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Project Appraisal at a Glance

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Strategic Level
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Modified internal rate of return (MIRR)

The MIRR overcomes the problem of the **reinvestment assumption** and the fact that **changes in the cost of capital over the life of the project** cannot be incorporated in the IRR method.

Consider a project requiring an initial investment of Rs. 24.5 million, with cash inflows of Rs. 15 million in years 1 and 2 and cash inflows of Rs. 3 million in years 3 and 4. The cost of capital is 10%.

If we calculate the IRR:

Year	*Cash flow* Rs Mn	*Discount factor @ 10%*	*Present value* Rs Mn	*Discount factor @ 25%*	*Present value* Rs Mn
0	(24.500)	1.000	(24.500)	1.000	(24.500)
1	15.000	0.909	13.635	0.800	12.000
2	15.000	0.826	12.390	0.640	9.600
3	3.000	0.751	2.253	0.512	1.536
4	3.000	0.683	2.049	0.410	1.230
			5.827		(0.134)

$$\text{IRR} = 10\% + \left[\frac{5.827}{5.827 + 0.134} \times (25\% - 10\%\right] = 24.7\%$$

The MIRR is calculated on the basis of **investing the inflows** at the **cost of capital**.

The table below shows the **values of the inflows if they were immediately reinvested at 10%**. For example, the Rs. 15 million received at the end of year 1 could be reinvested for three years at 10% pa (multiply by 1.1 × 1.1 × 1.1 = 1.331).

Year	*Cash inflows* Rs Mn	*Interest rate multiplier*	*Amount when reinvested* Rs Mn
1	15.000	1.331	19.965
2	15.000	1.21	18.150
3	3.000	1.1	3.300
4	3.000	1.0	3.000
			44.415

Total return = $\frac{44.415}{24.5}$ = 1.813

MIRR = $\sqrt[4]{1.813}$ – 1 = 1.16 – 1 = 16%

In theory, the MIRR of 16% will be a **better measure** than the IRR of 24.7%.

MIRR has the advantage over IRR that it assumes the **reinvestment rate** is the **company's cost of capital**. IRR assumes that the reinvestment rate is the IRR itself, which is usually untrue.

In many cases where there is conflict between the NPV and IRR methods, the MIRR will give the same indication as NPV, which is the **correct theoretical method**. This helps when explaining the appraisal of a project to managers, who often find the concept of rate of return easier to understand than that of net present value.

Risk and uncertainty

Only if management know for certain what is going to happen in the future can they appraise a project in the knowledge that there is no risk. However, the future is uncertain by nature. There are, nevertheless, techniques which can be used to enable managers to make a judgement on risk and uncertainty.

The NPV could depend on a number of uncertain independent variables.

- Selling price
- Sales volume
- Cost of capital
- Initial cost
- Operating costs
- Benefits

Sensitivity analysis

Sensitivity analysis therefore provides an indication of why a project might fail. Management should review critical variables to assess whether or not there is a strong possibility of events occurring which will lead to a negative NPV. Management should also pay particular attention to controlling those variables to which the NPV is particularly sensitive, once the decision has been taken to accept the investment.

A simple approach to deciding which variables the NPV is particularly sensitive to is to calculate the sensitivity of each variable:

$$\text{Sensitivity} = \frac{\text{NPV}}{\text{Present value of project variable}} \%$$

Capital rationing

We have seen in the last chapter that the decision rule with discounted cash flow (DCF) techniques is **to accept all projects which result in positive net present values (NPVs)** when discounted at the company's cost of capital. If an entity suffers **capital rationing**, it will not be able to enter into all projects with positive NPVs because there is not enough capital for all the investments. In this section we look at techniques to deal with this problem.

Capital rationing is a restriction on an organisation's ability to invest capital funds, caused by an internal budget ceiling being imposed on such expenditure by management (**soft capital rationing**), or by external limitations being applied to the company, as when additional borrowed funds cannot be obtained (**hard capital rationing**).

Single period rationing with divisible projects

With **single period capital rationing**, investment funds are a limiting factor in the current period. The total return will be maximised if management follows the decision rule of maximising the return per unit of the limiting factor. They should therefore **select those projects whose cash inflows have the highest present value per Rs. 1 of capital invested**. In other words, rank the projects according to their **profitability index (PI)**.

$$\textbf{Profitability index} = \frac{\text{NPV of project}}{\text{Initial cash outflow}}$$

Equivalent annual cost

When an asset is being replaced with an identical asset, the equivalent annual cost method is a technique which can be used to determine the **best time** to replace the asset.

When an investment is being evaluated in terms of annual running costs, it may be appropriate to convert the capital cost into an **annualised cost** at the company's cost of capital. For example, when the capital expenditure is only a relatively small feature of a project and annual running costs are a much more significant item, annual cash flow is the key factor in the decision.

FORMULA TO LEARN

$$\textbf{Equivalent annual cost} = \frac{\text{PV of costs over n years}}{\text{n year annuity factor}}$$

(a) **'PV of costs'** is the present value of the **purchase cost** plus the ongoing costs minus any subsequent disposal proceeds at the end of the item's life.

(b) The **n year annuity factor is** at the company's cost of capital, for the number of years of the item's life.

Real options

Real options theory is an attempt to incorporate real-life uncertainty and flexibility into the capital investment decision. A major capital investment may not always be set in stone.

Real options attempt to incorporate **flexibility** to adapt decisions in response to unexpected market developments. It is argued that traditional methods such as NPV fail to accurately capture the economic value of investments in an environment of widespread uncertainty and rapid change. The real options method applies **financial options theory** to quantify the value of this flexibility.

International investment appraisal

In this section we look at the complications in investment appraisal calculations where there is an international element. These include exchange rates, differing inflation rates and taxation.

Purchasing power parity

$$\text{Future spot rate A\$/B\$} = \text{Spot rate A\$/B\$} \times \frac{1 + \text{country A inflation rate}}{1 + \text{country B inflation rate}}$$

Interest rate parity (expectations theory)

$$\text{Future spot rate A\$/B\$} = \text{Spot rate A\$/B\$} \times \frac{1 + \text{nominal country A interest rate}}{1 + \text{nominal country B interest rate}}$$