Paper 15 – Strategic Cost Management and Decision Making

Paper 15 - Strategic Cost Management And Decision Making

Time Allowed: 3 hours **Full Marks: 100**

Section A

1. Answer the following and each question carries 2 marks. [10×2= 20]

(i) A company has the capacity of production of 80,000 units and presently sells 20,000 units at ₹ 100 each. The demand is sensitive to selling price and it has been observed that with every reduction of ₹ 10 in selling price the demand is doubled. What should be the target cost at full capacity if profit margin on sale is taken as 25%?

(a) ₹ 75 (b) ₹ 90 (c) ₹ 60 (d) ₹ 25

(ii) If the direct labour cost is reduced by 20% with every doubling of output, what will be the cost of labour for the sixteenth unit produced as an approximate percentage of the cost of the first unit produced?

(a) 51.2% (b) 40.96% (c) 62% (d) None of these

(iii) A company determines its selling price by marking up variable costs 60%. In addition, the company uses frequent selling price mark down to stimulate sales. If the mark down average 10%, what is the company's contribution margin ratio?

(a) 30.6% (b) 44% (c) 86.4% (d) None of these

(iv) B Ltd. Has earned net profit of ₹ 1 lakh, and its overall P/V ratio and margin of safety are 25% and 50% respectively. What is the total fixed cost of the company?

(a) ₹ 2,50,000 (b) ₹ 2,00,000 (c) ₹ 3,00,000 (d) ₹ 1,00,000

(v) A company has 2,000 units of an obsolete item which are carried in inventory at the original purchase price of ₹ 30,000. If these items are reworked for ₹ 10,000, they can be sold for ₹ 18,000. Alternatively, they can be sold as scrap for ₹ 3,000 in the market. In a decision model used to analyze the reworking proposal, the opportunity cost should be taken as:

(a) ₹ 8,000 (b) ₹ 12,000 (c) ₹ 3,000 (d) ₹ 10,000

(vi) The total cost of manufacturing a component is as under at a capacity of 50,000 units of production:

	₹
Prime cost	10.00
Variable overheads	2.40
Fixed Overheads	4.00
	16.40

The selling price is ₹ 21 per unit. The variable selling and administrative expenses is 60 paise per component extra. During the next quarter only 10,000 units can be produced and sold. Management plans to shut down the plant estimating that the fixed manufacturing cost can be reduced to ₹ 74,000 per quarter. When the plant is operating, the fixed overheads are incurred at a uniform rate throughout the year. Additional costs of plant shutdown for the quarter are estimated at ₹ 14,000.
The shut down pint for the quarter in units of product will be :
(a) ₹ 25,000 (b) ₹ 14,000 (c) ₹ 11,000 (d) ₹ 20,000

(vii) A company manufactures two products using common material handling facility. The total budgeted material handling cost is ₹ 60,000. The other details are:

	Product X	Product Y
Number of units produced	**30**	**30**
Material moves per product line	**5**	**15**
Direct labour hour per unit	**200**	**200**

Under activity based costing system the material handling cost to be allocated to product X (per unit) would be:

(a) ₹ 1,000 (b) ₹ 500 (c) ₹ 1,500 (d) ₹ 2,500

(viii) A company operates throughput accounting system. The details of product X per unit are as under.

Selling Price	**₹ 50**
Material Cost	**₹ 20**
Conversion cost	**₹ 15**
Time on bottleneck resources	**10 minutes**

The return per hour for product X is:

(a) ₹ 210 (b) ₹ 300 (c) ₹ 180 (d) ₹ 90

(ix) The information relating to the direct material cost of a company is as under:

	₹
Standard price per unit	**3.60**
Actual quantity purchased in units	**1,600**
Standard quantity allowed for actual production in units	**1.450**
Material price variance on purchase (favourable)	**240**

What is the actual purchase price per unit?

(a) ₹ 3.45 (b) ₹ 3.75 (c) ₹ 3.20 (d) ₹ 3.25

(x) If the time taken to produce the first unit of a product is 4000 hrs, what will be the total time taken to produce the 5th to 8th unit of the product, when a 90% learning curve applies?

(a) 10,500 hours (b) 12,968 hours (c) 9,560 hours (d) 10,368 hours

Answer:

(i) (c)

Demand	Price (₹)
20,000	100
40,000	90
80,000	80

Target Cost = ₹80 - (25% of 80) = ₹ 80 - 20 = ₹ 60

(ii) (b)

1st	100%
2nd	80% x 100%
4th	80% of 2nd
8th	80% of 4th
16th	80% of 8th = 0.80 x 0.80 x 0.80 x 0.80 = 40.96%

Say, 41% of the time required for the 1st unit.

