Capital Budgeting

Capital Budgeting decision is considered the most important and most critical decision for a finance manager. It involves decisions related to long-term investments of capital nature. The returns from such investments are scattered over a number of years. Since it requires a huge amount of funds, it is considered irreversible.

Some examples of capital budgeting decisions are Purchase of new plant and machinery, replacement of old plant and machinery, expansion and diversification decision, research and development projects etc.

Definition of Capital Budgeting

According to Charles T. Horngren:
"Capital Budgeting is long-term planning for making and financing proposed capital outlays."

According to L.J. Gitman:
"Capital Budgeting refers to the total process of generating, evaluating, selecting and following up on capital expenditure alternatives."

Nature of Capital Budgeting

1. It is a long-term investment decision.
2. It is irreversible in nature.
3. It requires a huge amount of funds.
4. It is the most critical and complicated decision for a finance manager.
5. It involves an element of risk as an investment is to be recovered in the future.

The process of Capital Budgeting

The process of capital budgeting involves following steps

1. **Project Generation:** In the first step, projects for investments are identified. This projects may be undertaken to increase revenue or to reducing cost. for this, proposals for expanding production capacity, proposals for replacement of plant etc. could be undertaken.
2. **Project Evaluation:** In this step, costs and benefits from such projects are evaluated. Projects are judged on the basis of profitability and return it offers to the firm.
3. **Project Selection:** The projects generated and evaluated are then screened at various levels of management. After screening, the top management may decide whether to select or reject the proposal.
4. **Project Execution:** A project is executed after final selection is made by the management. Required funds are allocated to execute the project.
5. **Follow-up:** Executed projects are then followed-up. Actual performance of the project is compared with the expected performance and deviations are found out. With the help of which future decisions are taken.

Techniques of Capital Budgeting:

Most important and most widely used method of project appraisals are

Traditional Methods (Non-Discounting Techniques)

1. Pay-back period Method
2. Accounting Rate of Return

Modern Methods (Non-Discounting Techniques)

1. Net Present Value Method
2. Profitability Index
3. Internal Rate of Return Method
4. Terminal Value Method
5. Discounted Payback Period Method

Payback Period Method

This method is the simplest and most widely used method. Payback period is the time required to recover the initial investment. A firm is always interested in knowing the amount of time required to recover its investment.

It is based on the concept of cash flow and is a non-discounting technique.

Formula for Payback period

1. **When Cash inflows are even/equal:**
   When cash inflow of all year is equal, we use the following formula

   Payback period = $\frac{\text{Initial Investment}}{\text{Annual Cah Inflow}}$

2. **When cash inflows are uneven**
   When cash inflows of each years different we use the formula below

   Payback Period = $E + \frac{B}{C}$

   Where,

   E = Year immediately Preceding to year of recovery
   B = Amount left to be recovered
   C = Cash inflow during the year of final recovery

   To apply this formula, we have to first calculate the **cumulative cash inflows** of each year.

Decision Criteria

1. In case of competing projects, a project with a lower payback period should be selected.
2. If there is only one project in consideration it would be selected only if it has a payback period as per managements expectation.

Merits of Payback Period Method

1. It is easy to calculate and simple to understand.
2. It is useful in case of those industries where there is a lot of uncertainty and instability because it lays emphasis on the speedy recovery of investment.

3. Many firms want to recover their investment as quickly as possible. This method is more appropriate for them to know how quickly they could get their investments back.
4. It shows liquidity of the investment.

Demerits of Payback period method

1. Neglects cash flows occurring after the payback period: This method does not consider the amount of profit earned after the recovery of the cost of investment. Some projects may have higher cash inflows after the payback period.
2. This method does not consider the time value of money.
3. This method does not consider the risk associated with the project.

1. **Post Payback period:** The duration in excess of payback period till the economic life of a project.

   Post Payback period = Economic life – payback period

2. **Post Payback Profitability:** The amount of profit, which a project could earn after the recovery of initial investment is called as payback profitability.

