UNIT – 3

Capital Budgeting

Objectives

The objectives of this unit are to

● understand the concept, nature and process of capital budgeting

● explain the different techniques of capital budgeting and their comparison

● commiserate the risk factor in capital budgeting techniques

● to discuss capital rationing, its approaches and steps involved in it

Introduction

Modern corporate organizations formulate strategic planning to undertake programmes/projects and allocate appropriate resources to them over the next coming years. These programmes/projects are related to establishment, expansion, diversification, and acquisition etc. of business which require huge capital expenditure but generate revenues over a long period of time in future. Such types of decisions are evaluated in terms of their costs and benefits. Capital budgeting techniques are used as tool to help financial managers in taking such types of decisions. Capital budgeting is the process of identifying, analysing and selecting investment projects whose returns will be realized in coming years. It involves the planning of expenditures on long terms assets, the returns from which will be received in future time periods. Capital budgeting is a current outlay or a series of outlays of funds in return for an anticipated flow of future benefits. It is a decision making process to evaluate the purchase of major long term/fixed assets or acquisition of some existing business. Thus capital budgeting may be defined as the firm's decisions to invest its current funds most effectively in long term activities in anticipation of cash inflows/future benefits over a series of years.

3.1 Importance of Capital Budgeting Decisions

Capital budgeting decisions have immense importance for a business. These decisions may be responsible for make or mar the enterprise as there is commitment of large funds and the decisions are generally irreversible. The flowing features of capital budgeting make these decisions so much crucial and significant for financial management:

1. **Involvement of Risk and Uncertainties**
   The capital budgeting decisions require huge amount of cash outflow in present period but return in from of cash inflows will be only in future period. Thus the chance of success of these types of decisions are totally depends on the correct forecasting of future scenario. The future always has uncertainties and there is no tool or technique is available so that it can be estimated accurately and correctly. The estimating of future cash inflows, the cut off rate (cost of capital) and life of the project make these decisions risky.

2. **Impact on Present and Future profitability**

   Capital budgeting decisions have a significant effect on the profitability of business concern. These decisions not only affect the present earning of the firm but also the profit making capacity of the firm long time period. The future growth and profitability of the firm depends upon the investment decisions taken today. A rational capital expenditure decision enhances the firm's profitability where as irrational approach may harm and hamper the growth and profitability of firm.

3. **Long term Investment of Huge funds**

   These decisions require huge amount of scarce financial resources in fixed assets for long period. If valuable resources of the firm blocked in unprofitable projects it will results heavy loss of capital and revenues

4. **Irreversible in Nature**.

   Long term investment decisions once taken, cannot be easily reversed. If it become unavoidable to reverse these decisions, it is not possible without incurring huge loss to the firm.

5. **Corporate Image**.

   Capital budgeting decisions affect the profitability of the firm which is reflected in the market price of share. So the image of the firm is affected by the success or failure of capital budgeting decisions.

3.2 Complexities Involved in Capital Budgeting decisions: Following three factors makes the capital budgeting decisions complicate:

1. **Measurement problem:** Evaluation of a project requires identifying and measuring its costs and benefits of that project, which are difficult since they involve tedious calculations and lengthy process. Majority of the replacement or expansion programmes have an impact on some other activities of the company or have some intangible consequences.

2. **Uncertainty:** Selection or rejection of a capital expenditure project depends on expected costs and benefits in the future. Future is uncertain, if any one try to predict the future it will be childish or foolish. Hence, it is very difficult to predict the future cash inflows.

3. **Temporal spread:** The costs and benefits which are associated with a particular capital expenditure project is spread out over a long period of time say 5-10 years or 10-15 years depend upon the type of projects. The temporal spread creates some problems in estimating discount rates for conversion of the future cash inflows in present values and establishing equivalences.

3.3 Phases/Process of Capital Budgeting/Capital Expenditure

The Capital Budgeting Decisions are complex decisions require investment of huge amount in anticipation of future earnings for long period of time. The dynamic business environment, micro and macro economic variables create uncertainties for future period. So it is not so easy task to choose a project or investment proposal in present which will increase the wealth of shareholders in future. The process of selecting an investment proposal (capital budgeting decision) requires sequential steps discussed below:

1. **Identifying of Investment Opportunities:** The process of capital budgeting decisions starts with the identification and generating a proposal for investments. There could be various reasons for an

entrepreneur to take up investments proposal. It may be manufacturing new product, addition of a new product line or expanding the existing one or reduce the costs of outputs. It involves a careful study from many different angles of investment proposals/opportunities available in different sectors of an economy.