(iii) (a)
When V (Var. cost) = 100, SP = 160, M.Cost/SP = 60/100
SP after 10% mark down of SP = 144, Cost = 60-16=44
Contribution Margin Ratio = 44/144=0.3056=30.6%

(iv) (d)
MS=Profit/PV Ratio = ₹4 Lakh: MS=50%; BE Sales = (1-0.50) = 0.50
Hence BES = ₹4 lakh
Fixed Cost 25% of ₹4,00,000 = ₹1,00,000

(v) (c)
Original price is not relevant

Rework income	₹18,000	
Deduct cost of rework	10,000	
Net inflow	₹8,000	It is relevant

The other alternative relevant cash flow is from sale as scrap = ₹3,000 Hence, the opportunity cost is ₹3,000.

(vi) (b)

Contribution per unit of component	**₹**	**₹**
Variable Prime cost	10.00	
Variable overhead	2.40	
Selling/Administrative expenses	0.60	13.00
Contribution		Rs. 8.00

Avoidable fixed cost per quarter
= total fixed cost-(unavoidable fixed cost + additional shut down cost)
=(50,000 x ₹4) ' (₹74,000 + ₹14,000) = ₹1,12,000.
The required shut down point for the quarter = ₹1,12,000 / ₹8 = 14,000 units.

(vii) (b)
Total moves in material handling = 5+15=20
Percentage move for Product A = 5/20=25%
Material handling cost to be allocated to Product A = ₹60,000/25%=Rs.15,000
i.e., ₹. 15,000/30=₹500 per unit.

(viii) (c)
(Selling Price - Material Cost)/ Time of bottleneck resource
= [(₹50 - ₹20)/10 minutes] x 60 = ₹180 per hour.

(ix) (a)
Actual quantity bought x standard price
= 1,600 x ₹3.60 = Rs. 5,760
Deduct favorable price variance 240
Actual quantity x actual price = 5,520
Or, 1,600 x actual price = ₹5,520 So,
Actual price ₹5,520/1,600 = ₹3.45

(x) (d)

Units	Average Time (hours)	Total Time (hours)
1	4000	4000
2	3600	7200
4	3240	12960
8	2916	23328

Total time for 5th to 8 units = 23328 - 12960 = 10368 hrs.

Section B
Answer any five questions from Question No. 2 to 8
Each question carries 16 marks. 5 × 16 = 80

2. (a)

A2Z p.l.c supports the concept of tero technology or life cycle costing for new investment decisions covering its engineering activities. The financial side of this philosophy is now well established and its principles extended to all other areas of decision making. The company is to replace a number of its machines and the Production Manager is torn between the Exe Machine, a more expensive machine with a life of 12 years, and the Wye machine with an estimated life of 6 years. If the Wye machine is chosen it is likely that it would be replaced at the end of 6 years by another Wye machine.

The pattern of maintenance and running costs differs between the two types of machine and relevant data are shown below:

	Exe	Wye
Purchase price	₹ 19,000	₹ 13,000
Trade-in value/breakup/scrap	₹ 3,000	₹ 3,000
Annual repair costs	₹ 2,000	₹ 2,600
Overhaul costs	(at year 8) ₹ 4,000	(at year 4) ₹ 2,000
Estimated financing costs averaged over machine life	10%p.a	10% p.a.

You are required to: recommend with supporting figures, which machine to purchase, stating any assumptions made. [8]

(b) (i)

A machine which originally cost ₹12,000 has an estimated life of 10 years and it depreciated at the rate of ₹1,200 per year. It has been unused for some time, however, as expected production orders did not materialise.

A special order has now been received which would require the use of the machine for two months.

The current net realisable value of the machine is ₹ 8,000. If it is used for the job, its value is expected to fall to ₹ 7,500. The net book value of the machine is ₹ 8,400. Routine maintenance of the machine currently costs ₹ 40 per month. With use, the cost of maintenance and repairs would increase to ₹ 60 per month.

What would be the relevant cost of using the machine for the order so that it can be charged as the minimum price for the order?

(ii) X Ltd. has been approached by a customer who would like a special job to be done for him and is willing to pay ₹ 22,000 for it. The job would require the following materials:

Materials	Total units required	Units already in stock	Book Value of units in stock	Realizable Value	Replacement Cost
			₹/unit	₹/unit	₹/unit
A	1,000	0	—	—	6

B	**1,000**	**600**	**2**	**2.5**	**5**
C	**1,000**	**700**	**3**	**2.5**	**4**
D	**200**	**200**	**4**	**6**	**9**

A. Material B is used regularly by X Ltd. and if stocks were required for this job, they would need to be replaced to meet other production demand.

