L) = 20(\lambda L)^{0.6} (\lambda K)^{0.5} = \lambda^{1.1} \text{ times } Q(K, L)$$

Since, $\alpha + \beta = 1.1 > 1$

So, Q exhibits Increasing Returns to Scale.

iii) $Q = 100 + 3K + 2L$

Let $K = 2$ and $L = 2$

$$Q = 100 + 6 + 4 = 110$$

Let's double the inputs, $L = 4$ and $K = 4$

$$Q = 100 + 12 + 8 = 120$$

We observe that output got less than double by doubling the input values.

So, Q exhibits Decreasing Returns to Scale.

iv) $Q = 5K^a L^b$, Where $a + b = 1$

Augmenting Q by factor λ

$$Q(\lambda K, \lambda L) = 5(\lambda L)^a (\lambda K)^b = \lambda^{a+b} \times Q(K, L)$$

Since, $a + b = 1$

So, Q exhibits Constant Returns to Scale.

v) $Q = K/L$

Augmenting Q by factor λ

$$Q(\lambda K, \lambda L) = (\lambda K / \lambda L) = (K/L)$$

So, the production function exhibits Constant Returns to Scale

4. Discuss different concepts of cost.

[Model Question]

Answer:

The various concepts of cost are as follows:

Concept of Costs in terms of Treatment:

- i) **Accounting costs:** Accounting costs are those for which the entrepreneur pays direct cash for procuring resources for production. These include costs of the price paid for raw materials and machines, wages paid to workers, electricity charges, the cost incurred in hiring or purchasing a building or plot, etc. Accounting costs are treated as expenses. Chartered accountants record them in financial statements.
- ii) **Economic costs:** There are certain costs that accounting costs disregard. These include money which the entrepreneur forgoes but would have earned had he invested his time, efforts and investments in other ventures. For example, the entrepreneur would have earned an income had he sold his services to others instead of working on his own business.

Similarly, potential returns on the capital he employed in his business instead of giving it to others, the output generated by his resources which he could have used for others' benefits, etc. are other examples of economic costs. Economic costs help the entrepreneur calculate supernormal profits, i.e. profits he would earn above the normal profits by investing in ventures other than his.

Concept of Costs in terms of the Nature of Expenses:

- i) **Outlay costs:** The actual expenses incurred by the entrepreneur in employing inputs are called outlay costs. These include costs on payment of wages, rent, electricity or fuel charges, raw materials, etc. We have to treat them as general expenses for the business.
- ii) **Opportunity costs:** Opportunity costs are incomes from the next best alternative that is foregone when the entrepreneur makes certain choices. For example, the entrepreneur could have earned a salary had he worked for others instead of spending time on his own business. These costs calculate the missed opportunity and calculate income that we can earn by following some other policy.

Concept of Costs in terms of Traceability:

- i) **Direct costs:** Direct costs are related to a specific process or product. They are also called traceable costs as we can directly trace them to a particular activity, product or process. They can vary with changes in the activity or product. Examples of direct costs include manufacturing costs relating to production, customer acquisition costs pertaining to sales, etc.
- ii) **Indirect costs:** Indirect costs, or untraceable costs, are those which do not directly relate to a specific activity or component of the business. For example, an increase in charges of electricity or taxes payable on income. Although we cannot trace indirect costs, they are important because they affect overall profitability.

Concept of Costs in terms of the Purpose:

- i) **Incremental costs:** These costs are incurred when the business makes a policy decision. For example, change of product line, acquisition of new customers, upgrade of machinery to increase output are incremental costs.
- ii) **Sunk costs:** Sunk costs are costs which the entrepreneur has already incurred and he cannot recover them again now. These include money spent on advertising, conducting research, and acquiring machinery.

Concept of Costs in terms of Payers:

- i) **Private costs:** These costs are incurred by the business in furtherance of its own objectives. Entrepreneurs spend them for their own private and business interests. For example, costs of manufacturing, production, sale, advertising, etc.
- ii) **Social costs:** As the name suggests, it is the society that bears social costs for private interests and expenses of the business. These include social resources for which the firm does not incur expenses, like atmosphere, water resources and environmental pollution.

Concept of Costs in terms of Variability:

- i) **Fixed costs:** Fixed costs are those which do not change with the volume of output. The business incurs them regardless of their level of production. Examples of these include payment of rent, taxes, interest on a loan, etc.
- ii) **Variable costs:** These costs will vary depending upon the output that the business generates. Less production will cost fewer expenses, and vice versa, the business will pay more when its production is greater. Expenses on the purchase of raw material and payment of wages are examples of variable costs.

5. What is Break-even analysis? How to calculate break-even point?**[Model Question]****Answer:**

Break-even analysis in economics, business, and cost accounting refers to the point at which total costs and total revenue are equal. A break-even point analysis is used to determine the number of units or dollars of revenue needed to cover total costs (fixed and variable costs).

It can also be explained in another way.

Break-even analysis refers to the identifying of the point where the revenue of the company starts exceeding its total cost i.e., the point when the project or company under

consideration will start generating the profits by the way of studying the relationship between the revenue of the company, its fixed cost, and the variable cost.

Calculation of break-even point:

There are two approaches to calculate the break-even point. One can be in quantity termed as **break-even quantity**, and the other is sales, which are termed as **break-even sales**.

In the first approach, we have to divide the fixed cost by contribution per unit i.e.

$$\text{Break-Even Point (Qty)} = \text{Total Fixed Cost} / \text{Contribution per Unit}$$

- Where, Contribution per Unit = Selling Price per Unit – Variable Cost per Unit

In the second approach, we have to divide the fixed cost by contribution to sales ratio or profit-volume ratio i.e.

$$\text{Break-Even Sales (Rs)} = \text{Total Fixed Cost} / \text{Contribution Margin Ratio},$$

- Where Contribution Margin Ratio = Contribution per Unit / Selling Price per Unit

Unit 3: Different Types of Market & Role of Government

Unit at a glance:

The market is presented as a form that is for the cultural advantage of the general public. The market structure comprises different types of markets, and the structures are portrayed by the nature and the level of competition that exists for the goods and services in the market. The forms of the market, both for the products market and the factor market or the service market, is to be decided by the idea of rivalry that is winning in a specific kind of market.

The Market structure is an expression that is resultant for the quality or the adequacy of the market competition that is winning in the market. There are seven primary market structures:

- Monopoly
- Oligopoly
- Perfect competition
- Monopolistic competition
- Monopsony
- Oligopsony
- Natural monopoly

In a market economy, the government has a role. The government gives specific goods and services that are funded by taxes, such as military defense, environmental protection, and property rights protection. The government is also responsible for providing services that the private sector is unwilling or cannot offer.

Governments may control some enterprises while supporting others through subsidies. Governments also impose taxes on their residents and transfer the proceeds to the needy, including the senior population.

Let us study the role of government in the market economy as defined by Samuelson and other modern economists. According to them, governments have four primary roles in a market economy.

1. Increase efficiency.
2. Provide infrastructure.
3. Promote equity.
4. Encourage macroeconomic growth and stability.

Answer: decrease

23. The term oligopoly refers to (two/few) sellers dominating the industry.

[Model Question]

Answer: Few

24. (Capitalism/Socialism) is an economic system in which capital goods are owned by private individuals or businesses and the production of goods and services is based on supply and demand in general market.

[Model Question]

Answer: Capitalism

25. (Market forces/ Government) determine prices in a capitalist economy.

[Model Question]

Answer: Market Forces

26. Under (oligopoly/perfect competition), a price has no control over the price of its product.

[Model Question]

Answer: Perfect Competition

Long Answer Type Questions

- ➲ 1. Discuss the characteristics of the perfectly competitive market.

[Model Question]

Answer:

The essential characteristics of Perfect Competition are as follows :

- A Large Number of Buyers and Sellers:** Under perfect competition there are a large number of buyers and sellers of a commodity. The numbers of buyers are so many that a single buyer buys a very small part of the market supply. Similarly, a single seller supplies a very small part of the total output. For this reason, the size of a competitive firm becomes very small in relation to the industry to which it belongs.
- An Identical or a Homogeneous Product:** All the sellers in a perfectly competitive market supply an identical product. In other words, the products of all the competitive firms are the same.
- No Individual Control Over the Market Supply and Price:** As many sellers are selling an identical product, a single firm supplies a negligible or an insignificant portion of the industry. For this reason, it has no control over market supply and market price. In other words, a single firm cannot bring about an appreciable change in total supply through the variation in its own supply. As a result it cannot influence the market price through its own independent action. For this reason, a competitive firm is described as "a price-taker, not a price-maker", and it has to sell all the units of its own output at the prevailing market price. From this it follows that the demand curve or the average revenue curve of a competitive firm becomes

a horizontal line. As the price remains the same for all units of output, its marginal revenue curve becomes identical with the average revenue curve.

- d. **No Buyers' Preferences:** In a perfectly competitive market there is no preference of buyers for the product of any particular seller. As the products of all the sellers are identical, buyers can buy the product from any of them.
- e. **Perfect Knowledge:** Again, both buyers and sellers have a perfect or full knowledge relating to the price prevailing in the market. For this reason, there can exist only one price in a perfectly competitive product market.
- f. **Perfect Mobility of Factors:** The factors of production like labour or capital can freely move into the industry or freely go out of the industry. This is necessary to keep a proper balance between demand and supply of a commodity.
- g. **Free Entry and Free Exit of Firms:** In this type of market new firm can freely enter the industry or an existing firm can freely leave the industry in the long run.
- h. **Absence of Transport Cost and a Close Contact between Buyers and Sellers:** A market becomes perfectly competitive when both buyers and sellers stay at the same place so that there is a close contact between them. Because of this, neither buyers nor sellers have to bear any transport cost. If the same price is to prevail in all parts of the market, it is necessary that there is no transport cost. In the presence of any transport cost, prices will differ in the different segments of the same market.

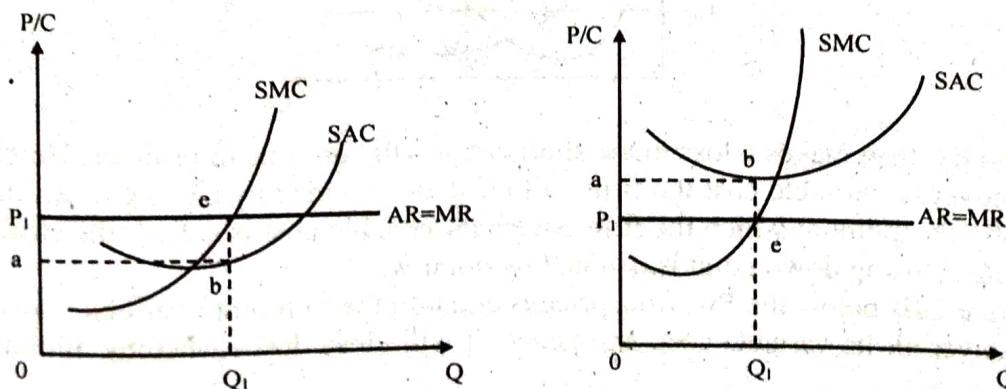
It may be noted that these conditions of a perfect market are rarely found in reality. For this reason, perfect or pure competition is unreal. The markets of a few agricultural products (e.g., paddy, wheat, oilseeds, etc.) and of mining products (e.g., iron ore, coal, etc.) are to a large extent perfectly competitive. The other examples of such markets are the stock exchange and the Foreign exchange market.

⇒ 2. Discuss the short-run and long-run equilibrium of a firm in a perfectly competitive market. [Model Question]

Answer:

Short-run Equilibrium of the Firm:

Below graph shows the Short-run Equilibrium of the Firm.



In the short, the firm is in equilibrium at point e. At this point,
 $MR = MC$

$MR = MC$ as the first-order condition. At this point, the second-order condition is also satisfied. That is, at point e slope of the MC curve is greater than the slope of the MR curve.

The slope of the $MC >$ Slope of the MR curve

Since MC is always positive, at equilibrium MR also positive. The equilibrium price is P_1 and the quantity is Q_1 .

3. What happens in the short-run perfect competition?

[Model Question]

Answer:

The total revenue of the firm is equal to the area of $0P_1eQ_1$ and the total cost is equal to the area of $0abQ_1$. The revenue of the firm is higher than the cost. Hence, the profit of the firm equal to the area of P_1eba . It is an excess profit or profit larger than normal profit.

The total revenue of the firm= $0P_1eQ_1$

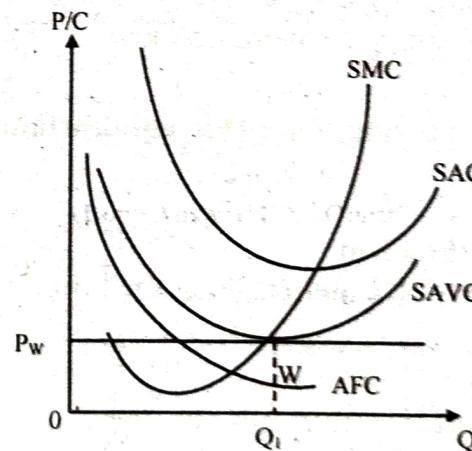
Total cost= $0abQ_1$

Profit of the firm= P_1eba

This implies that in the short-run, a perfectly competitive firm can make an excess profit. However, it does not mean that the firms necessarily earn excess profit in the short-run. It depends on the level of the SAC (short-run average cost) in the short-run equilibrium.