   Post Payback Profitability = Total Earning from project + Scrap Value – Payback amount

3. **Post Payback profitability index:** Percentage of extra earning over initial investment (payback amount).

   Post Payback profitability index = $\frac{Post\ Payback\ Profit}{Initial\ Investment} \times 100$

Accounting rate of return

This method is also called as financial statement method or unadjusted rate of return method.

It has two variations

(A) **Return on Investment (ROI):** When initial investment is taken into account for calculation it is called ROI.

When Operating Saving/Cash inflow is taken for calculation

Return on Investment (ROI) = $\frac{OS - \frac{NI}{n}}{NI} \times 100$

OR

When Profit after depreciation and tax is taken for calculation

$$= \frac{Average\ annual\ profit\ after\ tax}{Initial\ Investment}$$

(B) **Rate of Return (ARR)**: When Average investment is taken for calculation it is called ARR.

When Operating Saving/Cash inflow is taken for calculation

Accounting Rate of Return (ARR) $= \frac{OS - \frac{NI}{n}}{\frac{NI}{2}} \times 100$

OR

When Profit after depreciation and tax is taken for calculation

$$= \frac{Average\ annual\ profit\ after\ tax}{Average\ Investment}$$

Where,

OS = Operating Saving (same as cash inflow or Profit after tax but before depreciation)

NI = Initial Investment

N = Economic Life of the machine

$\frac{NI}{n}$ = Depreciation

$\frac{NI}{2}$ = Average investment

Calculation of Average Investment $\frac{NI}{2} =$

$$\frac{Initial\ Investment + installation\ charges - scrap}{2} + Working\ capital + Scrap$$

Note:

1. Since **Profit after tax** is taken for calculation of ARR or NOI, we have to deduct the amount of depreciation from Operating saving. that's why we have used the formula $OS - \frac{NI}{n}$ .In other words, we can simply say that $OS - \frac{NI}{n}$ **= Profit after tax.**
2. If profit after tax is given in the question, there is no need to deduct depreciation. The profit after tax amount should be used directly as $OS - \frac{NI}{n}$
3. The profit after tax should be averaged for calculation.

Decision Criteria

1. In case of many projects, a project with higher ARR or NOI will be selected.
2. In case of only one project, it would be selected if it earns more than companies predetermined required rate of return.

Advantages of Accounting Rate of Return Method

1. It is simple and easy to calculate.

2. It takes into account all the savings over the entire period of economic life of the investment.
3. It is based on accounting profit rather than cash inflow. Accounting profit can be easily obtained from financial statements.
4. It measures the benefit in percentage which makes it easier to compare with other projects.
5. This method helps to distinguish between projects, where the timing of savings is approximately the same.

Disadvantages of Accounting Rate of Return Method

1. This method ignores the time value of money.
2. This method is based on accounting profits rather than cash flows. In order to maximize the wealth of shareholders, cash flows should be taken for calculation
3. This method ignores the size of investment. Sometimes ARR may be the same for different projects but some of them may involve huge cash flows.
4. This method also ignores the life span of project. A proposal with longer life may have same ARR as another proposal with a shorter life span. On the basis of ARR both the projects must be placed at par, But the proposal with longer life should be preferred.
5. It also ignores size of investment of the project because two projects having significantly different initial cost, may have same ARR.

Net Present Value Method

The NPV Method is a discounted cash flow technique. This method compares between cash inflows and cash outflows occurring at the different time period. The major characteristic of this method is that it takes into account the time value of money and all cash inflows and outflows are converted to present value.