B. Materials C and D are in stock as the result of previous excess purchase and they have a restricted use. No other use could be found for material C but material D could used in another job as substitute for 300 units of material which currently cost ₹ 5 per unit (of which the company has no units in stock at the moment.)

What are the relevant costs of material, in deciding whether or not to accept the contract? Assume all other expenses on this contract to be specially incurred besides the relevant cost of material is ₹ 550. [2 + 6 = 8]

Answer:

(a)

Computation of present value of outflows and equivalent annual

		Exe machine		**Wye machine**
Initial cost (₹)		19,000.00		13,000.00
Less : scrap at the end of the life (₹)	(3000 × 0.32)	960.00	(3000 ×0.56)	1,680.00
		18,040.00		11,320.00
Present value of total annual cost (₹)	(2000 × 6.81)	13,620.00	(2600 × 4.36)	11,336.00
overhaul cost (₹)	(4000 ×.47)	1,880.00	(2000 × 0.68)	1,360.00
		33,540.00		24,016.00
capital recovery factor	(1/6.81)	0.15	(1/4.36)	0.23
equivalent annual cost (₹)		4,925.00		5,508.00

As the equivalent annual cost is less for exe machine, it is better to purchase the same.

(b)

(i) Computation of relevant cost of using the machine for the order

		₹
Fall in sale value, if used	(8000- 7500)	500.00
incremental maintenance cost	[(60 - 40)× 2]	40.00
		540.00

(ii) Computation of relevant cost of the job

		₹
A	(1000 × 6)	6,000.00
B	(1000 × 5)	5,000.00
C	[(700 × 2.5)+(300 × 4)]	2,950.00
D	(300 × 5)	1,500.00
		15,450.00
Add : other expenses		550.00
		₹1,6000.00

As the revenue from the order, which is more than the relevant cost of ₹ 16000 the order should be accepted

3. A small-scale manufacturing unit has employed skilled persons for doing pressing and welding operations on various products. The welders produce two different products, W_1 and W_2. The press operators also produce two products, P_1 and P_2. Due to specific skill requirements, the press operators can't do welding job and vice-versa. The labour hours and cost data in respect of the above 4 products are as under.

	W_1	W_2	P_1	P_2
Hours per unit	**4**	**4**	**5**	**2**
Price per unit (₹)	**50**	**50**	**80**	**65**
Direct Material per unit (₹)	**18**	**22**	**35**	**45**
Direct Labour Rate per hour	**₹ 4**	**₹ 4**	**₹ 4**	**₹ 4**
Variable Overheads per unit	**₹ 2**	**₹ 2**	**₹ 3**	**₹ 3**

The unit incurs ₹ 50,000 per annum on fixed costs for producing the above products. The available labour hours for welding are 20,000 and for pressing 16,000.

The unit has also observed that the market can absorb minimum 2,000 units of W_1 2,500 units of W_2 1,800 units of P_1 and 2,200 units of P_2. The demand keeps on fluctuating. The manager of the shop has, therefore suggested that the workers should be trained to do either of welding or pressing job so that any excess demand can be fulfilled. It is estimated that this decision will increase the burden of fixed costs by ₹ 5,000 p.a.

Required:

(a) Present the figures of optimum product mix assuming that the minimum marketable quantity is produced before the workers are trained and after they are trained.

(b) Prepare profitability statement for optimum product mix under both the above conditions and recommend whether it is advisable to train employees. [16]

Answer:

Statement showing computation per hour and determination of priority

	W_1	W_2	P_1	P_2
	₹	₹	₹	₹
i) selling price	50.00	50.00	80.00	65.00
ii) Variable cost				
a. direct material	18.00	22.00	35.00	45.00
b. direct wages	16.00	16.00	20.00	8.00
c. variable overheads	2.00	2.00	3.00	3.00
	36.00	40.00	58.00	56.00
iii) contribution	14.00	10.00	22.00	9.00
iv) contribution per hour	3.50	2.50	4.40	4.50
v) Priority	III	IV	II	I

Statement showing calculation of profit before workers are trained

	W_1	W_2	P_1	P_2	Total
Minimum units	2,000.00	2,500.00	1,800.00	2,200.00	
Units in remaining time	500.00			1,300.00	
i) Total units	2,500.00	2,500.00	1,800.00	3,500.00	
ii) contribution per unit	14.00	10.00	22.00	9.00	
iii) Total contribution	35,000.00	25,000.00	39,600.00	31,500.00	131,100.00
iv) Fixed cost					50,000.00
v) Profit					81,100.00

Working Notes:

	W_1 hours	P_2 hours
Available hours	20,000.00	16,000.00
Less : used for minimum	18,000.00	13,400.00
	2,000.00	2,600.00
units (2000/4)	500.00 (2600/2)	1,300.00

Statement showing calculation of profit after conversion

		W_1	W_2	P_1	P_2	
Minimum units		2,000.00	2,500.00	1,800.00	2,200.00	
Units in remaining time					2,300.00	
i) Total units		2,000.00	2,500.00	1,800.00	4,500.00	
ii) Contribution per unit	₹	14.00	10.00	22.00	9.00	
iii) Total contribution	₹	28,000.00	25,000.00	39,600.00	42,500.00	133,100.00
iv) Fixed cost	₹					55,000.00
v) Profit	₹					78,100.00

From the above, it is not advisable to convert the machines into versatile machines.

4. (a) The budgeted output of a single product manufacturing company for 2016-17 was 5,000 units. The financial results in respect of actual output of 4,800 units achieved during the year were as under:

Direct Material	**₹ 29,700**
Direct Wages	**44,700**
Variable overheads	**72,750**
Fixed overheads	**39,000**
Profit	**36,600**
Sales	**2,22,750**

The standard direct wage rate is ₹ 4.50 per hour and the standard variable overhead rate is ₹ 7.50 per hour.

The cost accounts recorded the following variances for the year.

Variances	**Favourable**	**Adverse**
Material Price	**₹ ——**	**₹ 300**
Material usage	**——**	**600**
Wage rate	**750**	**—**
Labour efficiency	**——**	**2,250**
Variable overhead expense	**3,000**	**——**
Variable overhead efficiency	**——**	**3,750**
Fixed overhead expense	**——**	**1,500**
Selling price	**6,750**	**——**

Required to:

(i) Prepare a statement showing the original budget.
(ii) Prepare the standard product cost sheet per unit.
(iii) Prepare a statement showing the reconciliation of originally budgeted profit and actual profit. [4 + 4 + 4 = 12]

(b) Distinguish between Standard Costing from Budgetary Control. [4]

Answer:

(a)

Statement showing original budget and standard cost per unit:

Element	Actual (₹)	Variance (₹)	Standard Cost 4800 (₹)	Standard Cost Per unit (₹)	Original Budget 5000 units (₹)
Material	29700	300A	28800	6.00	30000
Direct Wags	44700	750	46200	9.00	45000
		2250A			
Value Overhead	75750	3000	72000	15.00	75000
		3750A			
Fixed Overhead	39000	1500A	37500	7.50	37500
	186150	3750F	181500	37.50	187500
Profit (b/f)	36600	8400A	34500	7.50	37500
		2100F			
Sales	222750	6750F	216000	45.00	225000

Statement showing reconciliation of budgeted profit with Actual profit:

	(₹)
Budgeted Profit	37,500
Add: All favorable variances	10,500
	48,000
Less All adverse variance	8,400
	39,600
Less: (5000-4800) 7.5 profit variances	1,000
Less: (5000-4800) 7.5 profit variances	1,500
Actual Profit	36,600
(or)	
Standard Profit	34,500
Add	10,500
	45,000
Less:	8,400
Actual Profit	36,600
Budgeted Profit	37,500
Less: 8400 + 9000	17,400
	20,100
Add:	3,750
Variable Cost	6,000
Sales price variance	6,750
	36,600

(b)

Despite the similarity in the basic principles of Standard Costing and Budgetary Control, the two systems vary in scope and in the matter of detailed techniques. The difference may be summarized as follows:

1. A system of Budgetary Control may be operated even if no Standard Costing system is in use in the concern.

2. While standard is an unit concept, budget is a total concept.
3. Budgets are the ceilings or limits of expenses above which the actual expenditure should not normally rise; if it does, the planned profits will be reduced. Standards are minimum targets to be attained by actual performance at specified efficiency.
4. Budgets are complete in as much as they are framed for all the activities and functions of a concern such as production, purchase, selling and distribution, research and development, capital utilisation, etc. Standard Costing relates mainly to the function of production and the related manufacturing costs.
5. A more searching analysis of the variances from standards is necessary than in the case of variations from the budget.
6. Budgets are indices, adherence to which keeps a business out of difficulties. Standards are pointers to further possible improvements.

[Any Four Points]

5. (a) Division A is a profit centre which produces three products X, Y and Z. Each product has an external market.

	X	Y	Z
External market price per unit	**₹ 48**	**₹ 46**	**₹ 40**
Variable cost of production in division A	**₹ 33**	**₹ 24**	**₹ 28**
Labour hours required per unit in division A	**3**	**4**	**2**

Product Y can be transferred to Division B, but the maximum quantity that might be required for transfer is 300 units of Y.

