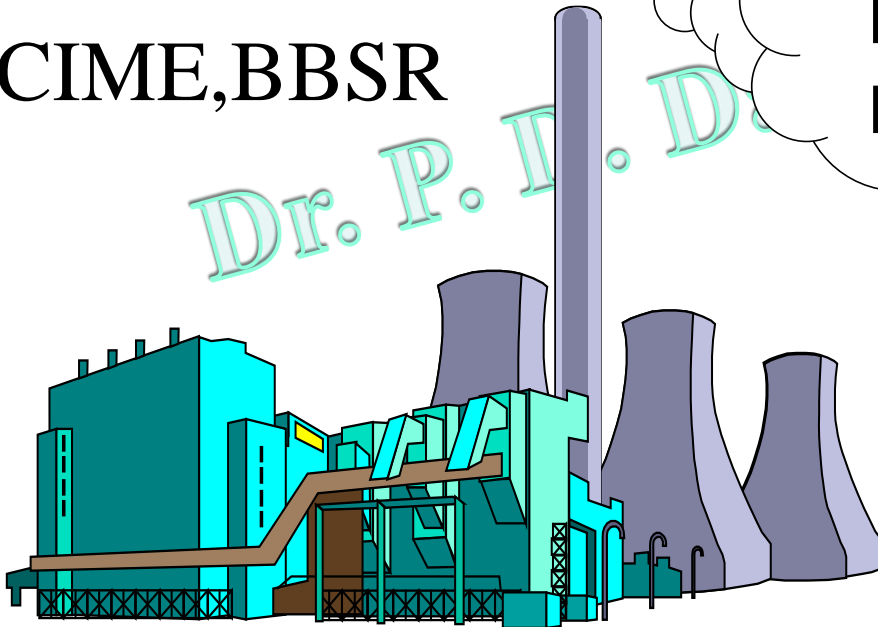


Capital Budgeting

By
Dr.P.D.Das
CIME,BBSR

Should we
build this
plant?



Capital Expenditure Features

- They have long term consequences
- they involve substantial outlays
- they may be difficult or expensive to reverse

Capital Budgeting

The planning and control of capital expenditure is termed as capital budgeting. It is the art of finding assets that are worth more than they cost to achieve a predetermined goal i.e optimizing wealth of business enterprise. In other words

- Analysis of potential additions to fixed assets.
- Long-term decisions; involve large expenditures.
- Very important to firm's future.

Nature of Investment Decisions

- The **investment decisions** of a firm are generally known as the **capital budgeting, or capital expenditure decisions**.
- The firm's investment decisions would generally include **expansion, acquisition, modernisation and replacement** of the long-term assets. Sale of a division or business (**divestment**) is also as an investment decision.
- Decisions like the change in the **methods of sales distribution**, or an **advertisement campaign** or a **research and development programme** have long-term implications for the firm's expenditures and benefits, and therefore, they should also be evaluated as investment decisions.

Importance of Investment Decisions

- They influence the firms growth in the long run.
- They affect the risk of the firm.
- They involve commitment of large amount of funds.
- They are irreversible or reversible at substantial loss.
- They are among the most difficult decisions to make.

