

ADVANCED CAPITAL BUDGETING DECISIONS

CLASS 12

Topic Replacement Project

Question 1:

An existing company has a machine which has been in operation for two years, its estimated remaining useful life is 4 years with no residual value in the end. Its current market value is ₹ 3 lakhs. The management is considering a proposal to purchase an improved model of a machine gives increase output. The details are as under:

Particulars	Existing Machine	New Machine
Purchase Price	₹ 6,00,000	₹ 10,00,000
Estimated Life	6 years	4 years
Residual Value	0	0
Annual Operating days	300	300
Operating hours per day	6	6
Selling price per unit	₹ 10	₹ 10
Material cost per unit	₹ 2	₹ 2
Output per hour in units	20	40
Labour cost per hour	₹ 20	₹ 30
Fixed overhead per annum excluding depreciation	₹ 1,00,000	₹ 60,000
Working Capital	₹ 1,00,000	₹ 2,00,000
Income-tax rate	30%	30%

Assuming that - cost of capital is 10% and the company uses written down value of depreciation @ 20% and it has several machines in 20% block.

Advice the management on the Replacement of Machine as per the NPV method. The discounting factors table given below:

Discounting Factors	Year 1	Year 2	Year 3	Year 4
10%	0.909	0.826	0.751	0.683

(Source: ICAI)

ANSWER:

(i) Calculation of Net Initial Cash Outflows:

Particulars	₹
Purchase Price of new machine	10,00,000
Add: Net Working Capital	1,00,000
Less: Sale proceeds of existing machine	3,00,000
Net initial cash outflows	8,00,000

(ii) Calculation of annual Profit Before Tax and depreciation

Particulars	Existing machine	New Machine	Differential
(1)	(2)	(3)	(4) = (3) – (2)
Annual output	36,000 units	72,000 units	36,000 units
	₹	₹	₹
(A) Sales revenue @ ₹ 10 per unit	3,60,000	7,20,000	3,60,000
(B) Cost of Operation			
Material @ ₹ 2 per unit	72,000	1,44,000	72,000
Labour			
Old = 1,800 × ₹ 20	36,000		
New = 1,800 × ₹ 30		54,000	18,000
Fixed overhead excluding depreciation	1,00,000	60,000	(40,000)
Total Cost (B)	2,08,000	2,58,000	50,000
Profit Before Tax and depreciation (PBT) (A – B)	1,52,000	4,62,000	3,10,000

(iii) Calculation of Net Present value on replacement of machine

Year	PBT	Depreciation @ 20% WDV	PBT	Tax @ 30%	PAT	Net cash flow	PVF @ 10%	PV
(1)	(2)	(3)	(4 = 2-3)	(5)	(6 = 4-5)	(7 = 6 + 3)	(8)	(9 = 7 x 8)
1	3,10,000	1,40,000	1,70,000	51,000	1,19,000	2,59,000	0.909	2,35,431.000
2	3,10,000	1,12,000	1,98,000	59,400	1,38,600	2,50,600	0.826	2,06,995.600
3	3,10,000	89,600	2,20,400	66,120	1,54,280	2,43,880	0.751	1,83,153.880
4	3,10,000	71,680	2,38,320	71,496	1,66,824	2,38,504	0.683	1,62,898.232
								7,88,478.712
Add: Release of net working capital at year end 4 (1,00,000 x 0.683)								68,300.000
Less: Initial Cash Outflow								8,00,000.000
NPV								56,778.712

Advice: Since the incremental NPV is positive, existing machine should be replaced.