	X	Y	Z
The maximum external sales are:	**800 units**	**500 units**	**300 units**

Instead of receiving transfers of Product Y from Division A, Division B could buy similar product in the open market at a slightly cheaper price of ₹ 45 per unit.

What should the transfer price be for each unit for 300 units of Y, if the total labour hours available in Division A are?

(i) 3800 hours (ii) 5600 hours. [5 + 5 = 10]

(b) What is Bench trending and how does it differ from Bench Marking? [6]

Answer:

(a)

Computation of contribution per labour hour from external sales:

	X	Y	Z
Market price (₹)	48	46	40
Variable cost (₹)	33	24	28
Contribution (₹)	15	22	12
Labour hours required	3	4	2
Contribution per labour hour (₹)	5	5.50	6
Priority	III	II	I

Computation of transfer price when
(i) The capacity is 3800 hours:
Hours required for Z = 300 × 2 = 600

Y = 500 × 4	= 2000
	2600
X = 800 × 3	2400
	5000

The existing capacity is not sufficient to produce the units to meet the external sales. In order to transfer 300 units of Y, 1200 hours are required in which division A will give up the production of X to this extent.

	₹
Variable cost of Y	24
(+) contribution lost by giving up production of X to the extent of 1200 hours = 1200 × 5 = 6000	
∴ Opportunity cost per unit = (6000/300)	20
Required transfer price	**44**

(ii) If the capacity is 5600 hours:

Variable cost	24
Contribution cost of giving up x to extent of 600 hours = 600 x 5 =300	
Opportunity cost per uit = (3000/300)	10
	34

(b)

Bench Trending: Continuous monitoring of specific process performance with a selected group of benchmarking is a systematic and continuous measurement process of comparing through measuring an organization business processes against business leaders (role models) anywhere in the world, to gain information that will help organization take action to improve its performance. The continuous process of enlisting the best practices in the world for the processes, goals and objectives leading to world class levels of achievement.

Benchmarking is the process of comparing the cost, time or quality of what one organization does against what another organization does. The result is often a business case for making changes in order to make improvements.

Benchmarking is a powerful management tool because it overcomes "paradigm blindness". Paradigm Blindness can be summed up as the mode of thinking, "the way we do it is the best because this is the way we've always done it". Bench Marking opens organizations to new methods, ideas and tools to improve their effectiveness. It helps crack through resistance to change by demonstrating other methods of solving problems than the one currently employed and demonstrating that they work, because they are being used by others.

(a) Identify your problem areas.
(b) Identify other industries that have similar processes.
(c) Identify organizations that are leaders in these areas.
(d) survey companies for measures and practices
(e) Visit the "best practice" companies to identify leading edge practices.
(f) Implement new and improved business practices.

6. (a) A Small retailer has studied the weekly receipts and payments over the past 200 weeks and has developed the following set of information:

Weekly Receipts (₹)	Probability	Weekly Payments (₹)	Probability
3000	**0.20**	**4000**	**0.30**
5000	**0.30**	**6000**	**0.40**
7000	**0.40**	**8000**	**0.20**

12000	0.10	10000	0.10

Using the following set of random numbers, simulate the weekly pattern of receipts and payments for the 12 weeks of the next quarter, assuming further that the beginning bank balance is ₹8000. What is the estimated balance at the end of the 12 weekly period? What is the highest weekly balance during the quarter? What is the average weekly balance for the quarter?

Random Numbers

For Receipts	03	91	38	55	17	46	32	43	69	72	24	22
For payment	61	96	30	32	03	88	48	28	88	18	71	99

According to the given information, the random number interval is assigned to both the receipts and the payments. [8]

(b) A captain of a cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows:

Batting Position						
		III	IV	V	VI	VII
Batsmen	A	40	40	35	25	50
	B	42	30	16	25	27
	C	50	48	40	60	50
	D	20	19	20	18	25
	E	58	60	59	55	53

Make the assignment so that the expected total average runs scored by these batsmen are maximum. [8]

Answer:

(a)

Range of random numbers							
Receipt (₹)	Probability	Cumulative probability	Range	Payments (₹)	Probability	Cumulative probability	Range
3000	0.20	0.20	0-19	4000	0.30	0.30	0-29
5000	0.30	0.50	20-49	6000	0.40	0.70	30-69
7000	0.40	0.90	50-89	8000	0.20	0.90	70-89
12000	0.10	1.00	90-99	10000	0.10	1.00	90-99