It involves following steps

1. Cash inflows and outflows are determined.
2. A discount rate or cut-off rate is determined. This rate is also called as cost of capital, required rate of return, the target rate of return, hurdle rate etc.
3. With the help of this rate of return, present value of cash inflows are calculated. For this purpose, Present Value Factor should be calculated at a given rate with the help of this formula PVF = $\frac{1}{(1+r)n}$ or it could be taken from the PVF Table.
4. Cash inflows of each year are then multiplied with Present Value Factor (P.V.F.)
5. Discounted cash inflow of all years is added along with the discounted value of working capital released and salvage value. In this way, the Present Value of Cash inflow is obtained
6. Finally, NPV is calculated by deducting PV of cash outflow from PV of cash inflows

NPV = P.V. of cash inflows –PV of cash outflows

Note:

1. If working capital released in the end and salvage value is given in the question, it must be discounted with the PVF of last year and must be added as a cash inflow in the last years.

2. The initial outflow is not required to be discounted because it is already a present outflow. But if there is any further cash outflow in the following years like overhauling charges, maintenance charges etc. that should be discounted at PV factor of that year and should be added to cash outflow.

Decision Criteria

1. If NPV is Positive, the project must be selected. Otherwise rejected.
2. If there are more than two projects with positive NPV. The project with higher NPV should be selected.

Merits of Net Present Value

1. This method recognizes the time value of money as cash inflows arising at different time interval are discounted to present values. This is a major improvement over traditional techniques.
2. This method recognizes risk involved in the project with the help of discounting rate.
3. This method is best for mutually exclusive projects where only one project is to be selected among many.
4. In NPV, all cash flows are considered including working capital used and released, salvage value is also considered.
5. This method is considered best for wealth maximization of shareholders as it is based on cash inflow rather than accounting profit.
6. It considers total benefits arising out of project till the end of the project.
7. The discount rate applied for discounting the cash flows is actually the minimum required rate of return. This minimum rate of return incorporates both the pure return as well as the premium required to set-off the risk.

Demerits of Net Present Value Method

1. It requires difficult calculation.
2. The NPV technique requires the predetermination of required rate of return, which itself is a difficult job. If that rate is not correctly taken, then the whole exercise of NPV may give wrong result.
3. It does not provide a measure of projects own rate of return, rather it evaluates a proposal against an external variable i.e. minimum rate of return.
4. The method may not provide satisfactory results in case of projects having different amount of investment and different economic life.

Profitability Index

This method is also known as Benefit-Cost Ratio Method. It is based on Net Present Value method and calculates the benefit on per rupee investment.

$$\text{Profitability Index} = \frac{\boldsymbol{PV\ of\ Cash\ Inflow}}{\boldsymbol{PV\ of\ Cash\ Outflow}}$$

Decision Criteria

Accept if PI is more than 1
Reject if PI is less than 1

Merits of PI

1. It is superior to NPV method.
2. It gives due consideration to the time value of money and cost involved in the project.
3. PI techniques give better result in case of projects having different outlays.
4. In PI all cash flows are considered including working capital used and released, salvage value is also considered.
5. This method is considered best for wealth maximization of shareholders as it is based on cash inflow rather than accounting profit.
6. It considers total benefits arising out of project till the end of the project.
7. The discount rate applied for discounting the cash flows is actually the minimum required rate of return. This minimum rate of return incorporates both the pure return as well as the premium required to set-off the risk.

Demerits of PI

1. It is more difficult to understand.
2. It requires computation of required rate of return to be used as discount rate.

Internal Rate of Return (IRR)

IRR is also known as Time-adjusted rate of return. IRR is the rate at which NPV becomes zero. In other words, we could say that IRR is the rate at which present value of cash inflows and present value of cash outflows will be equal.

In this technique, unlike net present value, we are not given a discount rate. The discount rate is ascertained by trial and error.