Working Notes:

1. Calculation of Annual Output

Annual output = (Annual operating days x Operating hours per day) x output per hour

Existing machine = $(300 \times 6) \times 20 = 1,800 \times 20 = 36,000$ units

New machine = $(300 \times 6) \times 40 = 1,800 \times 40 = 72,000$ units

2. Base for incremental depreciation

Particulars	₹
WDV of Existing Machine	
Purchase price of existing machine	6,00,000
Less: Depreciation for year 1	1,20,000
Depreciation for Year 2	<u>96,000</u>
WDV of Existing Machine (i)	3,84,000
Depreciation base of New Machine	
Purchase price of new machine	10,00,000
Add: WDV of existing machine	3,84,000
Less: Sales value of existing machine	3,00,000
Depreciation base of New Machine (ii)	10,84,000
Base for incremental depreciation [(ii) – (i)]	7,00,000

(Note: The above solution have been done based on incremental approach)

Alternatively, solution can be done based on Total Approach as below:

i. Calculation of depreciation:

Existing Machine						
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Opening balance	6,00,000	4,80,000	3,84,000	3,07,200	2,45,760	1,96,608.00
Less: Depreciation @ 20%	1,20,000	96,000	76,800	61,440	49,152	39,321.60
WDV	4,80,000	3,84,000	3,07,200	2,45,760	1,96,608	1,57,286.40

New Machine				
	Year 1	Year 2	Year 3	Year 4
Opening balance	10,84,000*	8,67,200	6,93,760	5,55,008.00
Less: Depreciation @ 20%	2,16,800	1,73,440	1,38,752	1,11,001.60
WDV	8,67,200	6,93,760	5,55,008	4,44,006.40

* As the company has several machines in 20% block, the value of Existing Machine from the block calculated as below shall be added to the new machine of ₹ 10,00,000:

WDV of existing machine at the beginning of the year	₹ 3,84,000
Less: Sale Value of Machine	₹ 3,00,000
WDV of existing machine in the block	₹ 84,000

Therefore, opening balance for depreciation of block = ₹ 10,00,000 + ₹ 84,000 = ₹ 10,84,000

ii. Calculation of annual cash inflows from operation:

Particulars	EXISTING MACHINE			
	Year 3	Year 4	Year 5	Year 6
Annual output (300 operating days x 6 operating hours x 20 output per hour)	36,000 units	36,000 units	36,000 units	36,000 units
	₹	₹	₹	₹
(A) Sales revenue @ ₹ 10 per unit	3,60,000.00	3,60,000.00	3,60,000.00	3,60,000.00
(B) Less: Cost of Operation				
Material @ ₹ 2 per unit	72,000.00	72,000.00	72,000.00	72,000.00
Labour @ ₹ 20 per hour for (300 x 6) hours	36,000.00	36,000.00	36,000.00	36,000.00
Fixed overhead	1,00,000.00	1,00,000.00	1,00,000.00	1,00,000.00
Depreciation	76,800.00	61,440.00	49,152.00	39,321.60
Total Cost (B)	2,84,800.00	2,69,440.00	2,57,152.00	2,47,321.60
Profit Before Tax (A – B)	75,200.00	90,560.00	1,02,848.00	1,12,678.40
Less: Tax @ 30%	22,560.00	27,168.00	30,854.40	33,803.52
Profit After Tax	52,640.00	63,392.00	71,993.60	78,874.88
Add: Depreciation	76,800.00	61,440.00	49,152.00	39,321.60
Add: Release of Working Capital				1,00,000.00
Annual Cash Inflows	1,29,440.00	1,24,832.00	1,21,145.60	2,18,196.48