Simulation of data for a period of 12 weeks					
Week	Random No. for receipt	Expected Receipt (₹)	Random No. for payment	Expected Payment (₹)	Week end Balance (₹)
Opening Balance					8000
1	03	3000	61	6000	5000 (8000 + 3000 – 6000)
2	91	12000	96	10000	7000
3	38	5000	30	6000	6000
4	55	7000	32	6000	7000
5	17	3000	03	4000	6000
6	46	5000	88	8000	3000
7	32	5000	48	6000	2000

8	43	5000	28	4000	3000
9	69	7000	88	8000	2000
10	72	7000	18	4000	5000
11	24	5000	71	8000	2000
12	22	5000	99	10000	(3000)

Estimated balance at the end of 12th week = ₹ (3,000)
Highest balance = ₹ 7,000
Average balance during the quarter = 45,000/12 = ₹ 3,750

(b)

	III	IV	V	VI	VII
A	40	40	35	25	50
B	42	30	16	25	27
C	50	48	40	60	50
D	20	19	20	18	25
E	58	60	59	55	53

Loss Matrix

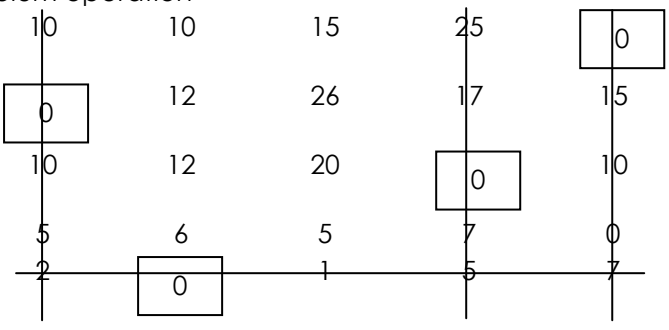
20	20	25	35	10
18	30	44	35	33
10	12	20	0	10
40	41	40	42	35
2	0	1	5	7

Row Operation

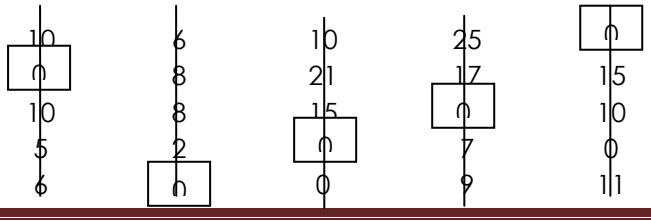
M_3

10	10	14	25	0
0	12	25	17	15
10	12	19	0	10
5	6	4	7	0
2	0	0	5	7

Colum operation



Improved Matrix



Maximum Average Runs

A	->	VII	– 50
B	->	II	– 42
C	->	VI	- 60
D	->	V	- 20

7. (a) A civil engineering firm has to bid for the construction of a dam. The activities and time estimates are given below:

Activity	DURATION		
	Optimistic	Most likely	Pessimistic
1 – 2	14	17	25
2 – 3	14	18	21
2 – 4	13	15	18
2 – 8	16	19	28
3 – 4 (dummy)			
3 – 5	15	18	27
4 – 6	13	17	21
5 – 7 (dummy)			
5 – 9	14	18	20
6 – 7 (dummy)			
6 – 8 (dummy)			
7 – 9	16	20	41
8 – 9	14	16	22

The policy of the firm with respect to submitting bids is to bid the minimum amount that will provide a 95% of probability of at best breaking even. The fixed costs for the project are 8 lakhs and the variable costs are ₹ 9,000 everyday spent working on the project. The duration is in days and the costs are in terms of rupees.

What amount should the firm bid under this policy? (You may perform the calculations on duration etc. upto two decimal places). [10]

(b) A firm manufacturers and sells two products Alpha and Beta. Each unit of Alpha requires 1 hour of machining and 2 hours of skilled labour, whereas each unit of Rate uses 2 hours of machining and 1 hour of labour. For the coming month the machine capacity is limited to 720 machine hours and the skilled labour is limited to 780 hours. Not more than 320 units of Alpha can be sold in the market during a month. Unit contribution from Alpha is ₹ 6 and from Beta is ₹ 4.
Develop a suitable model that will enable determination of the optimal product mix to maximize the contribution. [6]

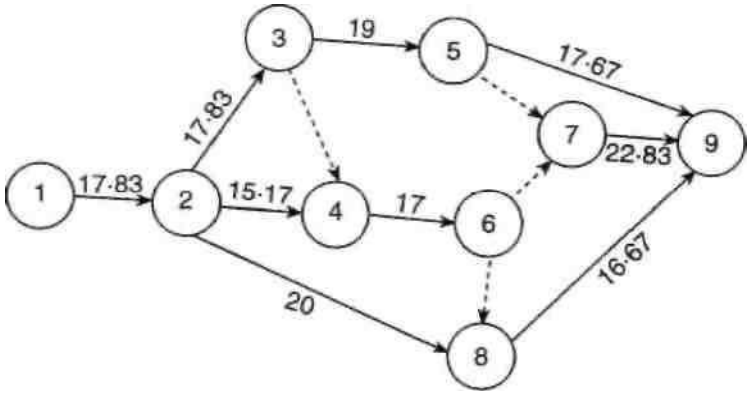
Answer:

(a)

The expected duration and variance of each activity is computed in the following table:

Activity	optimistic (t_0)	Time most likely (t_m)	Pessimistic (t_p)	Expected duration $t_e = \frac{1}{6}(t_o + 4t_m + t_p)$	Variance $\left[\frac{1}{6}(t_p - t_o)\right]^2$
1—2	14	17	25	17.83	3.36
2—3	14	18	21	17.83	1.36
2—4	13	15	18	15.17	
2—8	16	19	28	20.00	
3—4	—	—	—	—	

3—5	15	18	27	19.00	4
4—6	13	17	21	17.00	
5—7	—	—	—	—	
5—9	14	18	20	17.67	
6—7	—	—	—	—	
6—8	—	—	—	—	
7—9	16	20	41	22.83	17.36
8—9	14	16	22	16.67	



The various paths and their lengths are as follows:

	Path	duration
I.	1-2-3-5-7-9	77.49*
II.	1-2-3-5-9	72.33
III.	1-2-3-4-6-7-9	75.49
IV.	1-2-3-4-6-8-9	69.33
V.	1-2-8-9	54.50
VI.	1-2-4-6-8-9	66.67
VII.	1-2-4-6-7-9	72.83

Thus, the critical path is 1—2—3—5—7—9 with project duration of 77.49 days. Project variance is obtained by summing variances of critical activities, σ^2 = 3.36 + 1.36 + 4 + 17.36 = 26.08.

∴Standard duration of project length, $\sigma = \sqrt{26.08} = 5.11$

To calculate the project duration which will have 95% chances of its completion, we find the value of Z corresponding to 95% area from normal distribution area table which is 1.645. Thus

$$P(X \le T_S) = P\left(Z \le \frac{T_S - 77.49}{5.11}\right) = 0.95$$

$$\frac{T_S - 77.49}{5.11} = 1.645 \text{ or } T_S = 1.645 \times 5.12 + 77.49 = 86 \text{ days}$$

Since the fixed cost of the project is ₹8 lakhs and the variable cost is ₹9,000 per day, amount to bid = ₹8 lakhs + ₹9,000 × 86 = ₹15,74,000.

(b)

Products	Machining	Skilled Labour	Contribution
Alpha	1 hr	2 hr	6/-
Beta	2 hr	1 hr	4/-
Available hours	720 hr	780 hr	

Let x_1 be the no. of units of Alpha produced

x_2 be the no. of units of Beta produced.

Objective function:

Max. $Z = 6x_1 + 4x_2$.

Subject to constraints

$x_1 + 2x_2 \leq 720$

$2x_1 + x_2 \leq 780$

$x_1 \leq 320$ and

$x_1 , x_2 \geq 0$

$x_1 + 2x_2 + S_1 = 720$

$2 x_1 + x_2 + S_2 = 780$

$x_1 + S_3 = 320$

Max. $Z = 6x_1 + 4x_2 + 0.S_1 + 0.S_2 + 0.S_3$

8. Write short notes on any four out of the following five questions. [4 × 4 = 16]

(a) Six Sigma

(b) Kaizen Costing

(c) Value Analysis

(d) Business Process Re-engineering.

(e) Socio Economic Costing

Answer:

(a) Six Sigma has two key methodologies: DMAIC and DMADV, both inspired by W. Edwards Deming's Plan-Do-Check-Act Cycle: DMAIC is used to improve an existing business process, and DMADV is used to create new product or process designs for predictable, defect-free performance.

DMAIC

- Basic methodology consists of the following five (5) steps:
- Define the process improvement goals that are consistent with customer demands and enterprise strategy.
- Measure the current process and collect relevant data for future comparison.
- Analyze to verify relationship and causality of factors. Determine what the relationship is, and attempt to ensure that all factors have been considered.
- Improve or optimize the process based upon the analysis using techniques like Design of Experiments.
- Control to ensure that any variances are corrected before they result in defects. set up pilot runs to establish process capability, transition to production and thereafter continuously measure the process and institute control mechanisms.