If the SAC is below the price at the equilibrium, the firm earns an excess profit. But, if the SAC is higher than the price at the equilibrium, the firm makes losses.

Producing with losses in the short-run perfect competition

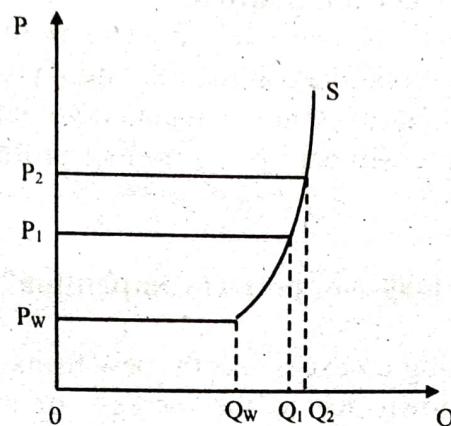


Although the firm makes a loss in the short-run it will continue to produce. However, if it cannot cover its variable cost the firm will close down since by closing down the firm is better off. The point at which the firm covers its variable cost is called 'the closing down point'. The closing down point is denoted by point w.

If the price falls below the P_w , (this price is equal to the minimum variable cost) the firm cannot cover all its variable cost, and hence, it will close down whereby minimizing the losses.

Supply Curve of the Firm and Industry

The supply curve of the firm can derive associate with the MC curve and demand curve of the firm. When the market price increases gradually it causes an upward shift in the demand curve of the firm. Since the firm's demand curve is the MR curve, the firm reaches the equilibrium at the points where the successive demand curve cuts the MC curve.

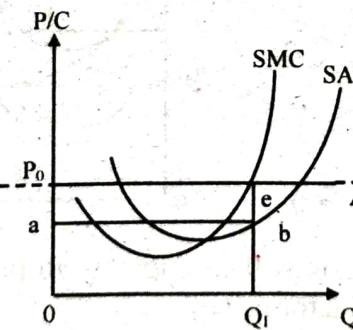
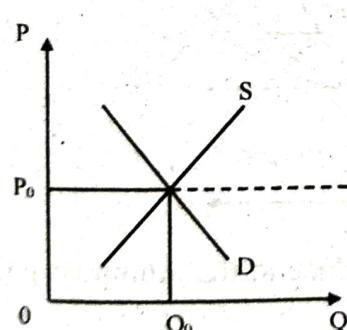


The quantity supplied by the firm increases as price rises. If the price falls below P_w , the firm will not supply any quantity. The firm will close down when the price falls P_w .

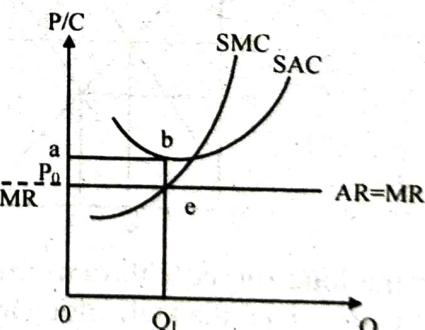
If we transfer the successive points of interaction of the MC curve and the demand curves to the separate graph, the supply curve of the firm can be formed which is identical to its MC curve to the right of the closing down point 'w'.

The supply curve of the industry is the horizontal sum of the supply curves of individual firms. The total market supply at each price is the sum of the quantities supplied by each firm at that price.

Short-run Equilibrium of the Industry



Excess profit in short-run



Losses in short-run

Given the market demand and supply, the industry is in equilibrium at the price that 'clears the market'. At that price, market demand is equal to the market supply. As shown in figure equilibrium price and quantity are P_0 and Q_0 , respectively. This will be a short-run equilibrium.

Under the prevailing market price, the firms can make excess profit or losses. So the firms that make losses in the short-run will make necessary adjustments. Otherwise, they will close down the firm in the long-run. The firms that earn excess profit will expand the size of the firms to maximize their profit.

Long-run equilibrium in perfect competition

In the long-run, firms can make the necessary adjustment to their capacity. Accordingly, they will adjust their capacity to produce at the minimum point of the Long-Run Average Cost (LAC) curve, which is tangent to the demand curve defined by the market price. In the long-run equilibrium, firms will earn just a normal profit which includes in the LAC (Long Average Cost).

4. What happens in the long-run perfect competition?

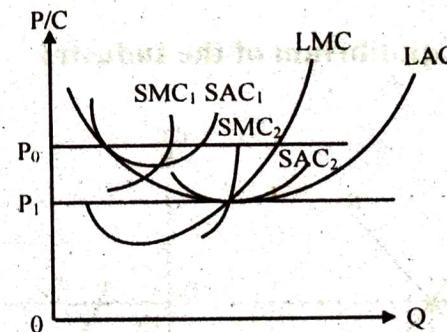
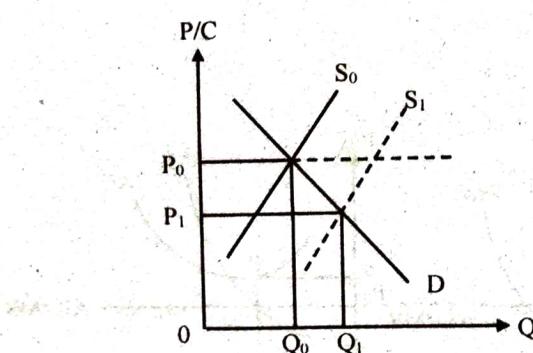
[Model Question]

Answer:

If the existing firms are making an excess profit, new firms will enter the industry. Then the market price will fall down due to the increase of market supply with the new entrants' supply. This will lead to shifting the demand curve down. Simultaneously, the cost curves will shift upward due to an increase in factor prices. These changes will continue until the LAC is tangent to the demand curve.

If the firms make losses inside the long-run they may go away the industry. As a result, the price will rise and the demand curve will shift upward. The cost will go down and price curves shift downward. These changes will continue until the remaining corporations attain the minimum factor of the LAC curve.

The below graph shows the firm which earns excess profits.



In the long-run equilibrium, firms adjust their capacity to produce at the minimum point of LAC, given the technology and factor prices.

At the equilibrium, $SMC = LMC = LAC = P = MR$

In the long-run equilibrium, both short-run and long-run equilibrium conditions coincide. When satisfying this condition the firm is working its optimal and no excess capacity and the resources are fully utilizing.

Long-run Equilibrium of the Industry

In the long-run, industry is in equilibrium when there is no tendency to expansion or contraction. So all the firms should be earned just a normal profit. In this situation, all firms will be operating at the minimum point of the LAC curve.

5. Discuss the functions of Government in a Modern Mixed Economy?

[Model Question]

Answer:

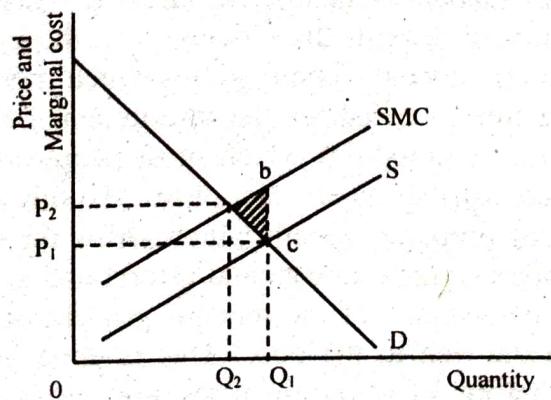
The following points highlight the seven major functions of government in a modern mixed economy. The Functions are:

- Improving Efficiency of the Economic System:** An important function of the government is to assist in the socially desirable allocation of scarce resources. This, in its turn, would require the government to perform certain subsidiary functions.
- Controlling Externalities and Public Goods:** The unregulated market may and often do produce too much air, water and land pollution as also greenhouse-gas emission, leaving too little resources for investment in public health or knowledge. An externality is a cost or a benefit imposed by a transaction on someone who was not a party to the transaction. Control of externalities is one of the important functions of the government.

In Fig. below, S represents the private cost of the firms. SMC includes the cost of the externality. If the firms do not internalize the externality, market output is Q_1 and price is P_1 . If the firms must account for the SMC, they produce only Q_2 . The shaded area, abc, shows the additional cost to society of producing Q_1 : the difference between the area under the SMC curve and the market demand curve.

This is why in industrially advanced countries governments seek to control harmful externalities or spend money on science and public health which are not adequately taken care of (and supported by) private industry.

The government alone can tax such activities as cigarette smoking which are harmful to society and which impose external public costs. It can also subsidies other activities such as scientific and industrial research and development which are socially beneficial.



A solution to the externality problem lies in enforcing property rights. A property right is the exclusive ownership of specific goods or the exclusive privilege to behave in a certain manner. When individual property rights are not clearly established, governments have to intervene.

- Supplying Correct Information:** This is an age of information and knowledge and information is now treated as a separate factor of production, a new form of capital particularly after the recent information revolution all over the world.

And in a world of uncertainty it is necessary for consumers to collect adequate information to be able to take the correct decision. However, unregulated markets provide very little, if any, information for consumers to make rational decisions.

That is why food-processing firms are required, by law, to provide information on the nutrition of food products and on the energy efficiency of household appliances like water coolers and washing machines.

Similarly, firms manufacturing life-saving drugs and pharmaceuticals are required to provide sufficient information to the government on the safety and usefulness of new drugs before they can be commercially introduced.

Moreover, the government can spend money to collect additional information itself, which, it thinks, is essential not only for the smooth functioning of the economy but also for controlling and managing the economy through the planning system.

This is why the Government of India has set up the Central Statistical Organization (C.S.O.) of the Planning Commission which collects and supplies information on certain key macro-variables such as national income, national product, the contribution of different industries to social product and so on.

In short, since markets do not always provide a socially optimal level of information, the government may have a role in providing this information. Information is an important issue.

Some observers claim that providing information is the only function that government should perform in offsetting externalities and other socio-economic problems. However, the truth is that there are several possible allocational problems for government to handle.

- d) **Improving the Distribution of Income:** Even when the invisible hand works smoothly and efficiently, the free play of market forces creates another problem, viz., the problem of income inequality. In fact, the market system is a system of rewards and penalties. It rewards the efficient, i.e., those who can read the market signals properly and produce the commodities which most people want to buy at a price. At the same time it penalizes the inefficient, i.e., those who read wrong signals and produce commodities which most people do not want to buy. This inequality in income distribution is a fact of life. To this we have to add inequality in the distribution of property, wealth which arises for various reasons: laws of inheritance (of property), luck, talents and efforts and so on. And it is one of the important economic functions of the modern government to redistribute income (and wealth) from the rich to the poor. This is done in advanced countries by spending a major portion of government revenues to maintain minimum standard of health, nutrition and income through such schemes as transfer programmes, medical care and social security. In India and other developing countries where there is no safety net for the poor in the form of a comprehensive social security system, this goal—income redistribution—is sought to be achieved through other measures such as public distribution system of food grains, land reform, progressive income taxes on the rich and subsidy for the poor, and above all, the control of big business and multinationals.

- e) **Grants and Subsidies:** Governments also award grants that give firms exclusive rights to a national resource or to the production of a good or service. Governments award cable television and radio rights as well as landing rights at airports to firms for no more than the application cost. By doing so the government is releasing control over scarce resources technically owned by the whole community. Governments also often decide to favour some firms and entire industries relative to others. This support is often provided in the form of a subsidy. A subsidy is a payment to a firm in the form of tax reduction or a fixed amount of money, or a payment based on the output of the firm. The subsidy lowers the firm's production costs. A government subsidizes a firm when the firm would not otherwise produce output at the level the government desires. A government can use subsidies to encourage production by firms that create positive externalities. Government's subsidies cover a wide array of firms and industries: museums, public television and radio stations, bus and passenger train services, public parks, highways and bridges, and universities. In offering subsidies, governments lower the direct costs to those consuming the goods and services and increase the quantity consumed. In recent years most modern governments have passed laws and imposed regulations designed to ensure equal employment, housing and educational opportunities for the weaker sections of society.
- f) **Macroeconomic Stabilization:** The capitalist economies prior to the Great Depression of 1929 were prone to business cycles—periodic bouts of inflation and unemployment. However, today, government has the responsibility of avoiding such economic fluctuations by judicious and appropriate use of monetary and fiscal measures, as well as close regulation of the financial system. Furthermore, government attempts to stabilize the economy, i.e., it tries to smooth out the ups and downs of the business cycle, in order to avoid either large-scale unemployment at the bottom of the cycle or accelerating price inflation at the top of the cycle. More recently, government has become more concerned about promoting long-term growth of the economy by expanding production capacity.
- g) **Representing the Country at the International Level:** In recent years, international trade and investment have become much more important to a modern mixed economy than they were in the past. This very fact implies that government now plays a critical role representing the interests of the nation at the international level and negotiating beneficial agreements with other countries on a wide range of issues.