Particulars	NEW MACHINE			
	Year 1	Year 2	Year 3	Year 4
Annual output (300 operating days x 6 operating hours x 40 output per hour)	72,000 units	72,000 units	72,000 units	72,000 units
	₹	₹	₹	₹
(A) Sales revenue @ ₹ 10 per unit	7,20,000.00	7,20,000.00	7,20,000.00	7,20,000.00
(B) Less: Cost of Operation				
Material @ ₹ 2 per unit	1,44,000.00	1,44,000.00	1,44,000.00	1,44,000.00
Labour @ ₹ 30 per hour for (300 x 6) hours	54,000.00	54,000.00	54,000.00	54,000.00
Fixed overhead	60,000.00	60,000.00	60,000.00	60,000.00
Depreciation	2,16,800.00	1,73,440.00	1,38,752.00	1,11,001.60
Total Cost (B)	4,74,800.00	4,31,440.00	3,96,752.00	3,69,001.60
Profit Before Tax (A – B)	2,45,200.00	2,88,560.00	3,23,248.00	3,50,998.40
Less: Tax @ 30%	73,560.00	86,568.00	96,974.40	1,05,299.52
Profit After Tax	1,71,640.00	2,01,992.00	2,26,273.60	2,45,698.88
Add: Depreciation	2,16,800.00	1,73,440.00	1,38,752.00	1,11,001.60
Add: Release of Working Capital				2,00,000.00
Annual Cash Inflows	3,88,440.00	3,75,432.00	3,65,025.60	5,56,700.48

iii. Calculation of Incremental Annual Cash Flow:

Particulars	Year 1 (₹)	Year 2 (₹)	Year 3 (₹)	Year 4 (₹)
Existing Machine (A)	1,29,440.00	1,24,832.00	1,21,145.60	2,18,196.48
New Machine (B)	3,88,440.00	3,75,432.00	3,65,025.60	5,56,700.48
Incremental Annual Cash Flow (B – A)	2,59,000.00	2,50,600.00	2,43,880.00	3,38,504.00

iv. Calculation of Net Present Value on replacement of machine:

Year	Incremental Annual Cash Flow (₹) (A)	Discounting factor @ 10% (B)	Present Value of Incremental Annual Cash Flow (₹) (A x B)
1	2,59,000.00	0.909	2,35,431.000
2	2,50,600.00	0.826	2,06,995.600
3	2,43,880.00	0.751	1,83,153.880
4	3,38,504.00	0.683	2,31,198.232
Total Incremental Inflows			8,56,778.712
Less: Net Initial Cash Outflows (Working note)			8,00,000.000
Incremental NPV			56,778.712

Advice: Since the incremental NPV is positive, existing machine should be replaced.

Working Note:

Calculation of Net Initial Cash Outflows:

Particulars	₹
Cost of new machine	10,00,000
Less: Sale proceeds of existing machine	3,00,000
Add: incremental working capital required (₹ 2,00,000 – ₹ 1,00,000)	1,00,000
Net initial cash outflows	8,00,000

Question 2:

ABC Company Ltd. has been producing a chemical product by using machine Z for the last two years. Now the management of the company is thinking to replace this machine either by X or by Y machine. The following details are furnished to you:

	Z	X	Y
Books value (Rs.)	1,00,000	—	—
Resale value now (Rs.)	1,10,000	—	—
Purchase price (Rs.)	—	1,80,000	2,00,000
Annual fixed costs (including depreciation) (Rs.)	92,000	1,08,000	1,32,000
Variable running costs (including labour) per unit (Rs.)	3	1.50	2.50
Production per hour (unit)	8	8	12

You are also provided with the following details:

Selling price per unit	(Rs.) 20
Cost of materials per unit	(Rs.) 10
Annual operating hours	2,000
Working life of each of the three machines (as from now)	5 years
Salvage value of machines Z Rs. 10,000, X Rs. 15,000, Y Rs. 18,000	

The company charges depreciation using straight line method. It is anticipated that an additional cost of Rs. 8,000 per annum would be incurred on special advertising to sell the extra output of machine Y. Assume tax rate of 50% and cost of capital 10%. The present value of Re. 1 to be received at the end of the year at 10% is as under:

Year	1	2	3	4	5
Present value	.909	.826	.751	.683	0.621

Required: You are required to analyze the feasibility of the proposal and make recommendations.

Ignore capital gain tax

ANSWER:

ABC Company Ltd.