Capital Budgeting Process

Available Investment opportunities

Organisational
Goals

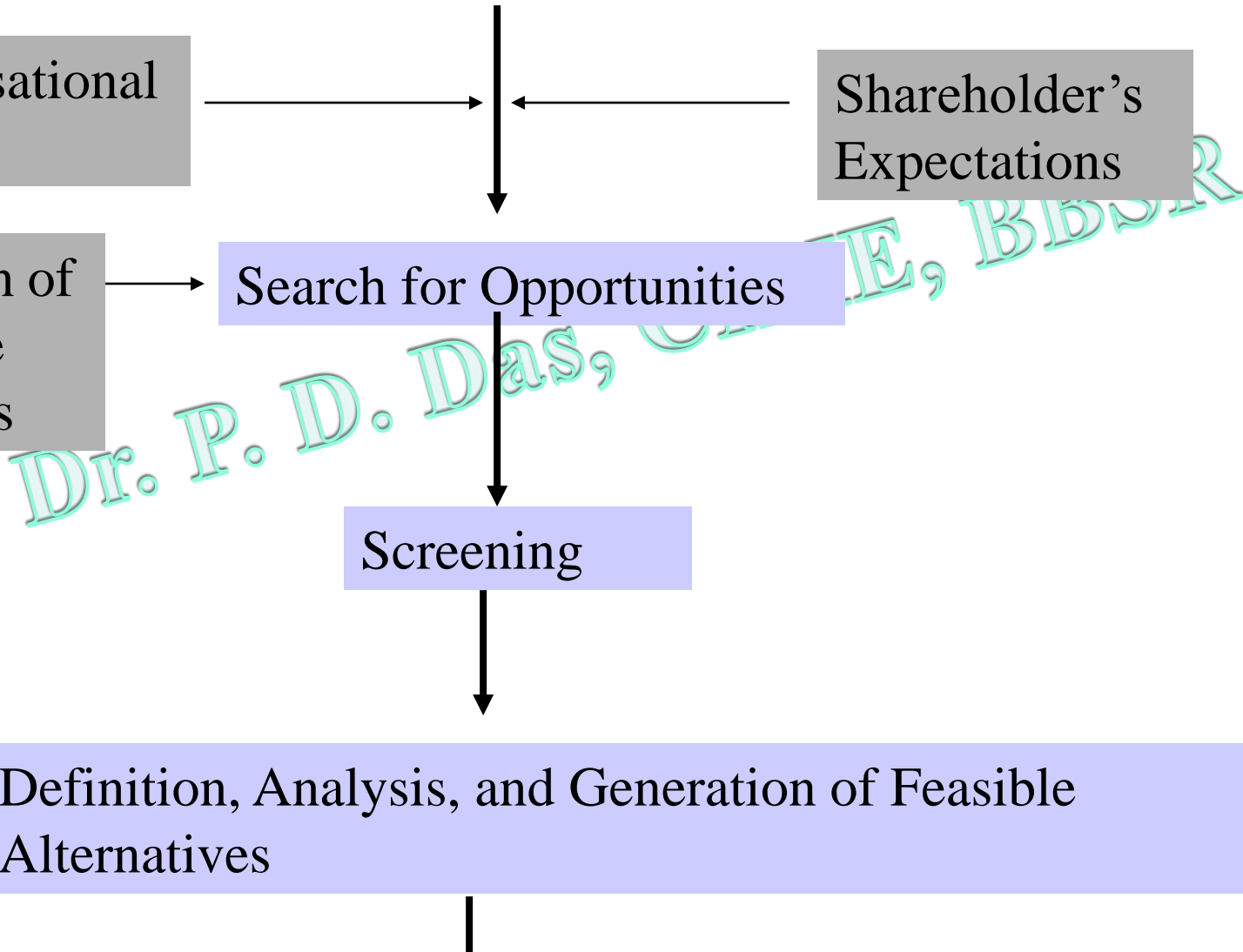
Shareholder's
Expectations

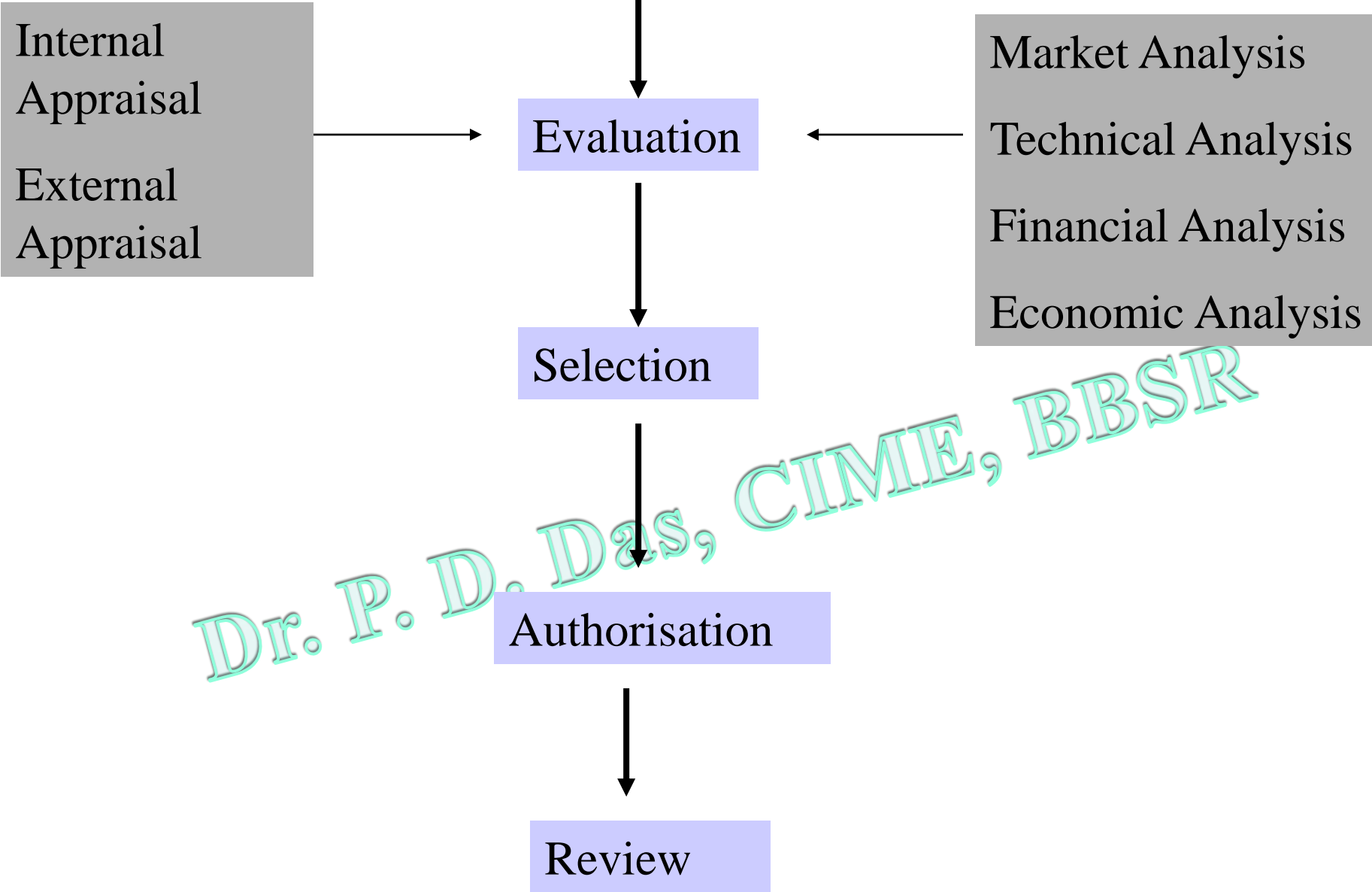
Rejection of
Unviable
proposals

Search for Opportunities

Screening

Definition, Analysis, and Generation of Feasible
Alternatives





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Steps

1. Estimate CFs (inflows & outflows).
2. Assess riskiness of CFs.
3. Determine $k = \text{WACC}$ for project.
4. Find NPV and/or IRR.
5. Accept if $\text{NPV} > 0$ and/or $\text{IRR} > \text{WACC}$.

Classification of Projects

- National and International Projects
- Industrial and Non-Industrial Projects
- Project based on level of technology
- Project based on size
- Project based on ownership
- Project according to purpose

Project based on level of technology

- High Technology Project
- Conventional Technology project
- Low technology project

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Project based on size

- Large project
- Medium Project
- Small project