Unit 4: Concept of Project

Unit at a glance:

The basic definition of a project is: "an organizational initiative to achieve certain outcomes within a timeframe and a budget." Moreover, a project is conceived when business needs are recognized in the processes being used within an organization. These needs are the "gaps" that require to be filled in an effort to set the organization on a growth path. These gaps are of strategic importance and could range from customer complaints, declining revenues, or new, upcoming business opportunities. They are treated as goals and targets to be achieved within a fixed period of time. It is expected that the defined goals would work as a catalyst to bring about changes to fine-tune and sharpen the working of a business set-up.

A project can only be managed well if the nature of the project is clearly understood by the project manager. A project has commonly been defined as a unique, temporary, multidisciplinary effort by an organization toward creating an output within a framework of checks and balances. When talking about the nature of a project, the three qualities that stand out are uniqueness, temporary nature, and its aim to create output/deliverables.

Short Answer Type Questions

A. Choose the correct answer from the given alternatives in each of the following:

1. Which from the following represents the correct project cycle? [Model Question]
(a) Planning → Initiating → Executing → Closing
(b) Planning → Executing → Initiating → Closing
(c) Initiating → Planning → Executing → Closing
(d) Initiating → Executing → Planning → Closing

Answer: (c)

2. While assessing your project processes, you have identified some uncontrolled process variations. Which of the following would be the appropriate chart you may use for this purpose? Select one:
(a) Pareto diagram
(b) PERT chart
(c) Control chart
(d) HR personnel chart [Model Question]

Answer: (c)

Concept of Project

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3. Once the project is approved and moves into the planning stage, what happens in the next phase of the project life cycle? Select one: [Model Question]
- (a) Agreements for risk sharing need to be concluded.
 - (b) The total risk on the project typically reduces as activities are performed without loss.
 - (c) Risks must be weighed against the potential benefit of the project's success in order to decide if the project should be chosen.
 - (d) Risks are identified with each major group of activities.

Answer: (d)

4. Risk must be considered in the _____ phase and weighed against the potential benefit of the project's success in order to decide if the project should be chosen. Select one: [Model Question]
- (a) completion
 - (b) execution
 - (c) planning
 - (d) initiation

Answer: (d)

B. Fill in the blanks in the following statements:

5. A process refers to ongoing, day-to-day activities in which an organization engages while producing goods and services. [Model Question]
6. The goals of a project are sometimes called deliverables. [Model Question]
7. Projects are customer focused. [Model Question]
8. Project management entails crossing functional and organizational boundaries. [Model Question]
9. In general, product life cycles are becoming shorter and product launch windows are becoming narrower. [Model Question]
10. Project management serves as an excellent training ground for future senior executives in most organizations. [Model Question]
11. The stages in a project's development are known as the project life cycle. [Model Question]
12. Detailed specifications, schematics, and schedules are all developed during the planning stage. [Model Question]
13. Creativity is at its zenith during the execution stage of the project life cycle. [Model Question]
14. The degree of risk associated with the project is at its highest during the conceptualization stage. [Model Question]
15. The triple constraint of project success is time, cost, performance. [Model Question]

16. Atkinson suggests that all groups that are affected by a project, otherwise known as stakeholders, should have a hand in assessing project success. **[Model Question]**
17. Project management maturity model are used to allow organizations to benchmark the best practices of successful project management firms. **[Model Question]**

C. State whether the following statements are True or False:

18. A difference between operations and projects is that operations end when their objectives have been reached, whereas projects do not. **[Model Question]**

Answer: False

19. Resources in a project should be used effectively because they are limited. **[Model Question]**

Answer: True

20. Every project should have a well-defined objective. **[Model Question]**

Answer: True

21. One of the main reasons why project management is challenging is because of the factor of uncertainty. **[Model Question]**

Answer: True

22. In order to be realistic, a project manager should always set discrete goals instead of a range of objectives. **[Model Question]**

Answer: False

D. Answer the following questions:

23. How Do You Plan a Project?

Answer:

A project will be a non-starter if it is not planned well. There are parameters and guidelines that should be followed when planning a project. These would be:

1. Create and analyze a business case thoroughly
2. Meet stakeholders for approval of the created business case
3. Define the scope of the project
4. Set up project goals and objectives
5. Determine project deliverables
6. Project schedules and milestones should be created
7. Tasks should be assigned, or resources planned according to members' strengths
8. Risk assessment

24. When is a Project Considered a Success?

[Model Question]

Answer:

A project is successful if it fulfills the following criteria of meeting business requirements, is delivered according to the schedule, does not go beyond the budget, and finally, is able to fulfill the goals and objectives of the project as deliverables. This shows that the project management team has done a good job of delivering the desired outcomes making the client a happy, satisfied customer. A successful project would be able to translate into profits what had earlier been unfilled gaps in the organizational processes and operations.

25. Define a Project.**[Model Question]****Answer:**

A project is a combination of set objectives to be accomplished within a fixed period. They are an excellent opportunity to organize your business and non-business goals efficiently. The changes made in the project completion process are expected to perform better. When you work on an office project, it requires experts from different departments to come together. When you are working on a school / college project, you collaborate with fellow students to meet the objective. While working on a personal project, you will be coordinating with your family or friends to accomplish the set objectives. Therefore, we can say one individual can own that project, but it is a group activity. These people are known as project managers.

E. Pick up the correct answer:

26. Projects require a team of people to come together temporarily to focus on specific (personal objectives/project objectives) **[Model Question]**

Answer: Project objectives.

27. (Project management/operations management) is aimed at producing an end product that will effect some change for the benefit of the organization that instigated the project. It is the initiation, planning and control of a range of tasks required to deliver this end product. **[Model Question]**

Answer: Project Management

Long Answer Type Questions

- Q 1. Describe the Types of projects. What are the general characteristics of a project? **[Model Question]**

Answer:

The nature of a project, its features, characteristics, and size decide the course of action for its fulfillment. It is the customer, contractor, and project management team that has to work in tandem with each other to see the project to its desired conclusion. The customer specifications and the consequent management strategy differ for every project and its type. There are four types of projects demanding different approaches. These are:

1. **Traditional Projects:** These are projects that follow a templated lifecycle. The course of the project is predicted, and so is its outcome. It is about creating products/goods, and services. With multiple and dynamic manufacturing practices available, competition is stiff and stringent planning for production is required. Some things have to be taken into account before chalking a production plan. These would be material requirements planning, supply chain management, production scheduling, Production lead time, capacity planning, and inventory control. Keeping a finger on all the segments of manufacturing means increased complexity in Operations. So manufacturing projects would have to be more precisely planned to the last detail, ensuring that all the tiniest details have been addressed and accounted for.
2. **Agile Projects:** Knowledge of general management and specialization in domain management is especially needed when we need to plan an iterative project. Here objectives can only be accomplished dependent on a series of operations that are themselves affected by resource constraints. There are glaring conflicts between stated objectives about scope, costs, timelines, and quality and the limitations clamped on human, material, and financial resources. Therefore, dealing with an agile project, certain guidelines have to be strictly followed. The first would be absolute clarity in specifications about project objectives and plans that include delineation of scope, budgeting, scheduling, determining budget demands, and forming project teams. Maximum resource utilization has to be ensured by keeping the supply chains working smoothly without delays so that there is strict adherence to prescribed schedules and plans. An operations strategy should be in place to control and coordinate planning, design, estimating, contracting, and completing small iterations. Lastly, a very efficient communication channel is needed to resolve issues among the project participants.
3. **Agency Projects:** Managing a project is all about multitasking. Several elements have to be simultaneously handled, all the while anticipating different outcomes to be achieved within the pre-decided timeframe and budget restrictions. There are some very common issues that a manager is bound to encounter, namely of scope definition, budget, communication, and conflict within the team. A cloudy outline of objectives can give rise to a host of problems, including those related to resource and stakeholder management. Oftentimes, this is the major cause of project failure. Along with the clarity of goals comes the setting of milestones and the calibration of results. This can be done by SMART (specific, measurable, attainable, relevant, timebound) and CLEAR (collaborative, limited, emotional, appreciable, refinable) means. A project has to be parceled into small packets and assigned to the members of the project team with their own objectives and goals. Another issue that has to be addressed mid-way is Scope creep. A project begins with a particular vision but can change course and move in a direction not envisaged. This can only be managed by firm navigation, increase of budget, and duration.
4. **Remote Projects:** The management of these projects vastly differs from the other three types of projects in the way they are planned, performed, or managed. The

goals and objectives in remote projects are not the same as in the other developmental projects, which have customer requirements as outputs and outcomes. Here, it would be a team or group of professionals located in different places but working on one project. The time zones and cities might differ, and the responsibilities too would be different, but the outcome targeted would be unified. Oftentimes, a remote project might have positive deliverables, or it might not have anything to do with bottom lines, and yet that project would be commissioned. An important example of a project which is in remote mode is a research project.

There are criteria for a project to be effectively executed. These are specific, measurable, achievable, relevant, and time-bound:

1. **Specific:** A project has to be planned such that every detail is specific and goal-oriented. A project's structure, goals, objectives, milestones, and costs have to be laid out very clearly from the start. For this, the members of the project team, as well as external consultants, should give active input. There has to be detailed planning and reporting with a command structure, list of personnel, communication channels, and costing drawn out in detail. Project ownership, and the work assigned to various resources, too, have to be regularly reviewed. Regularly scheduled review meetings have to be called to measure milestones.
2. **Measurable:** The project's objectives and achievements have to be measurable in terms of benefits gained/ or to be gained by the sponsor organization. It is not necessary that it is limited to monetary terms alone. It could also mean an increase in the company's goodwill standing or promotion of its status in the business arena etc.,
3. **Achievable:** The goals and objectives of a project have to be plausible and achievable. If a project is ambitious but unachievable, then it will have negative ramifications - project team's morale hitting a low, budget overrun, extended timeframe, and elusive deliverables.
4. **Relevant:** The project should have an outline with all the relevant details on paper. This includes handling costs, increasing operational efficiency, or any other detail in planning a project that might ultimately affect its efficacy and purpose.
5. **Time bound:** A timeframe is what makes a project relevant to the objectives of the organization. This means that it should have a start date and a finishing line to reach within the span of time required by the client/sponsor. Therefore, its planning should be such so as to have no detours and changes. It will not be able to keep to its committed schedule if the project has to incorporate unforeseen changes.

2. What do you mean by Project management? Discuss the Phases in Project life cycle? [Model Question]

Answer:

Project management is defined as the process of steering a project from the start through its lifecycle. The main objective of project management is to complete a project within the established goals of time, budget, and quality. Projects have life cycles since they aren't intended to last forever. This project management system helps your engineering

team track every initiative. A single system can manage every aspect of every project your engineering team is executing. In Notion, all the project work lives side-by-side deadlines and updates — saving you time bouncing between tools.

The project life cycle includes the steps required for project managers to successfully manage a project from start to finish.

There are five phases to the project life cycle. Each of these project phases represents a group of interrelated processes that must take place for a successful project.

Project Management life cycle is a five-step framework planned to assist project managers in completing projects successfully.

The primary competency of a project manager is to gain a thorough understanding of project management stages. Knowledge and planning for the five Project Management steps will help you plan and organize your projects so that it goes off without any hitches. It is simpler for a project manager to handle all the current details of the project when the project is broken down into various phases. Each phase of the cycle is goal-oriented has its own set of characteristics and contains product deliverables, which are reviewed at the end of the Project Management steps.

According to the Project Management Book of Knowledge (PMBOK), the Project Management life cycle should define the following aspects:

- What work needs to be achieved?
- Who will be involved in the team?
- What are the project deliverables?
- How to monitor the performance of each phase?