1. Calculation of IRR when savings are even

1. Calculate PV Factor by using the below formula (by coincidence, it is payback period)

   PVF = $\frac{Intial\ Investment}{Annual\ Cash\ Inflow}$
2. Search for a value nearest to PVF from PVAF table for given number of years.
3. One value should be higher and one value should be lower to PVF.
4. Take discount rates of higher and lower PVF.
5. Calculate present values of cash inflows with the help of these discount rates.
6. Apply the following formula

   In case of even savings we can use PVF directly, If we use PVF directly we can use the following farmula

$$PVF\ at\ Lower\ Rate + \frac{PVF\ at\ Lower\ Rate - PVF}{PVF\ \ at\ Lower\ Rate -\ PVF\ at\ Higher\ Rate} \times Higher\ rate - Lower\ rate$$

2. Calculation of IRR when savings are uneven

The above procedure which is applied for calculation of even saving is also applied here. The formula will change

$$\text{IRR} = Lower\ Rate + \frac{NPV\ at\ Lower\ Rate}{NPV\ at\ Lower\ Rate - NPV\ at\ Higher\ \ Rate} \times Higher\ rate - Lower\ rate$$

Important thing to remember:

1. This method is based on trial and error. We should keep in mind that we need two rates, one rate higher to PV Factor and another rate lower to PV factor. Then we need to calculate NPVs at those rates. NPV at one rate should be negative and NPV at one rate should be positive.
2. We should also keep in mind
    - Lower the rate, higher the NPV
    - Higher the rate, lower the NPV
3. Suppose NPV is Negative at 10% discount rate. Now, we need another NPV which should be Positive. So, going by the above rule, we should calculate NPV at some rate which is lower to 10%.
4. If two rates are given in the question, we simply need to calculate the NPV at both the rates and apply those values in the formula. (This is much better haha)

Merits of IRR

1. It takes into account time value of money. Thus, cash inflows occurring at different time interval are adjusted with the appropriate discount rate.
2. It is a profit oriented concept and helps in selecting those proposals which are expected to earn more than minimum required rate of return.
3. In IRR all cash flows are considered including working capital used and released, salvage value is also considered.
4. It is based on cash flow.

Demerits

1. It involves complicated trial and calculation.
2. It makes an implied assumption that the future cash inflows of a proposal are reinvested at a rate equal to IRR. This assumption is not true as the firms are able to reinvest only at a rate available in the market.
3. Many times it may yield multiple rates.

<u>Terminal Value Method</u>

1. This method is based on the assumption that cash inflows of each year is reinvested in another in another outlet at a certain rate of return till the economic life of the project.
2. Cash inflows of last year is not re-invested.
3. So, cash inflows of each year is compounded with the help of formula of compounding: FV = $PV\ (1 + R)^n$ Where PV is Rs.1.
4. Then this FV is multiplied with each year's cash inflow.

5. Total compounded value of annual cash inflow is obtained and then it is discounted to get the present value of compounded annual cash inflow.
6. Then it is compared with initial outflow to get the terminal value.

Decision Criteria

If IRR > Cost of Capital	Accept
If IRR <Cost of Capital	Reject

Discounted Payback Period

1. This method is an improvement over traditional payback period method.
2. It is a combination of the payback period method and discounted cash flow technique.
3. In this method, cash inflows of a project are discounted to get their present value.
4. Once the present value of cash inflows is calculated, the procedure to calculate PBP remains the same as traditional PBP method.

Risk and Uncertainty in Capital Budgeting

All the methods of evaluation of investment proposals are based on the benefits likely to be derived from the proposal. These benefits are measured in terms of cash flows which are just future estimates. The actual benefits in terms of cash inflows depend upon a variety of factors. If these factors are not properly forecasted at the time of estimating cash flows, there is very likelihood that actual returns will differ from the estimated returns. This is technically referred to as risk.
Thus, risk with reference to capital budgeting decisions may be defined as the variability which is likely to occur in future between estimated return and actual return. If the variability is greater, the project will be riskier and vice-versa.
The various techniques which are used to incorporate risk factor in the analysis of capital expenditure decision

1. Risk Adjusted Discount Rate (RADR)
2. Certainty Equivalent Coefficient (CEC)
3. Sensitivity Analysis
4. Probability Assignment
5. Standard Deviation
6. Coefficient of Variation
7. Decision Tree Analysis

By the supreme power of the Lord, we are blessed that we have to study only first two methods(Uhahahaha)

1. **Risk Adjusted Discount (RADR)**: This technique is simplest and most widely used method for incorporating risk in capital budgeting decision. It is based on the presumption that a comparatively higher rate of return is expected on risky project as compared to less

risky project. The RADR is obtained by adding the discount rate (Risk-free Rate) and Risk Premium Rate. RADR can be used with both NPV and IRR.