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Project based on ownership

- Public Sector Project
- Private Sector Project
- Joint Sector Project

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Project according to purpose

- Modernisation Project
- Replacement/Renewal project
- Expansion Project
- Diversification project
- Rehabilitation (of sick units) projects
- Upgradation projects
- Merger and acquisitions
- New project (Innovation or invention)

Types of Investment Decisions

- One classification is as follows:
 - Expansion of existing business
 - Expansion of new business
 - Replacement and modernisation
- Yet another useful way to classify investments is as follows:
 - Mutually exclusive investments
 - Independent investments
 - Contingent investments

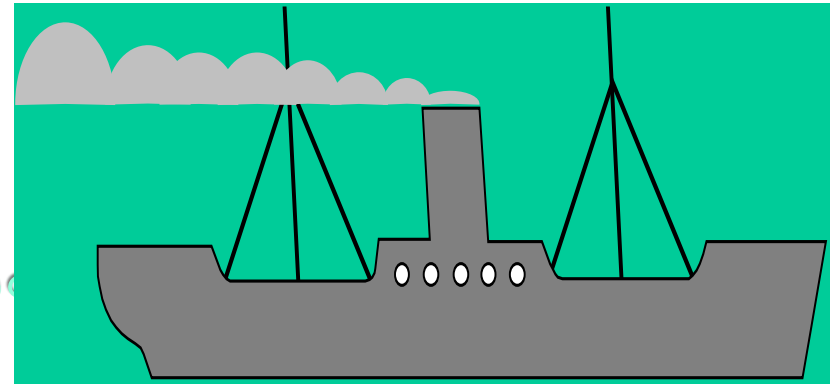
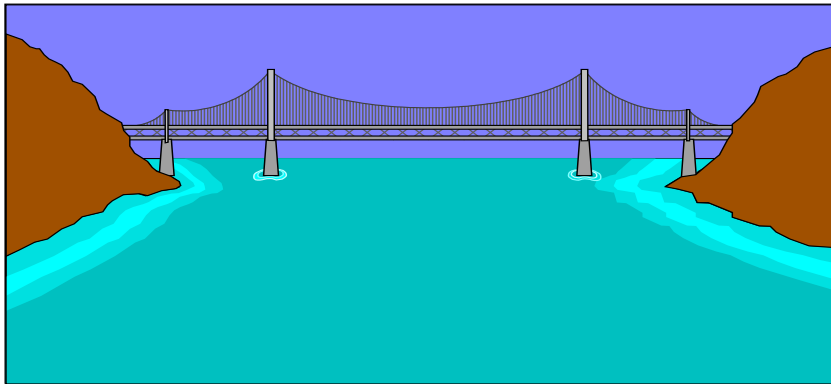
What is the difference between independent and mutually exclusive projects?

Projects are:

independent, if the cash flows of one are unaffected by the acceptance of the other.

mutually exclusive, if the cash flows of one can be adversely impacted by the acceptance of the other.