Phase-to-Phase Relationships: In cases where projects have two or more phases, the phases are considered part of a sequential process. However, in some situations, the project might benefit from overlapping or concurrent phases. The phase-to-phase relationships can be of two types:

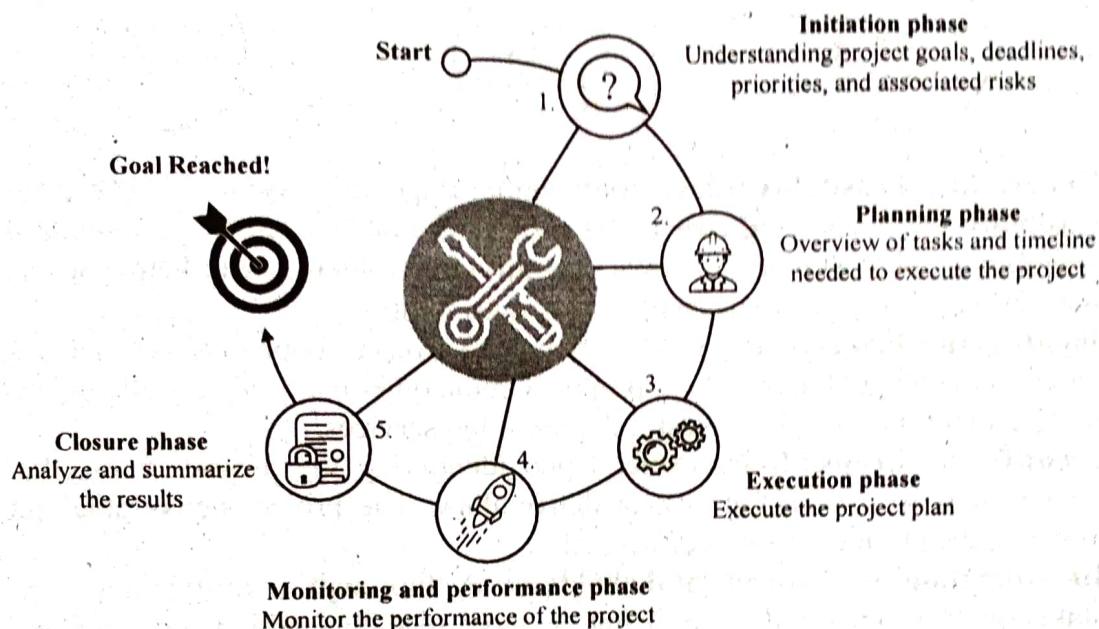
- **Sequential Relationship:** In a sequential relationship, a new phase starts only when the preceding phase is complete. In the figure given below, you can see an example of a project with three entirely sequential phases. The step-by-step nature of this approach decreases uncertainty, but may also remove options for reducing the overall schedule.
- **Overlapping Relationship:** In an overlapping relationship, as the name suggests, the next phase starts before the completion of the previous one. Overlapping phases sometimes need additional resources because work has to be done in parallel. It may increase risk or could lead to rework if a succeeding phase progresses before correct information is gathered from the previous phase.

Predictive Life Cycles: In predictive life cycles, also known as fully plan-driven the three major constraints of the project, the scope, time, and cost, are determined early in the project life cycle. These projects progress through a series of sequential or overlapping phases. Now the planning can be done for the entire project at a detailed level from the beginning of the project. Different work is usually performed in each

phase. Therefore, the composition and skills required of the project team may vary from phase to phase.

Adaptive Life Cycles: The adaptive life cycles, also known as change-driven or agile methods, are used in cases of high levels of change or application areas such as IT. Adaptive methods are also iterative and incremental, but the difference is that iterations are very rapid (typically with a duration of 2 to 4 weeks) and are fixed in time and cost. Sometimes the processes within the iterations can be going on in parallel.

5 Phases of Project Management Life Cycle:

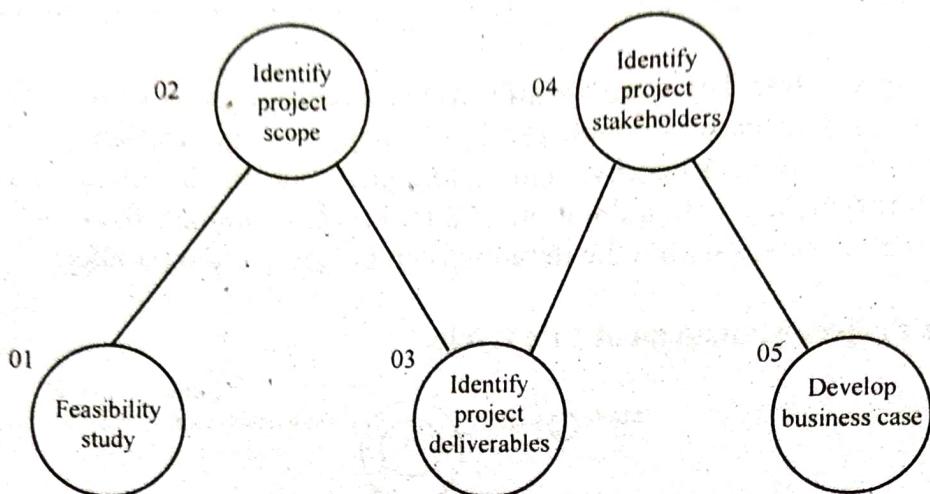


1. Project Initiation: Project initiation is the first Project Management life cycle phase, where the project starts. It provides an overview of the project, along with the strategies required to attain desired results. It is the phase where the feasibility and business value of the project are determined.

The project manager kicks off a meeting to understand the client and stakeholders' requirements, goals, and objectives. It is essential to go into minute details to have a better understanding of the project. Upon making a final decision to proceed, the project can move on to the next step: that is, assembling a project team.

The Project Charter is considered to be the most important document of any project as it comprises:

- Business vision and mission
- Project goals and benefits
- List of stakeholders
- Scope of the Project
- Project deliverables
- Risks associated with the project
- Project budget and resources



- 1. Undertake a Feasibility Study:** In the initial stage, it is essential to understand the feasibility of the project. See if the project is viable from the economic, legal, operational, and technical aspects. Identifying problems will help you analyze whether you can solve issues with appropriate solutions.
- 2. Identify the Project Scope:** Identifying the project scope involves defining the length, breadth, and depth of the project. On the other hand, it's equally essential to outline functions, deadlines, tasks, features, and services.
- 3. Identify the Project Deliverable:** Upon identifying the project scope, the very next step is to outline the project deliverables. The project deliverables include defining the product or services needed.
- 4. Identification of Project Stakeholders:** A thorough identification of project stakeholders is essential. It is better to have meetings with team members and experts to identify project stakeholders. Documentation of relevant information on stakeholders and their impact on the successful completion of the project is required.
- 5. Develop a Business Case:** Before developing a business case, check whether the essential pillars of the project such as feasibility, scope, and identification of stakeholders are in place. The very next step is to come up with a full-fledged business case.
The creation of a Statement of Work (SoW) and the formation of a team wrap up the project initiation phase.

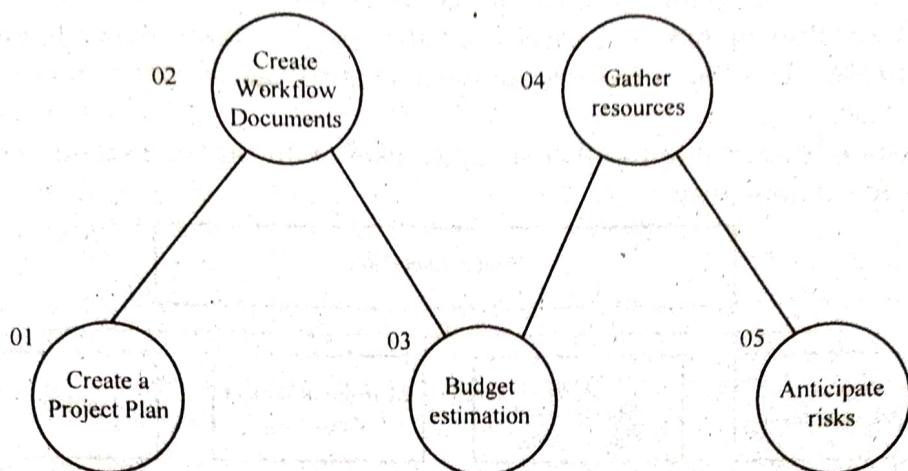
2. Project Planning: A lot of planning related to the project takes place during this phase. On defining project objectives, it is time to develop a project plan for everyone to follow.

The planning phase frames a set of plans which help to guide your team through the implementation phase and closing phase. The program created at this point will surely help you to manage cost, quality, risk, changes, and time.

The project plan developed should include all the essential details related to the project goals and objectives and should also detail how to achieve them. It is the most complex

phase in which project managers take care of operational requirements, design limitations, and functional requirements.

The project planning phase includes the following components:

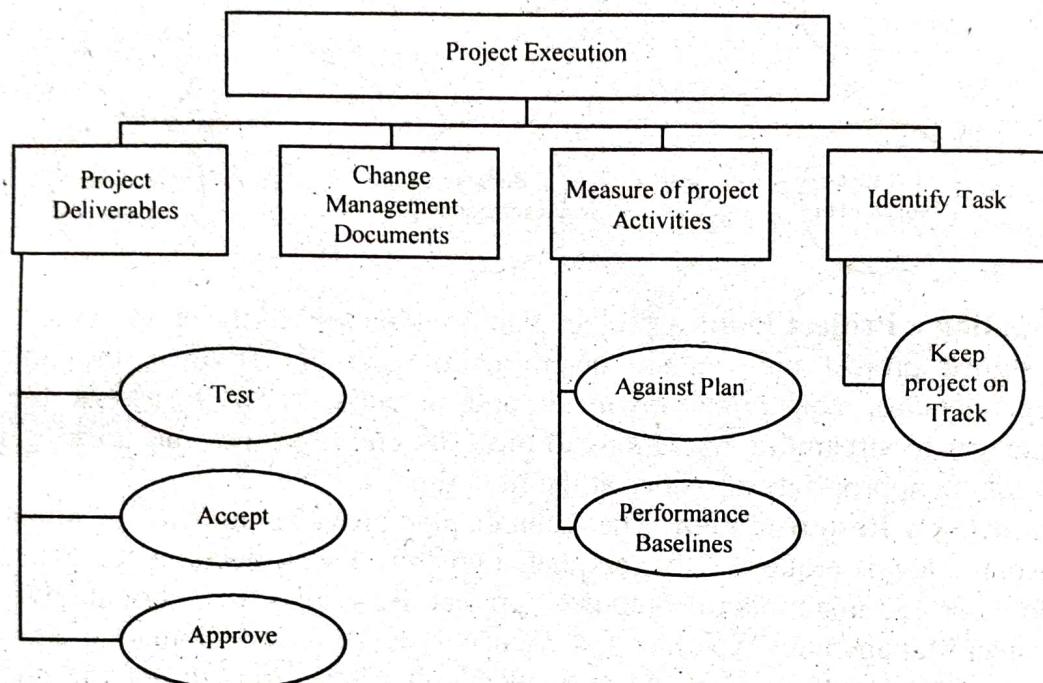


1. **Creating a Project Plan:** A project plan is a blueprint of the entire project. A well-designed project plan should determine the list of activities, the time frame, dependencies, constraints involved, and potential risks. It assists the project manager to streamline operations to meet the end objective and tracking progress by taking appropriate decisions at the right time.
 2. **Creating a Resource Plan:** The resource plan provides information about various resource levels required to accomplish a project. A well-documented plan specifies the labor and materials to complete a project. Resources used should have relevant Project Management expertise. Experience in the concerned domain is a priority.
 3. **Budget Estimation:** Framing a financial plan helps you to set the budget and deliver project deliverables without exceeding it. The final budget plan lists expenses on material, labor, and equipment. Creating a budget plan will help the team and the project managers to monitor and control the costs throughout the Project Management life cycle.
 4. **Gathering Resources:** Gathering resources is an essential part of project planning as it helps to monitor the quality level of the project. It is not enough to assemble a well-balanced team from internal and external resources. Resources like equipment, money, software solutions, and the workplace should be given to complete the assigned tasks.
 5. **Anticipating Risks and Potential Quality Roadblocks:** The risk plan will help you identify risks and mitigate them. It will comprise all the potential risks, the order of severity, and preventive actions to track it. Once threats are under control, it is possible to deliver the project on time adhering to quality.
- 3. Project Execution:** Project execution is the phase where project-related processes are implemented, tasks are assigned, and resources are allocated. The method also involves building deliverables and satisfying customer requirements. Project managers or team

leaders accomplish the task through resource allocation and by keeping the team members focused.

The team involved will start creating project deliverables and seek to achieve project goals and objectives as outlined in the project plan. This phase determines whether your project will succeed or not. The success of the project mainly depends on the project execution phase. The final project deliverable also takes shape during the project execution phase.

There are a lot of essential things that are taken care of during the execution phase. Listed below are a few among them:



- 1. Reporting Progress of a Project:** During the project execution phase, it is essential to get regular project updates as it provides the required information and even identifies the issues.
- 2. Hold Regular Meetings:** Before you kick off a project meeting, be clear about the agenda and make team members aware of what the meeting is all about well in advance. If communication is timely and straightforward, the productivity of ongoing projects and those that are in the pipeline will not get affected.
- 3. Manage Problems:** Problems within the project are bound to occur. Issues such as time management, quality management, and a weakening in the team's morale can hinder the success of a project. So make sure all problems are solved in the beginning.
- 4. Project Monitoring and Control:** The project monitoring and control phase is all about measuring the performance of the project and tracking progress. It is implemented during the execution phase. The main goal of this phase is to check whether everything aligns with the Project Management Plan, especially concerning financial parameters and timelines.