2. **Evaluation of Investment Proposals:** This step involves gathering, summarizing, analyzing, and evaluating relevant information about various investment alternatives which are considered for inclusion in capital budgeting process in terms of their costs and benefits and risk and return by applying mathematical and statistical tools viz. time value of money, averages, deviation etc

3. **Selection of Investment Proposal:** After evaluation of projects as mentioned in step No. 2 all investment alternatives are scanned by arranging them on the basis of return and risk in descending/ascending order for selecting the best which maximize the wealth of shareholders.

4. **Financing the Selected Project:** Once the proposal has been finalized, the different alternatives for raising or acquiring funds (use any one or mix of several source of funds such as equity share, preference shares, term loan, debentures or accumulated profits) have to be explored by the finance team. This is called preparing the capital budget.

5. **Execution or Implementation of Project:** Under this step accountability and responsibilities for implementing the proposals, completion of the project within a given time frame and cost limits are decided to avoid unnecessary delay and cost over runs. Principles of responsibility accounting and use of net work technique (PERT, CPM) are useful tool for implementation of project.

6. **Reviews of the Project:** The final stage of capital budgeting involves comparison of **the** actual performance of the project with the set standards periodically. The unfavorable results are identified and corrective measures are taken for completion of the project smoothly in time.

3.4 Techniques of Evaluating Investment Proposals

The investment evaluation techniques play a vital role in evaluating a project. Profitability of a firm will increase if the proposal is profitable and vice-versa. Selection of a profitable project will help to maximize value of the firm through the maximization of profits. A wide range of criteria has been suggested to judge the worthiness of investment alternatives by financial wizards. Evaluation techniques are divided in to two broad categories: 1) **Traditional Techniques or Non Discounting methods** (Average rate of return method, Payback period method) 2**) Discounting Techniques** (Net present value method, Profitability index method, Internal rate of return method)

(i) Accounting Rate of Return (ARR)

This technique is also known as average of return, return on investment method. In this method accounting profit after depreciation and taxes are computed and then average accounting profits are divided by Average Investment for computing average rate of return. This average rate of return is compared with pre-determined or target ARR. If it is more than or equal to target ARR, then the project is accepted otherwise rejected. If more than one project is given, and one of them is to be selected, then the project having highest ARR is accepted. This method covers the whole life of the project but the time value of money is ignored. The profit whether it is earned today or in later years is given equally weight.

Merits of ARR Method

The average rate of return method is simple and popular because it is easy to understand the calculations and profitability of a project is computed for whole life.

Limitations:

(1) **It ignores the item value of money**, the time value of money concept strongly advocates that the amount of money received today is more valuable than the same amount of money receivable in future. So the project resulting higher amount of profit in earlier years should be preferred over the others. But the ARR method ignores the time value of money.

(2) **Ambiguous**: The concepts of investment and earnings used for computations of ARR are not uniform. The concept of average investment if much more ambiguous. Some people compute it as initial cost plus salvage value and then divide it by two, while others compute it as initial cost minus salvage value and then divide it by two. Also it uses accounting profits after depreciation and taxes in ARR calculations. But the cash inflows after taxes are more acceptable in comparison of accounting profit.

(3) **Determination of pre-determined ARR is very difficult**: For accepting or rejecting a project the computed ARR is compared with the predetermined ARR. But how to determine pre-determined rate, it is a very difficult task. There is no universal criterion for a pre-determined sufficient for the project.

(4) **Based on Book value:** In ARR calculations the book values shown in balance sheets are used which neither reflect the values of assets in terms of their earning ability nor their market values.

Example: Moon Ltd. has a project costs ₹60,000 and has a scrap value of ₹12,000. Its stream of income before depreciation and taxes (EBDT) during its 5 years life are ₹12,000; ₹14,400; ₹16,800; ₹19,200 and ₹24,000. Assuming tax rate at 50% and depreciation on straight line basis, calculate the average rate of return for the project.