An Example of Mutually Exclusive Projects



BRIDGE vs. **BOAT** to get
products across a river.

Evaluation Criteria

- 1. *Non-discounted Cash Flow Criteria*
 - Payback Period (PB)
 - Discounted payback period (DPB)
 - Accounting Rate of Return (ARR)
- 2. *Discounted Cash Flow (DCF) Criteria*
 - Net Present Value (NPV)
 - Internal Rate of Return (IRR)
 - Profitability Index (PI)

Payback Period

Number of years required to recover the cost of investment.

$$\text{Payback} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}} = \frac{C_0}{C}$$

Example

- Assume that a project requires an outlay of Rs 50,000 and yields annual cash inflow of Rs 12,500 for 7 years. The payback period for the project is:

$$PB = \frac{\text{Rs } 50,000}{\text{Rs } 12,500} = 4 \text{ years}$$

PAYBACK

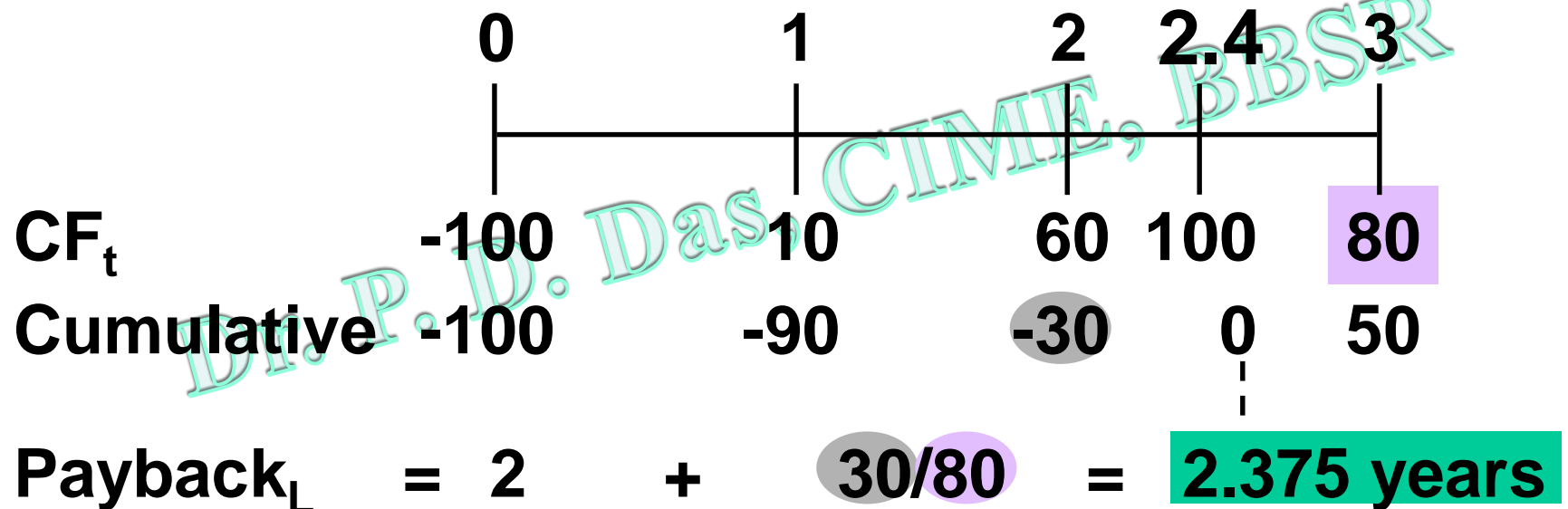
- **Unequal cash flows** In case of unequal cash inflows, the payback period can be found out by adding up the cash inflows until the total is equal to the initial cash outlay.
- Suppose that a project requires a cash outlay of Rs 20,000, and generates cash inflows of Rs 8,000; Rs 7,000; Rs 4,000; and Rs 3,000 during the next 4 years. What is the project's payback?