It is the responsibility of the project manager to make necessary adjustments related to resource allocation and ensure that everything is on track. To aid this, a project manager may conduct review meetings and get regular performance reports. Monitoring project activity after the project execution phase will allow the project manager to take corrective actions. Meanwhile, considering the quality of work will also help to make the necessary improvements. Keeping an eye on the budget will help to avoid unnecessary expenses and resources.

5. **Project Closure:** With much time and effort invested in project planning, it is often forgotten that the final phase of the Project Management life cycle phases is equally important.

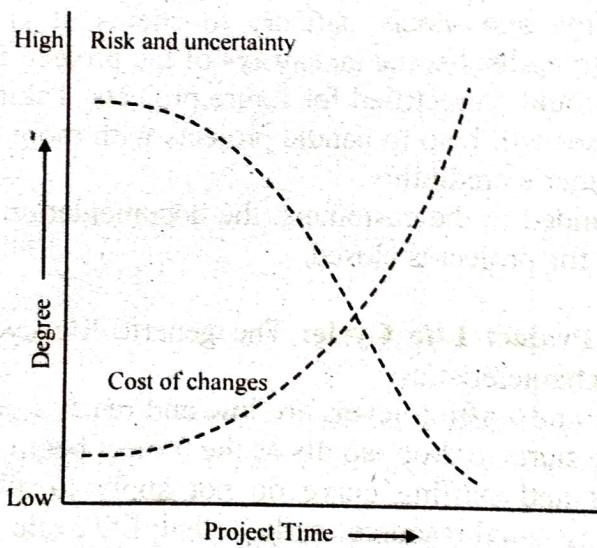
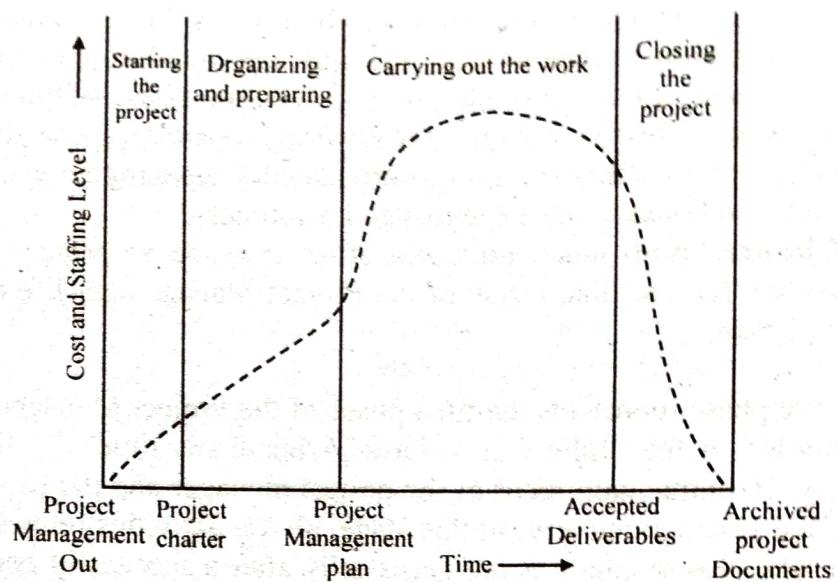
The project closure phase represents the final phase of the Project Management life cycle, which is also known as the “follow-up” phase. Around this time, the final product is ready for delivery. Here the main focus of the project manager and the team should be on product release and product delivery. In this stage, all the activities related to the project are wrapped up. The closure phase is not necessarily after a successful completion phase alone. Sometimes a project may have to be closed due to project failure.

Upon project completion and timely delivery to clients, it is the role of the project manager to highlight strengths, list the takeaways of the project, identify the ambiguities, and suggest how they could be rectified for future projects. Taking time to recognize the strengths and weaknesses will help to handle projects with more dedication; this, in turn, builds the project manager’s credibility.

Once the product is handed to the customers, the documentation is finalized, the project team is disbanded, and the project is closed.

Characteristics of a Project Life Cycle: The generic life cycle structure commonly exhibits the following characteristics:

- At the start, cost and staffing levels are low and reach a peak when the work is in progress. It again starts to drop rapidly as the project begins to halt.
- The typical cost and staffing curve do not apply to all projects. Considerable expenses secure essential resources early in their life cycle.
- Risk and uncertainty are at their peak at the beginning of the project. These factors drop over the life cycle of the project as decisions are reached, and deliverables are accepted.
- The ability to affect the final product of the project without impacting the cost drastically is highest at the start of the project and decreases as the project advances towards completion. It is clear from figure 2 that the cost of making new changes and rectifying errors increases as the project approaches completion.



These features are present almost in all kinds of project life cycles but in different ways or to different degrees. The intent of the adaptive life cycles lies particularly with keeping stakeholder influences higher and the costs of changes lower all through the life cycle than in predictive life cycles.

Let's take a look at how knowledge of the project life cycle benefits an organization:

- It helps professional services teams to be more proficient and profitable.
- The project life cycle helps the organization.
- It makes the flow of communication easier.
- The knowledge emphasizes reporting and examining previous projects.

Conclusion: After the successful accomplishment of the project, there may be a few unexploited project resources, including the remnant budget, which can be used by the project later. These are recorded as surplus resources and budget to prevent wastage; this is the last of the Project Management steps before the conclusion of the phases of the Project Management life cycle. Give yourself the chance to gain the best skills and practices in Project Management with the PMP certification training for enhanced efficiency and productivity while managing projects.

Unit 5: Feasibility Analysis of a Project

Unit at a glance:

A feasibility study evaluates a project's or system's practicality. As part of a feasibility study, the objective and rational analysis of a potential business or venture is conducted to determine its strengths and weaknesses, potential opportunities and threats, resources required to carry out, and ultimate success prospects. Two criteria should be considered when judging feasibility: the required cost and expected value.

A feasibility study is a comprehensive evaluation of a proposed project that evaluates all factors critical to its success in order to assess its likelihood of success. Business success can be defined primarily in terms of ROI, which is the amount of profits that will be generated by the project. In a feasibility study, a proposed plan or project is evaluated for its practicality. As part of a feasibility study, a project or venture is evaluated for its viability in order to determine whether it will be successful.

As the name implies, a feasibility analysis is used to determine the viability of an idea, such as ensuring a project is legally and technically feasible as well as economically justifiable. It tells us whether a project is worth the investment—in some cases, a project may not be doable. There can be many reasons for this, including requiring too many resources, which not only prevents those resources from performing other tasks but also may cost more than an organization would earn back by taking on a project that isn't profitable.

A well-designed study should offer a historical background of the business or project, such as a description of the product or service, accounting statements, details of operations and management, marketing research and policies, financial data, legal requirements, and tax obligations. Generally, such studies precede technical development and project implementation.

Short Answer Type Questions

A. Choose the correct answer from the given alternatives in each of the following:

1. The process of forecasting or approximating the time and cost of completing project deliverables is called [Model Question]

 - (a) Budgeting
 - (b) Predicting
 - (c) Estimating
 - (d) Planning

Answer: (c)

C. State whether the following statements are True or False:

10. The project feasibility study is a mixture of separate studies in marketing, technical, financial, socio-economic and management aspects of a project. [Model Question]

Answer: True

11. A project feasibility study helps to create a profitable project. [Model Question]

Answer: True

12. A project feasibility study will be used in evaluating the actual versus the expected outcome. [Model Question]

Answer: False

13. A project feasibility study guarantees success. [Model Question]

Answer: False

14. The project feasibility study has lost its usefulness in these times of great uncertainty. [Model Question]

Answer: False

15. In the assessment, a project may not push through. [Model Question]

Answer: False

16. The major concerns of a project feasibility study includes marketing, production, finance, organization, and socio-economic viable to any business project. [Model Question]

Answer: True

17. A project feasibility study increases the chances of success. [Model Question]

Answer: True

18. The data gathered for the feasibility study will be used to assess the project. [Model Question]

Answer: True

19. The feasibility study is a solution for failure. [Model Question]

Answer: False

D. Answer the following questions:

20. Differentiate between IRR and NPV. [Model Question]

Answer:

Basis for Comparison	NPV	IRR
Meaning	The total of all the present values of cash flows (both positive and negative) of a project is known as Net Present Value or NPV.	IRR is described as a rate at which the sum of discounted cash inflows equates discounted cash outflows.
Expressed in	Absolute terms	Percentage terms
What it represents?	Surplus from the project	Point of no profit no loss (Break even point)
Decision Making	It makes decision making easy.	It does not help in decision making
Rate for reinvestment of intermediate cash flows	Cost of capital rate	Internal rate of return
Variation in the cash outflow timing	Will not affect NPV	Will show negative or multiple IRR

21. What are the different types of feasibility study that entrepreneurs should undertake? [Model Question]

Answer:

A feasibility analysis evaluates the project's potential for success; therefore, perceived objectivity is an essential factor in the credibility of the study for potential investors and lending institutions. There are five types of feasibility study—separate areas that a feasibility study examines, described below.

- 1. Technical Feasibility:** This assessment focuses on the technical resources available to the organization. It helps organizations determine whether the technical resources meet capacity and whether the technical team is capable of converting the ideas into working systems. Technical feasibility also involves the evaluation of the hardware, software, and other technical requirements of the proposed system. As an exaggerated example, an organization wouldn't want to try to put Star Trek's transporters in their building—currently, this project is not technically feasible.
- 2. Economic Feasibility:** This assessment typically involves a cost/ benefits analysis of the project, helping organizations determine the viability, cost, and benefits associated with a project before financial resources are allocated. It also serves as an independent project assessment and enhances project credibility—helping decision-makers determine the positive economic benefits to the organization that the proposed project will provide.
- 3. Legal Feasibility:** This assessment investigates whether any aspect of the proposed project conflicts with legal requirements like zoning laws, data protection acts or social media laws. Let's say an organization wants to construct a new office

building in a specific location. A feasibility study might reveal the organization's ideal location isn't zoned for that type of business. That organization has just saved considerable time and effort by learning that their project was not feasible right from the beginning.

4. **Operational Feasibility:** This assessment involves undertaking a study to analyze and determine whether—and how well—the organization's needs can be met by completing the project. Operational feasibility studies also examine how a project plan satisfies the requirements identified in the requirements analysis phase of system development.
5. **Scheduling Feasibility:** This assessment is the most important for project success; after all, a project will fail if not completed on time. In scheduling feasibility, an organization estimates how much time the project will take to complete.

When these areas have all been examined, the feasibility analysis helps identify any constraints the proposed project may face, including:

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

22. State the importance of feasibility study.

[Model Question]

Answer:

The importance of a feasibility study is based on organizational desire to "get it right" before committing resources, time, or budget. A feasibility study might uncover new ideas that could completely change a project's scope. It's best to make these determinations in advance, rather than to jump in and to learn that the project won't work. Conducting a feasibility study is always beneficial to the project as it gives you and other stakeholders a clear picture of the proposed project.

Below are some key benefits of conducting a feasibility study:

- Improves project teams' focus
- Identifies new opportunities
- Provides valuable information for a "go/no-go" decision
- Narrows the business alternatives
- Identifies a valid reason to undertake the project
- Enhances the success rate by evaluating multiple parameters
- Aids decision-making on the project
- Identifies reasons not to proceed

Apart from the approaches to feasibility study listed above, some projects also require other constraints to be analyzed -

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

E. Pick up the correct answer:

23. The (Organization Objectives/General Objectives) in the Statement of goals is a summary statement of what the business aims to do including general time frame, dates, numbers and percentage. [Model Question]

Answer: General Objectives

24. The (Market Study/Feasibility Study), cover only the marketing, production, and organizational plans which can tell whether it is possible to launch the business idea. [Model Question]

Answer: Feasibility Study

25. The Feasibility Study for (declining businesses/on-going businesses), will be a description of the current state of the business as well as that of the expansion or the innovations being planned for. [Model Question]

Answer: On-going business

Long Answer Type Questions**Q 1. Distinguish between ROI and ROCE.**

[Model Question]

Answer:

ROCE examines how efficiently any company can use the available capital with the help of this equation:

ROCE	ROI
Definition	
Return on Capital Employed (ROCE) is a financial metric that helps to determine how efficient a company is in terms of generating revenue with the capital in hand.	Return on Investment (ROI) is a financial metric that helps to measure how well a company can generate revenue using the invested capital.
Formula	Metrics
The formula for Return on capital employed is as follows: $\text{ROCE} = \text{EBIT} / \text{Capital Employed}$ where: EBIT = Earnings before interest and taxes and Capital Employed = Total assets minus current liabilities	The formula of Return on investment is as follows: $\text{ROI} = \text{Profit from Investment} / \text{Cost of Investment} \times 100$
Metrics	
ROCE considered the operating income of a company, i.e. earnings before interest and tax (EBIT).	Return on investment considers the overall net profit, which remains after the payment of taxes and dividends.