Solutions:

Initial cost of Project = ₹ 60,000

Salvage Value after 5 years = ₹ 12,000

Annual Depreciation (Straight Line Method) $= \dfrac{\text{Cost} - \text{Salvage Value}}{\text{Life}}$

$$= \frac{60,000 - 12,000}{5} = ₹\ 9,600$$

Average investment $= \dfrac{\text{Cost} + \text{Salvage Value}}{2} = \dfrac{60,000 + 12,000}{2} = ₹\ 36,000$

CALCULATION OF AVERAGE INCOME AFTER DEPRECIATION & TAXES

Years	1 Rs.	2 Rs.	3 Rs.	4 Rs.	5 Rs.
Income before Depreciation & Taxes	12,000	14,400	16,800	19,200	24,000
Less: Depreciation	9,600	9,600	9,600	9.600	9,600
Earning Before Tax (EBT)	2,400	4,800	7,200	9,600	14,400
Less: Tax @ 50%	1.200	2,400	3,600	4,800	7,200
Earning After Tax (EAT)	1,200	2,400	3,600	4,800	7,200

Average Profit after Depreciation & Taxes = $\dfrac{1,200 + 2,400 + 3,600 + 4,800 + 7,200}{5}$

$$= \frac{19,200}{5} = ₹3,840$$

Now, ARR = $\dfrac{\text{Average Profit after Depreciation \& Taxes}}{\text{Average Investment}} \times 100 = \dfrac{3,840 \times 100}{36,000} =$ **6.40%**

This above average rate of return 6.40% is compared with pre-determined or target ARR. If it is $\geq$ to target ARR, then the project is accepted otherwise rejected. If more than one project is given, and one of them is to be selected, then the project having highest ARR is accepted.

(ii) Pay Back Period Method: The payback period is defined as the number of years required to recover the investment on a project. This method calculates the number of years required to pay back the original investment. It does not consider the whole life of project and total profitability during its economic life. Pay back is based on cash flows criterion. Here cash flows after taxed but before depreciation are used. For decision making computed payback period is compared with the predetermined payback. If computed payback period is less than the pre-determined payback period, the project would be accepted in opposite situation it would be rejected. When many projects are under consideration, they may be ranked according to the length of payback period. The projects having the shorter payback period will be selected. The payback period can be calculated in two different situations:

i) When yearly cash inflows are equal.

ii) When annual cash inflows are unequal. In case of unequal cash inflows, the payback period is calculated by adding up the cash inflows till the time they become equal to the original investment. In case the investment is recovered in between a year, it can be presumed that during the year there will be even flow of cash and the payback period is calculated on proportionate basis.

Merits:

(1) This method is very simple to apply and easy to understand.

(2)   It prefers the recovery of investment as early as possible. Longer periods may not yield profits because of greater uncertainty.

(3)   It is helpful in solving liquidity problems by early recovery of funds

(4)   The early cost recovery practices protect a firm against risk of Obsolescence.

Limitations

(1)   It does not consider whole life of project.

(2)   It does not consider the profitability of project..

(3)   It ignores time value of money.

(4)   It ignores salvage value of projects.

(5)   It ignores the rate of return on investment.

Example: A machine will cost ₹80,000 initially. It will also need a working capital of ₹ 20,000 at the zero period. The yearly profits before tax are expected to be ₹ 15,000 p.a. The machine has a life of 8 years and depreciation has been provided on straight line basis. The tax rate is 40%. Calculate the payback period for the machine. If the company has a policy of accepting only those projects which can be recouped in 5 years or less, should the company invest in this machine?

SOLUTION: Total Initial Investment = Cost of Machine + Working Capital
$$= 80,000 + 20,000 = ₹ 1,00,000$$

	₹
Profit before Taxes	15,000
Less: Tax @ 40%	6,000
Profit after Tax	9,000
Add: Depreciation	
$\dfrac{\text{Cost} - \text{Salvage Value}}{\text{Life}} = \dfrac{80,000}{8}$	10,000
Yearly Cash Flows after Tax before Depreciation (CFAT)	19,000

Now Pay Back Period = $\dfrac{\text{Total Initial Investment}}{\text{Annual CFAT}}$

$$= \frac{1,00,000}{19,000} = 5.26 \text{ years or 5 years and 3 months}$$

The computed payback period 5 years and 3 months is greater than pre set period 5 years hence the project is rejected.