$3 \text{ years} + 12 \times (1,000/3,000) \text{ months}$

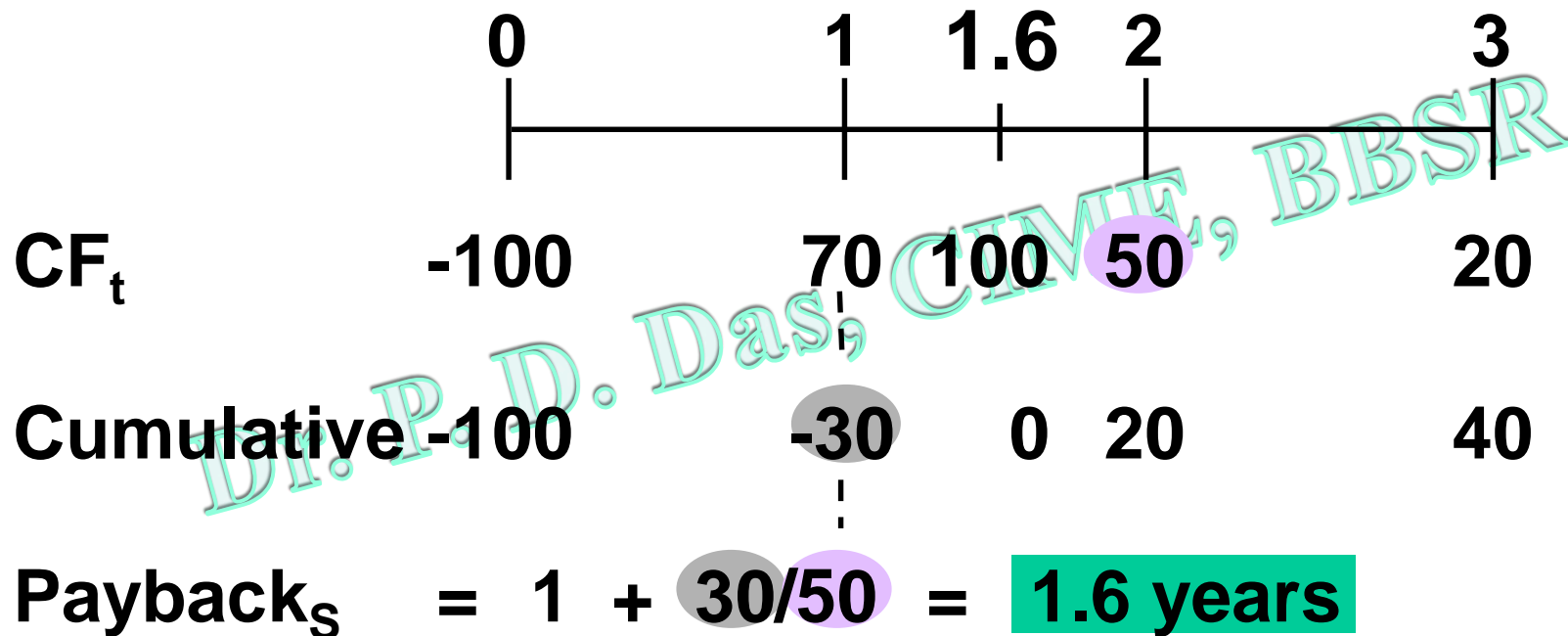
$3 \text{ years} + 4 \text{ months}$

Payback for Project L

(Long: Most CFs in out years)



Project S (Short: CFs come quickly)



Illustration

Initial Investment year	Project X (Rs 1,00,000)		Project X (Rs 1,00,000)	
	Cash Inflows	Total cash Inflows	Cash Inflows	Total cash Inflows
1	20,000		25,000	
2	20,000		25,000	
3	30,000		50,000	
4	30,000		20,000	
5	50,000		10,000	

Select which is a better project.

Illustration

The project involves a total initial expenditure of Rs 2,00,000 and it is estimated to generate future cash inflow of Rs 30,000, Rs 38,000, Rs 22,000, Rs 36,000, Rs 40,000, Rs 40,000, Rs 28,000, Rs 24,000 and Rs 24,000 in its last year. Calculate the payback period.

Merits of payback period

- It is simple to apply and easy to understand
- In case of capital rationing, a company is compelled to invest in projects having the shortest payback period.
- This method is suitable for projects whose future is uncertain. The shorter the payback period, the less risky is the project.

Contd...

Contd...

Merits of payback period

- This method gives an indication to the prospective investors specifying when their funds are likely to be repaid.
- It does not involve assumption of future interest rates.
- Ranking of projects according to their ability to repay quickly may be useful for firms experiencing liquidity constraints.

Demerits of payback period

- It ignores cash generation beyond the payback period.
- It ignores time value of money.
- It is a measure of projects capital recovery and not profitability.
- Though it measures projects liquidity, it does not indicate the liquidity position of the firm as a whole.

DISCOUNTED PAYBACK PERIOD

- The **discounted payback period** is the number of periods taken in recovering the investment outlay on the present value basis.
- The discounted payback period still fails to consider the cash flows occurring after the payback period.

Discounted Payback Illustrated

	Cash Flows (Rs)					Simple PB	Discounted PB	NPV at 10%
	C_0	C_1	C_2	C_3	C_4			
P	-4,000	3,000	1,000	1,000	1,000	2 yrs	—	—
PV of cash flows	-4,000	2,727	826	751	683	—	2.6 yrs	987
Q	-4,000	0	4,000	1,000	2,000	2 yrs	—	—
PV of cash flows	-4,000	0	3,304	751	1,366	—	2.9 yrs	1,421

Discounted Payback Period

It takes into account the timing of the cash flows. Uses discounted rather than raw CFs.

	0	1	2	3
		10%		
CF_t	-100	10	60	80
$PVCF_t$	-100	9.09	49.59	60.11
Cumulative	-100	-90.91	-41.32	18.79
Discounted payback	$= 2 + \frac{41.32}{60.11} = 2.7 \text{ yrs}$			

Recover invest. + cap. costs in 2.7 yrs.