ROCE	ROI
Scope	
Return on capital employed has a much broader scope than ROI, as it considers all the capital employed in a company.	Return on investment has a much narrower and refined scope than Return on capital employed, as it only considers the invested capital of a company.
Perspective	
Return on capital employed helps to take a look at the financial situation of the organization and is useful for further analysis from the company's perspective.	Return on investment helps to take a look at an organization's financial situation from the perspective of an investor. It also helps investors to get a better idea of the prospective returns, which they can get on the invested capital.
Indicator	
Return on capital employed is a good indicator of a company's ability to generate revenue.	Return on investment is a good indicator of a company's productivity in terms of its operating assets.

$\text{ROCE} = \text{EBIT}/\text{Capital Employed}$

where: EBIT = Earnings Before Interest and Taxes and Capital Employed = Total assets minus current liabilities

Capital employed is defined as the total amount of a firm's assets minus its current liabilities. It is synonymous with the available capital from the net profits. The higher the value that is derived using the ROCE formula, the more efficiently a company is utilizing their capital. It is important to understand that the ROCE is exceeding the cost of capital, or the company may end up facing financial issues. It can be very useful to compare the use of capital by different companies that are engaged in the same business with regard to capital intensive industries like auto companies, energy companies and telecommunications firms.

Return on Investment (ROI): ROI is defined as a popular profit metric that is used to evaluate the company's investments and its financial consequences with respect to the overall cash flow. The formula for ROI is as follows:

$\text{ROI} = \text{Profit from Investment}/\text{Cost of Investment} \times 100$

Any value of ROI that is greater than zero is a reflection of the net profitability. The higher values are an indication of the effective use of capital investment. A negative value is considered as a major warning signal of extremely poor capital management.

ROI can be utilized by the companies internally for the purpose of evaluating the profitability of production of a product versus another to determine which product's distribution and manufacturing represent an efficient use of the company's capital.

Difference between ROCE and ROI: Return on Capital Employed (ROCE) and Return on Invested Capital (ROI) are both profitability ratios that can help to give you a better idea of the financial soundness of a company. However, there are many areas of

difference between ROCE and ROI, which we should discuss below to get a better insight into this topic:

Conclusion: Given all this, both ROCE and ROI are two important profitability ratios that are similar to each other in spite of minor differences. It is also important to note these ratios hold good for companies with capital intensive business operations like manufacturing entities. The scope of ROCE and ROI is quite limited with respect to service-based companies.

Q 2. What do you mean by techno-economic project appraisal? [Model Question]

Answer:

Techno-economic assessment or techno-economic analysis (abbreviated TEA) is a method of analyzing the economic performance of an industrial process, product, or service. It typically uses software modeling to estimate capital cost, operating cost, and revenue based on technical and financial input parameters. One desired outcome is to summarize results in a concise and visually coherent form, using visualization tools such as tornado diagrams and sensitivity analysis graphs.

At present, TEA is most commonly used to analyze technologies in the chemical, bioprocess, petroleum, energy, and similar industries.

TEA can be used for studying new technologies or optimizing existing ones. Ideally, a techno-economic model represents the best current understanding of the system being modeled. The following are examples of typical uses.

- **Evaluating economic feasibility:** TEA can be used to anticipate whether a process will be sufficiently profitable under a certain set of assumptions. It can thereby help companies to avoid pursuing dead-ends.
- **Guiding research and development:** When combined with sensitivity analyses like Tornado Diagrams, TEA can be used to identify research and development (R&D) targets with the greatest potential to improve profitability. In this way, it can help companies bring their technologies to market more efficiently.
- **Quantifying uncertainty and risk:** Sensitivity analyses like Tornado Diagrams and Monte Carlo analysis can be used to quantify economic uncertainty in the model results. They can also be used to identify which variables are the source of the most uncertainty.

Q 3. What is Social Cost- Benefit analysis? [Model Question]

Answer:

SCBA, often known as Social Cost-Benefit Analysis in project management, has become a tool for effective financial evaluation. It is an approach to assessing infrastructure investments from a social (or economic) perspective. Get to know more from PMP training, which is the most prominent credential in project planning worldwide. It is a technique used for determining the value of money, specifically public investments, and it is becoming extremely popular. In addition, it helps in decision-making regarding the numerous parts of the organization and closely related project design programs. Social cost-benefit analysis in project management enables a complete comparison of several project options. This is not merely a financial concern. Even so, an SCBA recognizes

non-financial consequences as well. For instance, consider the effects of increased accessibility on the environment, the economy, and other factors.

Social cost-benefit analysis helps governments to pursue innovative initiatives that benefit all, not just a selected few. Additionally, it aids in the entire development of an economy by assisting in decision-making that increases job, investment, savings, and consumption, increasing a country's economic activity.

Social cost advantages can be used for both investments. Thus, public investment is vital for a developing nation's economic progress.

1. **Market Instability:** A private corporation would evaluate a deal based on productivity and relevant market prices. However, the government must consider additional variables. Determining social costs in the event of market inefficiency and when market pricing cannot specify them. These hidden social costs are referred to as shadow prices.
2. **Investments & Savings:** A venture that results in increased savings is considered an investment in a market.
3. **Income is distributed and redistributed:** The initiative should not lead to revenue accumulation in the control of a few and the distribution of income.
4. **Career and Living Standards:** The impact of a program on employment and level of livelihood will also be considered. Therefore, the contract should result in a rise in employment and living standards.
5. **Externalities:** Externalities can be detrimental and advantageous to an enterprise. As a result, both impacts must be considered before approving a deal. For example, positive externalities can take the shape of technological advances, while negative externalities might take the form of rapid urbanization and ecological degradation.
6. **Subsidy and Taxation:** Taxation and subsidies are treated as expenses and revenue, respectively. However, taxation and subsidy are regarded as transfer payments for social cost-benefit analysis.

SCBA's purpose is to establish the financial benefits of each venture in perspective of shadow prices because initiatives impact people's savings and investments and the development's impact on the revenue sharing in society. Additionally, it is critical to consider how certain factors like employment and self-sufficiency will be achieved if the strategy is delivered.

4. Discuss the significance of pre-feasibility and feasibility study in a project. [Model Question]

Answer:

Pre-feasibility study is a preliminary study undertaken to determine, analyze, and select the best business scenarios. In this study, we assume we have more than one business scenarios, then we want to know which one is the best, both technically and financially. In pre-feasibility we *select* the best idea among several ideas. It will be hard and takes time if we explore each scenario deeply. Therefore, shortcut method deem acceptable in this early stage and can be used to determine minor components of investment and production cost.

If the selected scenario is considered feasible, it is recommended to continue the study to feasibility to get deeper analysis of the selected project scenario.

The growth and recognition of project management training have changed significantly over the past few years, and these changes are expected to continue and expand. And with the rise of project management comes the need for a feasibility study.

It can be thrilling to start a complex, large-scale project with a significant impact on your company. You are creating real change. Failure can be scary. This article will help you get started if you have never done a feasibility study on project management.

So, what is a Feasibility Study:

A feasibility study is a comprehensive evaluation of a proposed project that evaluates all factors critical to its success in order to assess its likelihood of success. Business success can be defined primarily in terms of ROI, which is the amount of profits that will be generated by the project.

In a feasibility study, a proposed plan or project is evaluated for its practicality. As part of a feasibility study, a project or venture is evaluated for its viability in order to determine whether it will be successful.

As the name implies, a feasibility analysis is used to determine the viability of an idea, such as ensuring a project is legally and technically feasible as well as economically justifiable. It tells us whether a project is worth the investment—in some cases, a project may not be doable. There can be many reasons for this, including requiring too many resources, which not only prevents those resources from performing other tasks but also may cost more than an organization would earn back by taking on a project that isn't profitable.

A well-designed study should offer a historical background of the business or project, such as a description of the product or service, accounting statements, details of operations and management, marketing research and policies, financial data, legal requirements, and tax obligations. Generally, such studies precede technical development and project implementation.

Project management is the process of planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives. A feasibility study is a preliminary exploration of a proposed project or undertaking to determine its merits and viability. A feasibility study aims to provide an independent assessment that examines all aspects of a proposed project, including technical, economic, financial, legal, and environmental considerations. This information then helps decision-makers determine whether or not to proceed with the project.

The feasibility study results can also be used to create a realistic project plan and budget. Without a feasibility study, it cannot be easy to know whether or not a proposed project is worth pursuing.

Types of Feasibility Study:

A feasibility analysis evaluates the project's potential for success; therefore, perceived objectivity is an essential factor in the credibility of the study for potential investors and

lending institutions. There are five types of feasibility study—separate areas that a feasibility study examines, described below.

1. **Technical Feasibility:** This assessment focuses on the technical resources available to the organization. It helps organizations determine whether the technical resources meet capacity and whether the technical team is capable of converting the ideas into working systems. Technical feasibility also involves the evaluation of the hardware, software, and other technical requirements of the proposed system. As an exaggerated example, an organization wouldn't want to try to put Star Trek's transporters in their building—currently, this project is not technically feasible.
2. **Economic Feasibility:** This assessment typically involves a cost/benefits analysis of the project, helping organizations determine the viability, cost, and benefits associated with a project before financial resources are allocated. It also serves as an independent project assessment and enhances project credibility—helping decision-makers determine the positive economic benefits to the organization that the proposed project will provide.
3. **Legal Feasibility:** This assessment investigates whether any aspect of the proposed project conflicts with legal requirements like zoning laws, data protection acts or social media laws. Let's say an organization wants to construct a new office building in a specific location. A feasibility study might reveal the organization's ideal location isn't zoned for that type of business. That organization has just saved considerable time and effort by learning that their project was not feasible right from the beginning.
4. **Operational Feasibility:** This assessment involves undertaking a study to analyze and determine whether—and how well—the organization's needs can be met by completing the project. Operational feasibility studies also examine how a project plan satisfies the requirements identified in the requirements analysis phase of system development.
5. **Scheduling Feasibility:** This assessment is the most important for project success; after all, a project will fail if not completed on time. In scheduling feasibility, an organization estimates how much time the project will take to complete.

When these areas have all been examined, the feasibility analysis helps identify any constraints the proposed project may face, including:

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

Importance of Feasibility Study

The importance of a feasibility study is based on organizational desire to “get it right” before committing resources, time, or budget. A feasibility study might uncover new ideas that could completely change a project’s scope. It’s best to make these determinations in advance, rather than to jump in and to learn that the project won’t work. Conducting a feasibility study is always beneficial to the project as it gives you and other stakeholders a clear picture of the proposed project.

Below are some key benefits of conducting a feasibility study:

- Improves project teams' focus
- Identifies new opportunities
- Provides valuable information for a "go/no-go" decision
- Narrows the business alternatives
- Identifies a valid reason to undertake the project
- Enhances the success rate by evaluating multiple parameters
- Aids decision-making on the project
- Identifies reasons not to proceed

Apart from the approaches to feasibility study listed above, some projects also require other constraints to be analyzed -

- Internal Project Constraints: Technical, Technology, Budget, Resource, etc.
- Internal Corporate Constraints: Financial, Marketing, Export, etc.
- External Constraints: Logistics, Environment, Laws, and Regulations, etc.

Preparing a project's feasibility study is an important step that may assist project managers in making informed decisions about whether or not to spend time and money on the endeavour. Feasibility studies may also help a company's management avoid taking on a tricky business endeavour by providing them with critical information.

An additional advantage of doing a feasibility study is that it aids in the creation of new ventures by providing information on factors such as how a company will work, what difficulties it could face, who its competitors are, and how much and where it will get its funding from. These marketing methods are the goal of feasibility studies, which try to persuade financiers and banks whether putting money into a certain company venture makes sense.

➲ 5. Discuss various techniques of project risk analysis.

[Model Question]

Answer:

Risk is a part of every project that an organization takes on. If companies do not take risks as a part of their Project Management strategy, they become more likely to miss their project deadline. This is why planning for risks as a part of a Project Management strategy is crucial, and the Risk Management tools come in place. Only 27% of organizations can say that they 'always' use risk management practices in their project, while 35% use them only 'sometimes'.

To be able to successfully manage risks within projects, there are a few tools and techniques organizations can implement as a part of their Project Management process.

Top Risk Management Tools & Techniques for Project Management:

1. Brainstorming
2. Root Cause Analysis
3. SWOT Analysis
4. Risk Assessment Template for IT
5. Probability and Impact Matrix
6. Risk Data Quality Assessment
7. Variance and Trend Analysis
8. Reserve Analysis

These are some of the most widely used tools and techniques by project managers to ensure that they implement risk management along with their Project Management strategies successfully. This will help in protecting projects against the many risks they could face as well as other issues and challenges.

1. **Brainstorming:** Before any project begins, the first step is to plan a strategy. For this, the team members conduct brainstorming sessions with the project manager. This brainstorming session needs to include all the risks that could impact the project's completion and success.

The steps involved in this brainstorming process are:

- Reviewing all project documentation
- Overseeing all historic data and information about risks from previous projects that are similar to the current one
- Reading over articles related to the risks involved
- Understanding all organizational process assets
- Any information available that will give insight into the issues that might occur while the project is going on
- The project manager can also get in touch with experts, team members, and other stakeholders who might have experience with handling risk in similar projects.