Computation of yearly cash inflow

Machine		Z		X		Y
Sales (units)		16,000		16,000		24,000
Selling price per unit (Rs.)		20		20		20
Sales : (A)		3,20,000		3,20,000		4,80,000
Less: Costs						
Variable running costs	48,000		24,000		60,000	
Material cost	1,60,000		1,60,000		2,40,000	
Annual fixed cost	92,000	3,00,000	1,08,000	2,92,000	1,32,000	4,32,000
Additional cost (Special advertising)		—		—		8,000
Total costs: (B)		3,00,000	—	2,92,000		4,40,000
Profit before tax: (A) – (B)		20,000		28,000		40,000
Less: Tax @ 50%		10,000		14,000		20,000
Profit after tax		10,000		14,000		20,000
Add: Depreciation		20,000		33,000		36,400
Cash inflow		30,000		47,000		56,400

Computation of cash inflow in 5th year

Machine	Z	X	Y
Cash in flow	30,000	47,000	56,400
Add: Salvage value of machines	10,000	15,000	18,000
Cash inflow	40,000	62,000	74,000

Computation of Net Present Value

Year	Machine	Z		X		Y	
	Discounting factor	Cash inflow	P.V. of cash inflow	Cash inflow	P.V. of cash inflow	Cash inflow	P.V. of cash inflow
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	0.909	30,000	27,270	47,000	42,723	56,400	51,267.60
2	0.826	30,000	24,780	47,000	38,822	56,400	46,586.40
3	0.751	30,000	22,530	47,000	35,297	56,400	42,356.40
4	0.683	30,000	20,490	47,000	32,101	56,400	38,521.20
5	0.621	40,000	24,840	62,000	38,502	74,400	46,202.40
			1,19,910		1,87,445		2,24,934.00
Less: Purchase price			1,10,000		1,80,000		2,00,000.00
Net present value			9,910		7,445		24,934.00

Recommendation:

The net present value is higher in the case of Machine Y. Therefore, it is advisable that the company should replace machine Z with machine Y.

However, as the cost of investment is not the same for all machines, it would be better to base the decision on profitability index which is as under:

$$P.I. = \frac{\text{P.V. of cash inflow}}{\text{P.V. of cash outflow}}$$

$$\text{Machine Z} = \frac{1,19,910}{1,10,000} = 1.09$$

$$\text{Machine X} = \frac{1,87,445}{1,80,000} = 1.041$$

$$\text{Machine Y} = \frac{2,24,934}{2,00,000} = 1.12$$

Since the profitability index of machine Y is the highest therefore machine Z should be replaced by machine Y.

Question 3:

Prithvi Ltd. is a manufacturer of variety of electrical equipments. The existing machine is based on old technology. In order to improve the quality of the product and bring down operating cost, the management is planning to replace the existing machine with a new one based on latest technology. Following are the relevant information:

Existing machine:

Purchased	-- 5 years ago
Remaining life	-- 5 years
Depreciation	-- straight line basis
Current book value	-- Rs 3,00,000
Realizable market value	-- Rs 3,50,000
Annual depreciation	-- Rs. 28,000

New replacement machine:

Capital cost	-- Rs.10,00,000
Estimated useful life	-- 5 years
Estimated salvage value	-- Rs. 1,00,000

The replacement would permit an output expansion. As a result, sales is expected to increase by Rs. 2,50,000 per year. PV ratio is 40%. There would be reduction in operating expenses by 2,00,000. It would require an additional inventory of Rs. 2,00,000 and would cause an increase in accounts payable by Rs. 50,000.

Assuming a corporate tax rate of 30 % and cost of capital of 12%, advise the company about replacement of the existing machine.