Illustration

Geeta Limited is implementing a project with an initial capital outlay of Rs 7,600. Its cash inflows are as follows:

Year	Rs
1	6000
2	2000
3	1000
4	5000

The expected rate of return on the capital invested is 12 percent per annum. Calculate the discounted payback.

Accounting Rate of Return

$$\text{Accounting Rate of return} = \frac{\text{Average Annual PAT}}{\text{Average or Initial Investment}}$$

$$\text{Average Investment} = \frac{\text{Initial Investment} + \text{Salvage value}}{2}$$

Example

- A project will cost Rs 40,000. Its stream of earnings before depreciation, interest and taxes (EBDIT) during first year through five years is expected to be Rs 10,000, Rs 12,000, Rs 14,000, Rs 16,000 and Rs 20,000. Assume a 50 per cent tax rate and depreciation on straight-line basis.

$$\text{Accounting Rate of Return} = \frac{3,200}{20,000} \times 100 = 16 \text{ per cent}$$

Calculation of Accounting Rate of Return

(Rs)

Period	1	2	3	4	5	Average
Earnings before depreciation, interest and taxes (EBDIT)	10,000	12,000	14,000	16,000	20,000	14,400
Depreciation	8,000	8,000	8,000	8,000	8,000	8,000
Earnings before interest and taxes (EBIT)	2,000	4,000	6,000	8,000	12,000	6,400
Taxes at 50%	1,000	2,000	3,000	4,000	6,000	3,200
Earnings before interest and after taxes [EBIT (1– T)]	1,000	2,000	3,000	4,000	6,000	3,200
Book value of investment:						
Beginning	40,000	32,000	24,000	16,000	8,000	
Ending	32,000	24,000	16,000	8,000	—	
Average	36,000	28,000	20,000	12,000	4,000	20,000

Illustration

A machine is available for purchase at a cost of Rs 80,000 we expect to have a life of five years and to have a scrap value of Rs 10,000 at the end of the five year period. We have estimated that it will generate additional profits over its life. The profits generated in the 5 years are 20,000, 40,000, 30,000, 15,000, 5,000.

Calculate ARR

Merits of ARR

- It is easy to understand and calculate.
- It is not concerned with cash flows but profits.
- It takes into account all the years involved in the life of the project.
- It makes use of rapidly available accounting information.

Demerits of ARR

- It ignores time value of money.
- It is based on accounting profit and not cash flows.
- It is biased against short term projects.
- This method fails to distinguish the size of investment required for individual projects.

Net Present Value Method

- Cash flows of the investment project should be forecasted based on realistic assumptions.
- Appropriate discount rate should be identified to discount the forecasted cash flows.
- Present value of cash flows should be calculated using the opportunity cost of capital as the discount rate.
- Net present value should be found out by subtracting present value of cash outflows from present value of cash inflows. The project should be accepted if NPV is positive (i.e., $NPV > 0$).

Formula of NPV Method

- The formula for the net present value can be written as follows:

$$\text{NPV} = \left[\frac{C_1}{(1+k)} + \frac{C_2}{(1+k)^2} + \frac{C_3}{(1+k)^3} + \dots + \frac{C_n}{(1+k)^n} \right] - C_0$$
$$\text{NPV} = \sum_{t=1}^n \frac{C_t}{(1+k)^t} - C_0$$

Where

NPV= Net present value

C_0 =Initial investment

C_t =Cash flow at the end of the year t

n= life of the project

r= discount rate

Calculating Net Present Value

- Assume that Project X costs Rs 2,500 now and is expected to generate year-end cash inflows of Rs 900, Rs 800, Rs 700, Rs 600 and Rs 500 in years 1 through 5. The opportunity cost of the capital may be assumed to be 10 per cent.

$$\begin{aligned} \text{NPV} &= \frac{\text{Rs } 900}{(1+0.10)^1} + \frac{\text{Rs } 800}{(1+0.10)^2} + \frac{\text{Rs } 700}{(1+0.10)^3} + \frac{\text{Rs } 600}{(1+0.10)^4} \\ &\quad + \frac{\text{Rs } 500}{(1+0.10)^5} - \text{Rs } 2,500 \\ &= [\text{Rs } 900(\text{PVF}_{1, 0.10}) + \text{Rs } 800(\text{PVF}_{2, 0.10}) + \text{Rs } 700(\text{PVF}_{3, 0.10}) \\ &\quad + \text{Rs } 600(\text{PVF}_{4, 0.10}) + \text{Rs } 500(\text{PVF}_{5, 0.10})] - \text{Rs } 2,500 \\ &= [\text{Rs } 900 \times 0.909 + \text{Rs } 800 \times 0.826 + \text{Rs } 700 \times 0.751 \\ &\quad + \text{Rs } 600 \times 0.683 + \text{Rs } 500 \times 0.620] - \text{Rs } 2,500 \\ &= \text{Rs } 2,725 - \text{Rs } 2,500 = +\text{Rs } 225 \end{aligned}$$

Why is NPV Important?