2. **Root Cause Analysis:** This is a technique to help project members identify all the risks that are embedded in the project itself. Conducting a root cause analysis shows the responsiveness of the team members in risk management. It is normally used once a problem arises so that the project members can address the root cause of the issue and resolve it instead of just treating its symptom. It answers questions such as: What happened? Why did it happen? How? Once these questions are answered, it becomes easier to develop a plan of action so that it does not happen again in the future.

3. **SWOT Analysis:** SWOT is an analysis to measure the strengths, weaknesses, opportunities, and threats to a project. This tool can be used to identify risks as well. The first step is to start with the strengths of the project. Then team members need to list out all the weaknesses and other aspects of the project that could be improved. Here is where the risks of the project will surface. Opportunities and threats can also be used to identify positive risks and negative risks respectively. All findings need to be put on a grid to make analysis and cross-referencing easier.

4. **Risk Assessment Template for IT:** 66% of financial institutions believe that collaboration between business operations, such as projects, and risk management is a top priority when it comes to enterprise risk management. There are some techniques that are used for other departments that can be used to manage risks within a project as well.

A risk assessment template is usually made for IT processes in an organization, but it can be implemented in any project in the company. This assessment gives a list of risks in an orderly fashion. It is a space where all the risks can be collected in one place. This is helpful when it comes to project execution and tracking risks that become crises.

The risk assessment template comes with figures and probabilities of any risk occurring, along with the impact it will have on the project. This way the project manager and the team members are fully aware of the potential harm of any risk and the likelihood of it occurring.

5. **Probability and Impact Matrix:** Project managers can also use the probability and impact matrix to help in prioritizing risks based on the impact they will have. It helps with resource allocation for risk management. This technique is a combination of the probability scores and impact scores of individual risks. After all the calculations are over, the risks are ranked based on how serious they are. This technique helps put the risk in context with the project and helps in creating plans for mitigating it.
6. **Risk Data Quality Assessment:** When project managers use the risk data quality assessment method, they utilize all the collected data for identified risks and find details about the risks that could impact the project. This helps project managers and team members understand the accuracy and quality of the risk based on the data collected.

The data quality assessment is used to improve the project manager's understanding of the risks the project could face as well as collect all the information about the risk possible. By examining these parameters, they can come up with an accurate assessment of the risk.

7. **Variance and Trend Analysis:** Just like other control processes in the project, it helps when project managers look for variances that exist between the schedule of the project and cost and compare them with the actual results to see if they are aligned or not. If the variances rise, uncertainty and risk also rise simultaneously. This is a good way of monitoring risks while the project is underway. It becomes easy to tackle problems if project members watch trends regularly to look for variances.
8. **Reserve Analysis:** While planning the budget for the project, contingency measures and some reserves should be in place as a part of the budget. This is to keep a safeguard if risks occur while the project is ongoing. These financial reserves are a backup that can be used to mitigate risks during the project.

Conclusion: The Risk Management tools and techniques mentioned above can be used to manage risks in the project. Some of them are used before the project even begins, and some can be used while the project is ongoing. To be able to understand the risks to the project and utilize these tools and techniques to their full potential, the project members need to be fully aware of the risks present. This can only happen when they have prior knowledge and training in managing risks in a project. This way they can easily understand the issues and risks to a project and take appropriate action on time.

6. Discuss the different project evaluation techniques.

[Model Question]

Answer:

Any good business practice will have a method for monitoring, reviewing, and analyzing results, and in project management, that's where the evaluation step comes in.

Project evaluation is the systematic assessment of a project's worth or merit, usually intending to determine whether it was successful. This can be done during or after the project is completed, and it involves looking at different factors such as time, cost, and resources used.

Reviewing techniques are important for three main reasons:

1. They can help you track your progress and make sure you're on track to reach your goals.
2. They can help you identify areas where you may have had problems and stay agile enough to improve future projects.
3. They allow you to easily communicate plans to streamline the process moving forward.

There are other benefits as well but by proactively keeping those key directives in mind, project evaluation can become a useful tool in any project management process.

How to Evaluate Project Performance:

As referenced above, several key factors should be reviewed. Let's take a look at some of the most important, and examine some ways in which they can be evaluated.

Time: Though it is helpful, not every project has a clear timeline before it begins. Without proper time management, it can quickly get out of hand, and it's important to have some way of determining whether or not the project is on track. You can use a variety of tools for this, such as Gantt charts or the Critical Path Method (CPM).

Once a project has started, evaluating the time that each process is taking is important. This will help you identify any bottlenecks and see if the team is on track to meet the deadline. As you get closer to completion, you should also do a final review to make sure everything is on track.

At the end of a project, once all of the deliverables have been produced, it's important to compare the actual time it took to complete the project with the original estimate. This will help you determine if there were any delays or unexpected problems that arose.

For example, if the project was estimated to take two months but ended up taking four, you would want to investigate what caused the delay and put in place measures to prevent it from falling behind schedule again.

Cost: Nothing matters if it's costing you more than you're making.

One of the most important factors in any business is profit, and that's no different when it comes to projects. You need to be able to measure how much money was spent on the project and compare it to how much money was made. This will help you determine whether or not the project was successful and, if not, where you may have lost money.

There are a few ways to track cost:

- **Actual cost:** This is the amount of money that was spent on the project. It includes material costs, labour costs, and any other associated expenses.
- **Budgeted cost:** This is the amount of money that was planned to be spent on the project. It may not reflect the actual cost, especially if the project went over budget.

- **Actual vs. budgeted cost:** This compares the actual cost to the budgeted cost and shows how much (if any) money was overspent or underspent.

Sometimes, it's not as simple as comparing against a direct revenue source. For example, a project may be targeted to increase brand awareness or company culture instead of direct sales, which may not be easily reflected in the immediate financial reports. In these cases, you'll need to use a metric that can reflect the long-term value of the project. Either way, evaluating the cost of a project and comparing it to those predetermined value metrics is crucial to understanding whether or not it was a success, failure, or if it is even worth repeating.

Resources Used: When someone mentions resources, the mind often goes to physical materials that may be consumed in the process of creating something new. In business, resources don't just mean physical inventory though, and can instead refer to things like time, energy, and workforce.

Evaluating how resources are used can help you answer important questions such as:

- Did we use more or fewer resources than we estimated?
- What were the most and least resource-heavy aspects of the project?
- Which tasks took the longest to complete?
- Did we use the optimal resources for the job?

All of this information can help you make better decisions for future projects. For example, if employee burnout slowed down a project because there weren't enough workers, you may want to consider making new hires or expanding the budget of a certain department to avoid any future disruptions.

The Best Project Evaluation Methods:

You may still feel like you're in the dark on how to best start evaluating your projects. Luckily, we have a handy guide for some of the most common techniques and methods used today.

1. **Return on Investment (ROI):** The most popular and common way to evaluate a project is through its return on investment (ROI). This approach calculates the amount of money gained or lost as a result of the project. The calculation compares the initial investment with the final revenue generated by the project. A positive ROI means that the benefits are greater than the costs, while a negative ROI indicates that the costs outweighed any benefits.
2. **Cost-Benefit Analysis (CBA):** A cost-benefit analysis is another one of the most popular and successful techniques for evaluating projects. It takes into account the costs associated with a project and compares them to the benefits that are expected to be gained. Importantly, this does not necessarily need to be measured in revenue, and can instead take into account other things such as environmental or social benefits.
3. **Net Present Value (NPV):** The NPV measures the present value of all cash flows associated with a project-both benefits and costs. This approach is often used for long-term projects where some cash flows are received in the future.

NPV takes into account both the time value of money (the fact that money today is worth more than money tomorrow) and the risks associated with future cash flows. A positive NPV means that the present value of all benefits exceeds the present value of all costs, while a negative NPV means the opposite.

4. **Internal Rate of Return (IRR):** An IRR is used to determine how profitable a project is. It calculates the rate of return that would make the net present value of all cash flows from the project equal to zero. This can help you decide if a project is worth doing, and whether or not it's worth borrowing money to finance it. Generally, the higher the IRR, the better the investment.
5. **The Payback Period:** The payback period method measures how long it will take for a project to generate enough cash flow to cover its initial costs. It ignores cash flows after the payback period has been reached. This method is often used when there is uncertainty about future cash flows.
6. **Benefit-Cost Ratio (BCR):** Related but slightly different than a CBA, the benefit-cost ratio is an individual number that can be an easy way to tell if a project is going to provide positive value. A ratio greater than 1.0 would mean that it is expected to provide value, and could then be applied to several other analysis techniques to determine if the project is worthwhile.
Again, this can include benefits that are not directly tied to revenue, though a value will need to be assigned. In today's market, for instance, corporate social responsibility and sustainability can be just as important as anything else.
7. **Risk-Adjusted Discount Rate (RADR):** Instead of just looking at straight costs and benefits, a RADR takes into account the risk associated with a project and adjusts the discount rate accordingly. This can help you make better decisions about whether or not to undertake a risky project, giving you a more accurate estimate of future returns.

Each of these methods has its strengths and weaknesses, and you may find that one works better for your particular project than another. It's important to tailor the evaluation method to the project at hand so that you can get the most accurate results.

Guidelines for Project Evaluation

No matter what project evaluation and review technique you choose to follow, some simple guidelines can be applied universally:

- **Define the project goals and objectives:** This is essential for any evaluation process. Without a clear understanding of what you are trying to achieve, it will be difficult to determine whether or not the project was successful.
- **Collect data as the project progresses:** This data can be used to help evaluate performance and make necessary adjustments.
- **Analyze data to see if it meets your goals:** Not all data will be relevant, but you need to examine all of it to make informed decisions about the future of the project.
- **Make changes when necessary:** If the data shows that the project is not meeting its goals, then changes must be made to correct the course.
- **Document the evaluation process:** This will help ensure that future evaluations are consistent and provide a basis for improvement.

By setting specific goals and objectives, collecting data, and analyzing that data, you can determine whether or not the project was successful. If it wasn't, adjustments can be made to correct the course.

Final Thoughts-Common Mistakes to Avoid:

So you understand why it is important to evaluate your project performance, know some of the leading project evaluation methods, and have guidelines on how to create your review technique. Now let's look at some of the most common pitfalls and how to avoid them.

- **Not having specific goals and objectives:** You can't evaluate whether or not a project was successful if you don't know what you're trying to achieve. Be clear on your goals and make sure they are measurable.
- **Focusing on the wrong factors:** Just because something is easy to measure doesn't mean it's the most important thing. Make sure you're evaluating all aspects of the project that will impact its success.
- **Lack of data gathering and analysis:** This goes hand in hand with focusing on the wrong factors. If you're not gathering data and analyzing it, you won't be able to determine how well the project is doing.
- **Improper use of data:** Not all data is created equal. Make sure you're using the right data and analyzing it properly to make informed decisions about your project.
- **Reacting instead of responding:** When things go wrong (and they will), don't just react emotionally. Respond by evaluating what went wrong and how it can be fixed for future projects.

It's hard to overstate just how important the evaluation stage is in project management. If you can avoid some of those mistakes, you're already well on your way to evaluating your project successfully, and in turn, increasing your chances of project success!

Unit 6: Project Administration

Unit at a glance:

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.

A Gantt chart is a **project management tool** that **illustrates work completed over a period of time in relation to the time planned for the work**. It typically includes two sections: the left side outlines a list of tasks, while the right side has a timeline with schedule bars that visualize work.

The Program Evaluation and Review Technique (PERT) is a statistical tool used in project management, which was designed to analyze and represent the tasks involved in completing a given project.

Short Answer Type Questions

A. Choose the correct answer from the given alternatives in each of the following:

1. A horizontal bar chart that shows project tasks against a calendar is called
(a) milestone (b) goal (c) Gantt chart (d) PERT chart
Answer: (c)

2. If any one factor of a project changes, _____ other factor(s) is/are likely to be affected.
(a) all (b) one (c) at least one (d) at most one
Answer: (c)

3. Planning is
(a) Looking ahead (b) Looking back
(c) Guiding people (d) Delegation of authority.
Answer: (a)

[Model Question]

[Model Question]

[Model Question]

[Model Question]

[Model Question]

D. Answer the following questions:

23. Describe about the terms CPM and PERT.

[Model Question]

Answer:

CPM [Critical Path Method]:

In 1957, DuPont developed a project management method designed to address the challenge of shutting down chemical plants for maintenance and then restarting the plants once the maintenance had been completed. Given the complexity of the process, they developed the **Critical Path Method (CPM)** for managing such projects.

CPM provides the following benefits:

- Provides a graphical view of the project.
- Predicts the time required to complete the project.
- Shows which activities are critical to maintaining the schedule and which are not.

CPM models the activities and events of a project as a network. Activities are depicted as nodes on the network and events that signify the beginning or ending of activities are depicted as arcs or lines between the nodes.