DMIADV

Basic methodology consists of the following five steps:

- Defne the goals of the design activity that are consistent with customer demands and enterprise strategy.
- Measure and identify CTQs (critical to qualities), product capabilities, production process capability, and risk assessments.
- Analyze to develop and design alternatives, create high-level design and evaluate design capability to select the best design.
- Design details, optimize the design, and plan for design verifcation. This phase may

require simulations.

- Verify the design, set up pilot runs, implement production process and handover to process owners.

Some people have used dmaicr (Realize). Others contend that focusing on the fnancial gains realized through Six Sigma is counter-productive and that said fnancial gains are simply byproducts of a good process improvement.

(b) **ıntroduction:** The initial VE review may not be complete and perfect in all cost aspects. there may be further chances of waste reduction, cost and time reduction and product improvement. such continuous cost reduction technique is called as kaizen costing.

The review of product costs under the target costing methodology is not reserved just for the period up to the completion of design work on a new product. there are always opportunities to control costs after the design phase is completed, though these opportunities are fewer than during the design phase.

Meaning: kaizen costing refers to the ongoing continuous improvement program that focuses on the reduction of waste in the production process, thereby further lowering costs below the initial targets specified during the design phase. it is a Japanese term for a number of cost reduction steps that can be used subsequent to issuing a new product design to the factory floor.

Process of Kaizen Costing: activities in kaizen costing include elimination of waste in production, assembly, and distribution processes, as well as the elimination of unnecessary work steps in any of these areas. thus kaizen Costing is intended to repeat many of the value engineering steps, continuously and constantly refning the process, thereby eliminating out extra costs at each stage.

Kaizen Costing Vs Value Engineering: cost reductions resulting from kaizen costing are much smaller than those achieved with value engineering. But these are still signifcant since competitive pressures are likely to force down the price of a product over time, and any possible cost savings allow a Company to still attain its targeted proft margins.

Multiple Versions of Products - Continuous Kaizen Costing: multiple improved versions of products can be introduced to meet the challenge of gradually reducing costs and prices. the market price of products continues to drop over time, which forces a company to use both target and kaizen costing to reduce costs and retain its proft margin.

(c) Value analysis (VA) or Value engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. the goal of any Va study is to:

-improve value by sustaining or improving performance attributes
(of the project, product, and/or service being studied)
-while at the same time reducing overall cost
(including lifecycle operations and maintenance expenses).

Value Analysis can be defined as a process of systematic review that is applied to existing product designs in order to compare the function of the product required by a customer to meet their requirements at the lowest cost consistent with the specifed performance and reliability needed.

This is a rather complicated definition and it is worth reducing the definition to key points and elements:

(i) Value analysis (and Value engineering) is a **systematic, formal and organized process of analysis and evaluation**. it is not haphazard or informal and it is a management activity that requires planning, control and co-ordination.

(ii) the analysis concerns the **function of a product** to meet the demands or application needed by a customer. to meet this functional requirement the review process must include an understanding of the purpose to which the product is used.

(iii) Understanding the **use of a product** implies that specifications can be established to assess the level of ft between the product and the value derived by the customer or consumer.

(iv) To succeed, the **formal management process must meet these functional specifcation** and performance criteria consistently in order to give value to the customer.

(v) In order to yield a benefit to the company, the formal review process must result in a **process of design improvements** that serve to lower the production costs of that product whilst maintaining this level of value through function.

(d) Characteristics of Re-engineering Process

(i) Several jobs are combined into one

(ii) Often workers make decisions

(iii) The steps in the process are performed in a logical order

(iv) Work is performed, where it makes most sense

(v) Quality is built in.

(vi) Manager provides a single point of contact

(vii) Centralized and decentralized operations are combined.

(e) Socio Economics (also known as **social economics**) is the social science that studies how economic activity affects and is shaped by social processes. in general it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.

socioeconomics is sometimes used as an umbrella term with different usages. the term 'social economics' may refer broadly to the "use of economics in the study of society.

in many cases, socioeconomics focus on the social impact of some sort of economic change. such changes might include a closing factory, market manipulation, the signing of international trade treaties, new natural gas regulation, etc. such social effects can be wide-ranging in size, anywhere from local effects on a small community to changes to an entire society. examples of causes of socioeconomic impacts include new technologies such as cars or mobile phones, changes in laws, changes in the physical environment (such as increasing crowding within cities), and ecological changes (such as prolonged drought or declining fsh stocks). these may affect patterns of consumption, the distribution of incomes and wealth, the way in which people behave (both in terms of purchase decisions and the way in which they choose to spend their time), and the overall quality of life.

Companies are increasingly interested in measuring socio-economic impact as part of maintaining their license to operate, improving the business enabling environment, strengthening their value chains, and fuelling product and service innovation.