- Positive net present value of an investment represents the maximum amount a firm would be ready to pay for purchasing the opportunity of making investment, or the amount at which the firm would be willing to sell the right to invest without being financially worse-off.
- The net present value can also be interpreted to represent the amount the firm could raise at the required rate of return, in addition to the initial cash outlay, to distribute immediately to its shareholders and by the end of the projects' life, to have paid off all the capital raised and return on it.

Acceptance rule

$NPV > 0$

Accept

$NPV < 0$

Reject

$NPV = 0$

May Accept

The NPV method can be used to select between mutually exclusive projects; the one with the higher NPV should be selected.

Illustration

A firm can invest Rs 10,000 in a project with a life of three years. The projected cash flow are as follows:

Year	Rs
1	4,000
2	5,000
3	4,000

Calculate the NPV and decide whether the project is acceptable or not.

Merits of NPV

- Considers all cash flows
- it considers time value of money
- it is applicable for mutually exclusive projects
- it satisfies value additivity principle
- it is consistent with the wealth maximisation principle.

Demerits of NPV

- It is difficult to calculate and understand
- the NPV rule does not consider the life of the project. Hence, with mutually exclusive projects with different lives are being considered, NPV rule is biased for longer period.
- Sensitive to discount rates.

Internal Rate of Return

Internal Rate of return is a percentage discount rate which brings the cost of a project and its future cash flows to equality. It is also defined as the rate at which NPV is equal to zero.

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- The internal rate of return (IRR) is the rate that equates the investment outlay with the present value of cash inflow received after one period. This also implies that the rate of return is the discount rate which makes $NPV = 0$.

$$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \dots + \frac{C_n}{(1+r)^n}$$

$$C_0 = \sum_{t=1}^n \frac{C_t}{(1+r)^t}$$

$$\sum_{t=1}^n \frac{C_t}{(1+r)^t} - C_0 = 0$$

CALCULATION OF IRR

- **Uneven Cash Flows:** Calculating IRR by Trial and Error
 - The approach is to select any discount rate to compute the present value of cash inflows. If the calculated present value of the expected cash inflow is lower than the present value of cash outflows, a lower rate should be tried. On the other hand, a higher value should be tried if the present value of inflows is higher than the present value of outflows. This process will be repeated unless the net present value becomes zero.

- **Level Cash Flows**

- Let us assume that an investment would cost Rs 20,000 and provide annual cash inflow of Rs 5,430 for 6 years
- The IRR of the investment can be found out as follows

$$\text{NPV} = -\text{Rs } 20,000 + \text{Rs } 5,430(\text{PVAF}_{6,r}) = 0$$

$$\text{Rs } 20,000 = \text{Rs } 5,430(\text{PVAF}_{6,r})$$

$$\text{PVAF}_{6,r} = \frac{\text{Rs } 20,000}{\text{Rs } 5,430} = 3.683$$

Rationale for the IRR Method

If $IRR > WACC$, then the project's rate of return is greater than its cost-- some return is left over to boost stockholders' returns.

Example: $WACC = 10\%$, $IRR = 15\%$.
Profitable.

Acceptance rule

$IRR > K$

Accept

$IRR < K$

Reject

$IRR = K$

May Accept

In case of independent projects, IRR and NPV rules will give the same results if the firm has no shortage of funds.

Illustration

A company has to select one of the following two projects:

Particulars	Project A	Project B
Cost	11,000	10,000
Cash Inflows		
Year 1	6000	1000
2	2000	1000
3	1000	2000
4	5000	10,000

Using Internal rate of return suggest which project is preferable.

(hint: use factor $(F) = \text{Original investment} / \text{average cash inflow per year}$)

Merits of IRR

- Considers all cash flows
- true measure of profitability
- based on the concept of time value of money
- consistent with the wealth maximisation principle.

Demerits of IRR

- Requires estimates of cash flows which is a tedious task
- value additivity principle does not hold good
- at times fails to indicate correct choice of mutually exclusive projects
- at times yields multiple rates
- relatively difficult to compute.

Problems with IRR

- Non - Conventional Cash Flows
- Mutually Exclusive projects
- Lending and Borrowing type projects

Illustration

Non Conventional Cash Flows

Cash Flow			
Project	C_0	C_1	C_2
M	-160,000	1,000,000	-1,000,000

Calculate the IRR of this project.

Illustration

Mutually Exclusive Projects

Project	Cash Flow		IRR	NPV
	C_0	C_1		(Assuming $r=12\%$)
P	-10,000	20,000	?	?
Q	-50,000	75,000	?	?

Calculate NPV and IRR and suggest which project is a better one.