2) Discounting Methods: Under discounting techniques all projected cash inflows and outflows for an investment proposal are discounted to their present value by applying an interest rate. All discounting techniques are based on the time value of money, which states that a rupee received now is worth more than a rupee received in future. Money in hand can be invested to earn an income. To apply discounting methods for evaluating investment projects the assumption is often made that cash inflows from project occur at the end of accounting period. Three discounting cash flow methods are used in capital budgeting based on time value of money techniques are explained below:

a) Net Present Value: For computing NPV of the project all the cash outflows and cash inflows are estimated for full project life. Then present value of cash inflows and cash outflows are computed by multiplying each of them by their respective present value factors. The present value factors are computed on the basis of cut off rate and time of receiving cash inflows of the project. NPV is found by subtracting total present value of cash outflows from the total present value of cash inflows. If NPV is positive the project is accepted. On the other hand negative NPV indicate the project is unprofitable hence rejected. If more than one project is under consideration, the project having higher NPV is ranked higher and preferred.

Decision rule: Accept NPV>0,   Reject NPV<0   Consider NPV=0

Merits: This method consider the whole life of the project, salvage value, and time value and also based on Cash flows rather that accounting profit, hence it is a complete method and is used the most in capital budgeting decisions motivated by the objectives of wealth maximization of shareholders.

Limitations

1. Deciding the appropriate discount rate is a difficult task.
2. Not suitable if projects with unequal initial investment are compared. When projects involve different amount of investment, the method may not provide satisfactory answers. This technique selects the project having highest NPV but it ignores the initial cash outlays.
3. It ignores the life of project. In case of unequal lives of the project the method may give misleading results. So if two projects having economic life of 5 years and 10 years but NPV of both are same i.e. Rs 50,000 this technique ranks them equally but again it is not fair. In actual practice the company may select a project which has a shorter economic life even if its NPV is smaller.

Example: Y Ltd. is planning a machine for ₹ 1,40,000 which is likely to emanate following earning in next five years:

Years	1	2	3	4	5
Earnings (₹)	50,000	55,000	60,000	62,000	65,000

The machine will require additional working capital of ₹ 15,000. It will also require installation charges of ₹ 10,000. The machine will be depreciated on SLM basis and has salvage value of ₹ 25,000. The company is subject to tax at the rate of 50%. Should the machine be purchased if the cost of capital is 10%. Evaluate the project applying NPV method.

Solution:

Computation of cash flows: ₹

Cost of Machine   1,40,000

Add: Installation charges   10,000

Add: Additional working capital requirement   15,000

                                                                        1,65,000

Depreciation under SLM Method = $\dfrac{\text{Cost} - \text{Salvage Value}}{\text{Life of Asset}}$

$= \dfrac{1,50,000 - 25,000}{5}$ = ₹ 25,000

COMPUTATION OF CFAT

Years	Earning	EBT = Earning– Depreciation (₹ 25,000)	EAT = EBT (1–0.5) Tax Rate 50%	CFAT EAT + 25,000 (Depreciation)	P.V. Factor at 10%	P.V. of CFAT
1	50,000	25,000	12,500	37,500	0.909	34,087
2	55,000	30,000	15,000	40,000	0.826	33,040
3	60,000	35,000	17,500	42,500	0.751	31,918
4	62,000	37,000	18,500	43,500	0.683	29,710
5	65,000	40,000	20,000	45,000	0.621	27,945
						1,56,700

Terminal Cash Inflows:

   Salvage Value   = 25,000

Recovery (Releasing) of Working Capital = $\underline{15,000}$

                                                        40,000

Present Value of Terminal Cash Inflows = (40,000 x 0.621) = ₹ 24,840

   Gross Present Value of Cash Inflows = 1,56,700 + 24,840 = ₹ 1,81,540

   NPV = ₹ 1,81,540 – 1,65,000 = ₹ 16,540

   Since NPV is Positive, Y Ltd. should purchase the above plant.

2) Profitability Index: This method is also known as benefit cost ratio or desirability factor method. It computes the relationship between present value of cash inflows and the present value of cash outflows. The only difference between NPV and PI is that NPV is computed by subtracting cash outflows from P.V. of cash inflows while PI is computed by dividing present value of cash inflows by present value of cash outflows. The proposal is accepted if the profitability index is more than one and is rejected in case it is less than one. If PI coefficient = 1 then the project may be accepted only on the basis of non-financial considerations. If more than one project is under consideration, the project having higher PI should be selected. This method measures the present value of returns per rupee invested. A major drawback of NPV method was that it does not give satisfactory results while evaluating the projects requiring different initial investments. PI method provides a solution to this problem. Hence NPV method is considered good when the initial investment in various projects is same, whereas PI method is adopted when the initial cost of different projects are different.