ANSWER:

Initial Cash Outlay

		Rupees
Cost of new machine		10,00,000
Less : sold of old machine	3,50,000	
Less: Tax on profit on sale of machine 30% of Rs.50,000	15,000	3,35,000
Add: Increase in working capital(2,00,000-50,000)		1,50,000
Initial cash outlay		8,15,000
Additional Depreciation		
New Machine (10,00,000 – 1,00,000) 5 years	1,80,000	
Old machine annual depreciation	28,000	
Increase in depreciation		1,52,000
Annual cash inflow		
Increase in contribution(40% of 2,50,000)		1,00,000
Reduction in operating expenses		2,00,000
		3,00,000
Less increase in depreciation		1,52,000
Increase in profit before tax		1,48,000
Less tax @ 30%		44,400
Net savings after tax		1,03,600
Add: Depreciation		1,52,000
Net cash inflow p.a.		2,55,600
Terminal inflow		
Salvage	1,00,000	
Release of working capital	1,50,000	2,50,000

NET PRESENT VALUE

Year	Net cash inflow(Rs.)	PVIF	PV
0	-815000	1.000	-815000
1-5	255600	3.6048	921387
5	250000	0.5674	141850

NPV

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Since NPV of the proposal is positive, it is advisable to replace the old machine with the new machine.

Note : interest cost on additional investment, etc. has been ignored because it is a financial cost.

Question 4:

A company has an old machine having book value zero – which can be sold for ₹ 50,000. The company is thinking to choose one from following two alternatives:

- i. To incur additional cost of ₹ 10,00,000 to upgrade the old existing machine.
- ii. To replace old machine with a new machine costing ₹ 20,00,000 plus installation cost ₹ 50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil.

The expected after tax profits for the above three alternatives are as under :

Year	Old existing Machine (₹)	Upgraded Machine (₹)	New Machine (₹)
1	5,00,000	5,50,000	6,00,000
2	5,40,000	5,90,000	6,40,000
3	5,80,000	6,10,000	6,90,000
4	6,20,000	6,50,000	7,40,000
5	6,60,000	7,00,000	8,00,000

The tax rate is 40 per cent.

The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent.

P.V.F. of 15%, 5 = 0.870, 0.756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

ANSWER:

(A)	Cash Outflow	₹
(i)	In case machine is upgraded:	
	Upgradation Cost	10,00,000
(ii)	In case new machine installed:	
	Cost	20,00,000
	Add: Installation cost	50,000
	Total Cost	20,50,000
	Less: Disposal of old machine	
	₹ 50,000 – 40% tax	30,000
	Total Cash Outflow	20,20,000

Working Note:

- Depreciation – in case machine is upgraded
 $\text{₹ } 10,00,000 \div 5 = \text{₹ } 2,00,000$
- Depreciation – in case new machine is installed
 $\text{₹ } 20,50,000 \div 5 = \text{₹ } 4,10,000$
- Old existing machine – Book Value is zero. So, no depreciation.

(B) Cash Inflows after Taxes (CFAT)

Year	Old Existing Machine	Upgraded Machine			
	(i) EAT/CFAT ₹	(ii) EAT ₹	(iii) DEP ₹	(iv) CFAT ₹	= (iv)-(i) Incremental CFAT ₹
1	5,00,000	5,50,000	2,00,000	7,50,000	2,50,000
2	5,40,000	5,90,000	2,00,000	7,90,000	2,50,000
3	5,80,000	6,10,000	2,00,000	8,10,000	2,30,000
4	6,20,000	6,50,000	2,00,000	8,50,000	2,30,000
5	6,60,000	7,00,000	2,00,000	9,00,000	2,40,000

Cash Inflow after Taxes (CFAT)

Year	New Machine			
	(vi) EAT ₹	(vii) DEP ₹	(viii) CFAT ₹	(ix) = (viii) – (i) Incremental CFAT (₹)
1	6,00,000	4,10,000	10,10,000	5,10,000

2	6,40,000	4,10,000	10,50,000	5,10,000
3	6,90,000	4,10,000	11,00,000	5,20,000
4	7,40,000	4,10,000	11,50,000	5,30,000
5	8,00,000	4,10,000	12,10,000	5,50,000