Illustration

Lending and Borrowing type project

Project	Cash Flow		IRR	NPV (Assuming $r=10\%$)
	C_0	C_1		
P	-4,000	+6,000	?	?
Q	+4,000	-7,000	?	?

Which project is attractive?

Modified IRR

Step 1

Calculate the present value of the costs (PVC) associated with the project.

$$PVC = \sum_{t=1}^n \frac{\text{Cash Outflows}}{(1+r)^t}$$

Modified IRR

Step 2

Calculate the terminal value of the cash inflows expected from the project.

$$\text{Terminal Value} = \sum_{t=1}^n (\text{Cash Inflows})_t * (1+r)^{n-t}$$

Modified IRR

Step 3

Obtain MIRR

$$PVC = \frac{\text{Terminal value}}{(1 + \text{MIRR})^t}$$

Illustration

Year	Cash Flow (In Rs Million)
0	-120
1	-80
2	20
3	60
4	80
5	100
6	120

Calculate MIRR when cost of capital is 15 percent.

PROFITABILITY INDEX

- Profitability index is the ratio of the present value of cash inflows, at the required rate of return, to the initial cash outflow of the investment.
- The formula for calculating benefit-cost ratio or profitability index is as follows:

$$\begin{aligned} \text{PI} &= \frac{\text{PV of cash inflows}}{\text{Initial cash outlay}} = \frac{\text{PV}(C_t)}{C_0} \\ &= \sum_{t=1}^n \frac{C_t}{(1+k)^t} \div C_0 \end{aligned}$$

- The initial cash outlay of a project is Rs 100,000 and it can generate cash inflow of Rs 40,000, Rs 30,000, Rs 50,000 and Rs 20,000 in year 1 through 4. Assume a 10 percent rate of discount. The PV of cash inflows at 10 percent discount rate is:

$$\begin{aligned}
 PV &= \text{Rs } 40,000(\text{PVF}_{1, 0.10}) + \text{Rs } 30,000(\text{PVF}_{2, 0.10}) \\
 &\quad + \text{Rs } 50,000(\text{PVF}_{3, 0.10}) + \text{Rs } 20,000(\text{PVF}_{4, 0.10}) \\
 &= \text{Rs } 40,000 \times 0.909 + \text{Rs } 30,000 \times 0.826 \\
 &\quad + \text{Rs } 50,000 \times 0.751 + \text{Rs } 20,000 \times 0.68 \\
 NPV &= \text{Rs } 112,350 - \text{Rs } 100,000 = \text{Rs } 12,350 \\
 PI &= \frac{\text{Rs } 112,350}{\text{Rs } 100,000} = 1.1235.
 \end{aligned}$$

Acceptance Rules

$PI > 1$

Accept

$PI < 1$

Reject

$PI = 1$

May Accept

The project with positive NPV will have PI greater than one. PI less than means that the project's NPV is negative.

Illustration

A project is to be evaluated at 12 percent cost of capital.

Year	Cash Flow
0	1,00,000
1	25,000
2	40,000
3	40,000
4	50,000

Calculate PI

Investment Appraisal in Practice

A survey of capital budgeting practices in India, conducted by U.Rao Cherukeri revealed the following.

- Over time, discounted cash flow methods have gained in importance and internal rate of return is the most popular evaluation method.
- Firms typically use multiple evaluation methods.
- Accounting rate of return and payback period are widely employed as supplementary evaluation methods.
- Weighted average cost of capital is the most commonly used discount rate.
- Risk assessment and adjustment techniques have gained popularity. The most popular risk assessment technique is sensitivity analysis and the most common methods for risk adjustment are shortening of the payback period and increasing the required rate of return.

New Concepts in Financing and Execution of Projects

- B.O.O. - Build, Own and Operate - Under this entrepreneur will build the project from his own resources and he will own the project and he is also entitled to operate the project subsequent to its commercial launching. These type of projects are undertaken in core sector like power, steel, oil, railway etc by the private sector and the government will give guarantee to buy the output.

New Concepts in Financing and Execution of Projects

- B.O.T. - Build, Operate and Transfer - The private sector is invited by the government to undertake projects in core sector, when the government is unable to finance such projects due to scarcity of funds. Under this, the private sector will put the investment in bringing the project and the government allows them to operate for certain period and then transfer the project to the government.

New Concepts in Financing and Execution of Projects

- L.R.O.T.- Lease, rehabilitate, Operate and Transfer - Under LRROT concept, the government will give a running plant for rehabilitation to put the plant on profitability track for increasing its production capacity. The government adopts this concept when it reels under funds constraint.

New Concepts in Financing and Execution of Projects

- E.P.C.- Engineering, Procurement and Construct - In these projects, the contractor takes the complete responsibility to construct, erect, commission and supply the plant and keeps it ready to operate by the owner.
- Turnkey Contract - when a single contractor undertakes the responsibility for the entire work and complete it so that the owner merely turns the key and operates the plant.

END OF SESSION

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for any query,

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