Steps in CPM Project Planning:

1. Specify the individual activities.
2. Determine the sequence of those activities.
3. Draw a network diagram.
4. Estimate the completion time for each activity.
5. Identify the critical path (longest path through the network)
6. Update the CPM diagram as the project progresses.

PERT: The Program Evaluation and Review Technique (PERT) is a network model that allows for randomness in activity completion times. PERT was developed in the late 1950's for the U.S. Navy's Polaris project having thousands of contractors. It has the potential to reduce both the time and cost required to complete a project.

In a project, an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project network models represent activities and milestones by arcs and nodes. PERT originally was an activity on arc network, in which the activities are represented on the lines and milestones on the nodes. Over time, some people began to use PERT as an activity on node network. For this discussion, we will use the original form of activity on arc.

24. Briefly describe the determination of project duration using CPM and PERT.

[Model Question]

Answer:

PERT [Program Evaluation & Review Technique]: It is generally used for those projects where time required to complete various activities are not known as *a priori*. It is probabilistic model & is primarily concerned for evaluation of time. It is event oriented.

CPM [Critical Path Analysis]: It is a commonly used for those projects which are repetitive in nature & where one has prior experience of handling similar projects. It is a deterministic model & places emphasis on time & cost for activities of a project.

Determination of time to complete each activity:

The CPM system of networks omits the probabilistic consideration and is based on a Single Time Estimate of the average time required to execute the activity.

In PERT analysis, there is always a great deal of uncertainty associated with the activity durations of any project.

Therefore, the estimated time is better described by a probability distribution than by a single estimate. Three time estimates (*from beta probability distribution*) are made as follows:

- 1) **The Optimistic Time Estimate (t_o):** Shortest possible time in which an activity can be completed in ideal conditions. No provisions are made for delays or setbacks while estimating this time.
- 2) **The Most Likely Time (t_m):** It assumes that things go in normal way with few setbacks.
- 3) **The Pessimistic Time (t_p):** The max. possible time if everything go wrong & abnormal situations prevailed.

However, major catastrophes such as earthquakes, labour troubles, etc. are not taken into account.

The expected time (mean time) for each activity can be approximated using the weighted average i.e.

$$\text{Expected Time } (t_e) = (t_o + 4t_m + t_p)/6$$

Forward Pass Computation: It is the process of tracing the network from START to END. It gives the earliest start & finish times for each activity.

Backward Pass Computation: It is the process of tracing the network starting from LAST node & moving backward.

25. What are the utility of PERT Chart?

[Model Question]

Answer:

1. PERT stands for Program Evaluation and Review Technique
2. A PERT chart is a project management tool used to schedule, organize, and coordinate tasks within a project
3. PERTs become very complex very quickly, so the key to usage is to plan and manage small chunks of work

In conclusion it is presented as:

WBS Charts aids the team to visualize the plan

- Reduces inconsistencies in the project plan
- Reduces duplicated tasks
- Intuitive
- PERT Charts reinforce sequencing (bi-directional)

- Locates orphan tasks
- Promotes fixing obvious missing predecessors and successors
- Identifies wrong owners & process groups
- Opportunities to shorten timelines

26. Distinguish between PERT and CPM.**[Model Question]****Answer:****Difference between PERT and CPM**

PERT	CPM
1. PERT is that technique of project management which is used to manage uncertain (i.e., time is not known) activities of any project.	CPM is that technique of project management which is used to manage only certain (i.e., time is known) activities of any project.
2. 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.
3. It is a probability model.	It is a deterministic model.
4. 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.
5. It is appropriate for high precision time estimation.	It is appropriate for reasonable time estimation.
6. It has Non-repetitive nature of job.	It has repetitive nature of job.
7. There is no chance of crashing as there is no certainty of time.	There may be crashing because of certain time boundation.
8. It doesn't use any dummy activities.	It uses dummy activities for representing sequence of activities.
9. It is suitable for projects which required research and development.	It is suitable for construction projects.

27. Mention what is the characteristics of Gantt Chart Basics?**[Model Question]****Answer:**

- In Gantt chart, each task is displayed by one row
- Dates are displayed in incremental order like days, weeks or months as per the total length of the project
- For each task expected, time is displayed by a horizontal bar whose left end indicates the estimated beginning of the task and right end indicates the estimated completion date
- Task may run parallel, sequentially or overlapping
- The chart is represented in the bar formation to a length proportional to the fraction of the work that has been completed
- On the left of the line, you will see the completed tasks
- Future tasks line lies to the right of the line

- Current tasks are cross the line and are behind schedule when filled in section is on the left of the line and ahead of schedule when it is right of the line

28. Explain when and why you will use PERT charts and when and why you will use Gantt charts while you are a project manager. [Model Question]

Answer:

One significant advantage of PERT charts is that all individual tasks and dependencies are shown

- 1) PERT stands for Project Evaluation and review Technique
- 2) PERT network produces probabilistic measures, whereas Gantt only estimates.
- 3) A PERT chart displays the critical path for the overall project and the slack time
- 4) A Gantt chart offers a rapid overview
- 5) PERT and Gantt charts are not mutually exclusive techniques.

E. Pick up the correct answer:

29. (CPM/PERT) is a method for calculating the quickest way to complete a project by looking at all of the jobs involved and the time needed to complete each one.

[Model Question]

Answer: PERT

30. (Initiation, planning, implementation, and completion)/ . (planning, initiation, implementation and control) are the four essential phases of a typical project.

[Model Question]

Answer: Initiation, planning, implementation, and completion.

31. In order for a project to be finished, each step along the (direct/ critical) path must be accomplished.

[Model Question]

Answer: critical

32. The maximum time that would be required to accomplish an activity, according to the time estimates generated by PERT planners, is referred to as (pessimistic/ optimistic).

[Model Question]

Answer: Pessimistic

33. A (Work schedule/ Gantt chart) is a project management tool that illustrates work completed over a period of time in relation to the time planned for the work.

[Model Question]

Answer: Gantt chart

Long Answer Type Questions

Q 1. Write short notes on the following:

[Model Question]

- a) Gant Chart
- b) PERT and CPM

Answer:

a) Gant Chart: A Gantt chart, similar to a bar chart, lists tasks down the left side and elapsed time is marked off across the top. This graphical depiction of the schedule will track the planning and coordination of work that must be completed to produce the defined product. Major task groupings are entered as general areas of work (summary tasks), and then broken down into bodies of work that can be completed independently. Project detail can be added to the smallest increment of definable tasks. As work is completed, the project manager receives updates from each person or resource working, and the plan is updated frequently and then progress is measured against the plan. The Gantt chart reflects the entire schedule of work which might include duration, resources milestones, etc. A Gantt chart can also provide performance and efficiency information that directly impacts reward systems of monetary compensation and promotion.

Gantt chart information: The Gantt chart is versatile and timeless for use in every kind of project from building a house to constructing the tallest building and overhauling a computer system. The time required to build detail into the original plan and keep the plan updated throughout the project will provide all the information necessary to keep the project on track.

b) PERT and CPM: Project Evaluation and Review Technique (PERT): PERT is appropriate technique which is used for the projects where the time required or needed to complete different activities are not known. PERT is majorly applied for scheduling, organization and integration of different tasks within a project. It provides the blueprint of project and is efficient technique for project evaluation.

Critical Path Method (CPM): CPM is a technique which is used for the projects where the time needed for completion of project is already known. It is majorly used for determining the approximate time within which a project can be completed. Critical path is the largest path in project management which always provide minimum time taken for completion of project.

PERT (Project Evaluation and Review Technique):

- Another derivative of the GANTT chart
- Multiple time estimates were used for each activity that allowed for variation in activity times
- Activity times are assumed to be random, with assumed probability distribution ("probabilistic")

- Activities are represented by arrowed lines between the nodes or circles.

CPM (Critical Path Method):

- Tool to analyze project and determine duration, based on identification of "critical path" through an activity network.
- Knowledge of the critical path can permit management of the project to change duration
- A single estimate for activity time was used that did not allow for variation in activity times
- Activity times are assumed to be known or predictable ("deterministic")
- Activities are represented as nodes or circles.

Q 2. Discuss various techniques of project risk analysis.

[Model Question]

Answer:

Risk is a part of every project that an organization takes on. If companies do not take risks as a part of their Project Management strategy, they become more likely to miss their project deadline. This is why planning for risks as a part of a Project Management strategy is crucial, and the Risk Management tools come in place. Only 27% of organizations can say that they 'always' use risk management practices in their project, while 35% use them only 'sometimes'.

To be able to successfully manage risks within projects, there are a few tools and techniques organizations can implement as a part of their Project Management process.

Top Risk Management Tools & Techniques for Project Management

1. Brainstorming
2. Root Cause Analysis
3. SWOT Analysis
4. Risk Assessment Template for IT
5. Probability and Impact Matrix
6. Risk Data Quality Assessment
7. Variance and Trend Analysis
8. Reserve Analysis

These are some of the most widely used tools and techniques by project managers to ensure that they implement risk management along with their Project Management strategies successfully. This will help in protecting projects against the many risks they could face as well as other issues and challenges.

1. **Brainstorming:** Before any project begins, the first step is to plan a strategy. For this, the team members conduct brainstorming sessions with the project manager. This brainstorming session needs to include all the risks that could impact the project's completion and success.
 - 1) The steps involved in this brainstorming process are:
 - 2) Reviewing all project documentation

- 3) Overseeing all historic data and information about risks from previous projects that are similar to the current one
 - 4) Reading over articles related to the risks involved
 - 5) Understanding all organizational process assets
 - 6) Any information available that will give insight into the issues that might occur while the project is going on
 - 7) The project manager can also get in touch with experts, team members, and other stakeholders who might have experience with handling risk in similar projects.
2. **Root Cause Analysis:** This is a technique to help project members identify all the risks that are embedded in the project itself. Conducting a root cause analysis shows the responsiveness of the team members in risk management. It is normally used once a problem arises so that the project members can address the root cause of the issue and resolve it instead of just treating its symptom. It answers questions such as: What happened? Why did it happen? How? Once these questions are answered, it becomes easier to develop a plan of action so that it does not happen again in the future.
3. **SWOT Analysis:** SWOT is an analysis to measure the strengths, weaknesses, opportunities, and threats to a project. This tool can be used to identify risks as well. The first step is to start with the strengths of the project. Then team members need to list out all the weaknesses and other aspects of the project that could be improved. Here is where the risks of the project will surface. Opportunities and threats can also be used to identify positive risks and negative risks respectively. All findings need to be put on a grid to make analysis and cross-referencing easier.
4. **Risk Assessment Template for IT:** 66% of financial institutions believe that collaboration between business operations, such as projects, and risk management is a top priority when it comes to enterprise risk management. There are some techniques that are used for other departments that can be used to manage risks within a project as well.
- A risk assessment template is usually made for IT processes in an organization, but it can be implemented in any project in the company. This assessment gives a list of risks in an orderly fashion. It is a space where all the risks can be collected in one place. This is helpful when it comes to project execution and tracking risks that become crises.
- The risk assessment template comes with figures and probabilities of any risk occurring, along with the impact it will have on the project. This way the project manager and the team members are fully aware of the potential harm of any risk and the likelihood of it occurring.
5. **Probability and Impact Matrix:** Project managers can also use the probability and impact matrix to help in prioritizing risks based on the impact they will have. It helps with resource allocation for risk management. This technique is a combination of the probability scores and impact scores of individual risks. After all the calculations are over, the risks are ranked based on how serious they are.

This technique helps put the risk in context with the project and helps in creating plans for mitigating it.

- 6. Risk Data Quality Assessment:** When project managers use the risk data quality assessment method, they utilize all the collected data for identified risks and find details about the risks that could impact the project. This helps project managers and team members understand the accuracy and quality of the risk based on the data collected.

The data quality assessment is used to improve the project manager's understanding of the risks the project could face as well as collect all the information about the risk possible. By examining these parameters, they can come up with an accurate assessment of the risk.

- 7. Variance and Trend Analysis:** Just like other control processes in the project, it helps when project managers look for variances that exist between the schedule of the project and cost and compare them with the actual results to see if they are aligned or not. If the variances rise, uncertainty and risk also rise simultaneously. This is a good way of monitoring risks while the project is underway. It becomes easy to tackle problems if project members watch trends regularly to look for variances.

- 8. Reserve Analysis:** While planning the budget for the project, contingency measures and some reserves should be in place as a part of the budget. This is to keep a safeguard if risks occur while the project is ongoing. These financial reserves are a backup that can be used to mitigate risks during the project.

Conclusion: The Risk Management tools and techniques mentioned above can be used to manage risks in the project. Some of them are used before the project even begins, and some can be used while the project is ongoing. To be able to understand the risks to the project and utilize these tools and techniques to their full potential, the project members need to be fully aware of the risks present. This can only happen when they have prior knowledge and training in managing risks in a project. This way they can easily understand the issues and risks to a project and take appropriate action on time.