P.V. AT 15% - 5 Years – on Incremental CFAT

Year	Upgraded Machine			New Machine		
	Incremental CFAT ₹	PVF	Total P.V. ₹	Incremental CFAT	PVF	Total PV ₹
1	2,50,000	0.870	2,17,500	5,10,000	0.870	4,43,700
2	2,50,000	0.756	1,89,000	5,10,000	0.756	3,85,560
3	2,30,000	0.658	1,51,340	5,20,000	0.658	3,42,160
4	2,30,000	0.572	1,31,560	5,30,000	0.572	3,03,160
5.	2,40,000	0.497	1,19,280	5,50,000	0.497	2,73,350
Total P.V. of CFAT			8,08,680			17,47,930
Less: Cash Outflows			10,00,000			20,20,000*
N.P.V. =			-1,91,320			- 2,72,070

*Acquisition Cost (including installation cost)	₹ 20,50,000
Less: Salvage Value of existing machine net of Tax	₹ 30,000
	₹ 20,20,000

As the NPV in both the new (alternative) proposals is negative, the company should continue with the existing old Machine.

Question 5:

X & Co is contemplating whether to replace an existing machine or to spend money on overhauling it. X & Co currently pays no taxes. The replacement machine costs Rs.95,000 now and requires maintenance of Rs.10,000 at the end of every year for eight years. At the end of eight years it would have a salvage value of Rs.25,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows —

Year	Maintenance (Rs.)	Salvage (Rs.)
Present	0	40,000
1	10,000	25,000
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital for X & Co., is 15%. You are required to state, when should the firm replace the machine.

ANSWER:

1. Computation of Equivalent Annual Cost of New Machine / Replace Now Option

Particulars	Cash Flow	Year	Disc. Factor	Disc. Cash Flow
Cost of New Machine	95,000	0	1.000	95,000
Annual Repairs Cost	10,000	1 – 8	4.4873	44,873
Total Cash Outgo towards Cost				1,34,870
Less: Salvage Value	25,000	8	0.3269	(8,173)
Present Cost of Owning and Operating New Machine				1,31,700
Annuity Factor at 15% for first 8 Years				4.4873
Equated Annual Cost [Present Cost ÷ Annuity Factor]				Rs.29,349

2. Computation of Equivalent Annual Cost of Existing Machine

Particulars	Year	Cash Flow	Disc. Factor @ 15%	Disc. Cash Flow	Present Value of Cash Flows			
					Replace 1 Yr Later	Replace 2 Yrs Later	Replace 3 Yrs Later	Replace 4 Yrs Later
Opportunity Cost of Salvage Value	0	40,000	1.000	40,000	40,000	40,000	40,000	40,000
Maintenance	1	10,000	0.870	8,700	8,700	8,700	8,700	8,700
Maintenance	2	20,000	0.756	15,120	—	15,120	15,120	15,120
Maintenance	3	30,000	0.658	19,740	—	—	19,740	19,740
Maintenance	4	40,000	0.572	22,880	—	—	—	22,880
Present Value of Opportunity Cost and Cash Outflows					48,700	63,820	86,560	1,06,440
Less: Proceeds of sale in Year	1	25,000	0.870	21,750	(21,750)	—	—	—
	2	15,000	0.756	11,340	—	(11,340)	—	—
	3	10,000	0.658	6,580	—	—	(6,580)	—
	4	—	0.572	—	—	—	—	—
Net Present Cost					26,950	52,480	79,980	1,06,440
Annuity Factor for Salvage Period					0.870 [1 Yr]	1.626 [2 Yrs]	2.283 [3 Yrs]	2.855 [4 Yrs]
Equated Annual Cost					30,977	32,276	35,033	37,282

Recommendation:

- The Equated Annual Cost under Replace Now Option (Rs. 29,349) is less than the Equated Annual Cost of Replacing the Existing machine at different points in time viz., After 1 year, 2 years, 3 years and 4 years respectively.
- Therefore, the Company should replace the machinery immediately.