Steps to calculate NPV under RADR

1. ObtainRADR by adding the discount rate (Risk-free Rate) and Risk Premium Rate
2. Mutiply the cash inflow with PVF @ RADR
3. Calculate NPV

RADR = Risk-free rate (Discount rate) + Risk Premium rate

The following details relate to two projects X and Y :

	X	Y
	₹	₹
Cost of outlay	20,000	20,000
Cash inflows :		
Year 1	8,000	10,000
Year 2	8,000	12,000
Year 3	4,000	6,000

Riskless rate of return is 5%. Project X is less risky as compared to Project Y. The management considers risk premium rates at 5% and 10% respetively appropriate for discounting the cash inflows. State which project is better ?

Solution

Risk-Adjusted Discount Rate will be :

Project X = 5 + 5 = 10%

Project Y = 5 + 10 = 15%

Calculation of N. P. V. at R. A. D.

Year	*Project X*			*Project Y*		
	Cash Inflows	*P.V.F. @ 10%*	*P.V.*	*Cash Inflows*	*P.V.F. @ 15%*	*P.V.*
1	8,000	.909	7,272	10,000	.870	8,700
2	8,000	.826	6,608	12,000	.756	9,072
3	4,000	.751	3,004	6,000	.658	3,948
			16,884			21,720
Less : Cost			20,000			20,000
N.P.V.			– 3,116			+ 1,720

Since N.P.V. is positive in the case of project Y. Y is superior to X.

2. **Certainty Equivalent Coefficient (C.E.C)**: This method serves as an alternative to RADR method in incorporating risk in capital expenditure decision.
The riskiness of a project in this method is taken into account by adjusting the expected cash inflows rather than discount rate.

Steps to calculate NPV under CEC

1. Multiply the cash inflow with C.E.C given in the question. The amount thus obtained is Adjusted cash inflow.
2. Now this adjusted cash inflow is discounted with the discount given discount rate.
3. Calculate NPV.

Y Ltd. is considering an investment in one of the two mutually exclusive projects. Project X would involve initial outlay of ₹ 85,000 and Project Y would have an initial outlay of ₹ 75,000. The expected cash inflows with their certainty-equivalents for both projects are :

Year	Project X		Project Y	
	C.I.F (₹)	C.E.Q.	C.I.F. (₹)	C.E.Q.
1	45,000	0.8	45,000	0.9
2	50,000	0.7	45,000	0.8
3	55,000	0.5	50,000	0.6

The Company employes Certainty-Equivalent Approach for evaluating risky investments. The risk-free rate may be assumed to be 5%. You are required to suggest :

(i) Which project should be accepted?
(ii) Which project is riskier and why?
(iii) If the company wishes to employ Risk-Adjusted Discount Rate method, which project should be analysed at higher rate?

Solution

(i) Calculation of Net Present Value (Project X)

Year	C.I.F.	C.E.Q.	Adjusted C.I.F.	P.V.F. at 5%	P.V.
1	45,000	0.8	36,000	.952	34,276
2	50,000	0.7	35,000	.907	31,745
3	55,000	0.5	27,500	.864	23,760
			1,5	T.P.V.	89,781
	Less : Cash outflow				85,000
				N.P.V.	+ 4,781

(ii) Calculation of Net Present Value (Project Y)

Year	C.I.F.	C.E.Q.	Adjusted C.I.F.	P.V.F. at 5%	P.V.
1	45,000	0.9	40,500	.952	38,556
2	45,000	0.8	36,000	.907	32,652
3	50,000	0.6	30,000	.864	25,920
				T.P.V.	97,128
	Less : Cash outflow				75,000
				N.P.V.	22,128

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