Decision rule:

 Accept PI>1,　　　 Reject PI<1　　　 Consider PI=1

The profitability index method is discounting cash flows based technique like NPV method. It has following merits and limitations:

Merits: This method is having all merits of NPV method and most suitable in situation of capital rationing. Further when two projects requires different cash outlays PI method is more reliable

Limitations:

1. Like other DCF methods, it also involves difficult calculations.
2. Sometimes it is unable to make full utilisation of capital funds available. If selection is made on the basis of PI Method. Some Capital remains untitled.

Example: From the following information, calculate the net present value (NPV) and profitability index (PI) of two projects and suggest which of the two projects should be accepted assuming a discount rate of 10%.

	Project A	**Project B**
	₹	₹
Initial Investment	30,000	40,000
Scrap Value	2,000	3,000
Estimated Life	5 Year	5 Year

The profits before depreciation and after taxes (CFAT) as follows:

Year:	1	2	3	4	5
Project A (₹)	7,000	12,000	12,000	5,000	4,000
Project B (₹)	22,000	12,000	7,000	5,000	4,000

SOLUTION: CALCULATION OF PRESENT VALUE OF CASH FLOWS

Years	Cash Inflows			Present Value of Cash Flows	
	Project A	**Project B**	**P.V. Factor at 10%**	**Project A Initial Outlay ₹ 30,000**	**Project B Initial Outlay ₹ 40,000**
				₹	₹
1	7,000	22,000	0.909	6,363	19,998
2	12,000	12,000	0.826	9,912	9,912
3	12,000	7,000	0.751	9,012	5,257
4	5,000	5,000	0.683	3,415	3,415
5	4,000	4,000	0.621	2,484	2,484
Terminal Cash Inflows:					
Salvage Value					
Project A:		2,000	0.621	1,242	---
Project B:		3,000	0.621	---	1,863
Gross Present Value of Cash Inflows				32,428	42,929
Less: Cash Outflows				30,000	40,000
NPV				2,428	2,929

Profitability Index (PI) =PV of cash inflows ÷ PV of cash inflows

Project A: 32,428/30,000 = 1.081

Project B: 42,929/40,000 = 1.073

Suggestion:

a) According to NPV method Project B seems more profitable as NPV is greater than Project A. But we can see that it requires higher cash outlays in comparison of Project A.

b) If Cash Outlays are differ and capital available is limited, PI technique provides more reliable results. The PI is higher in case of Project A, hence we should select Project A.

c) Internal Rate of Return: IRR is the rate at which the sum of discounted cash inflows is equal to the sum of discounted cash outflows. In other words if cash flows of a project are discounted at IRR, its NPV will be equal to zero. This rate is also known as break even rate of project, time adjusted rate of return, marginal efficiency of capital, marginal productivity of capital and yield on investment.

IRR method is similar to NPV method. But there is a basic difference between these two methods. In NPV method the discount rate or cut off rate used to discount cash flows in generally the cost of capital.

It is a predetermined rate so cash inflows and outflows are not considered whole determining this rate. On the other hand IRR is determined entirely by cash inflows of the project. Hence IRR is usually the rate of return that a project earns. It is the discount rate at which the present value of cash inflows in equal to the present value of cash outflows. So at this rate NPV of the project is Zero.

Decision rule:

  Accept IRR>Cost of Capital,   Reject IRR<Cost of Capital,   Consider IRR=Cost of Capital

Merits:

1. It is discounted cash flow technique and considers the time value of money.

2. It considers the expected benefits over the entire economic life of the project.

3. IRR method does not use the concept of required rate of return which is very difficult to compute in appropriate manner. It itself determines discount rate.

4. Project having different degrees of risk can be easily compared.

Demerits:

1. Finding of IRR involves tedious calculations.

2. The rate may not be realistic if very high since reinvestment of cash flows may not be possible at such a high rate.

3. Under this method it is assumed that all cash inflows of project are reinvested at IRR rate. This assumption is not valid since the cash inflows may be used for other purposes such as dividend distribution or debt repayment.

Computation of IRR of a Project: The IRR of a project is computed by applying the following formulae

IRR= L+ ($P1-Q$) ÷ ($P1-p2$) × D
L- Lower discount rate

P1 - Present value of cash inflows at lower rate.

P2 - Present value of cash inflows at higher rate.

Q- Actual investment

D- Difference in Discount rate

i) When CFAT for each year are same (even)

Example: A project costs ₹ 60,000 and is expected to generate cash inflows of ₹ 12,500 each year over its life of 8 years. Calculate IRR of the project, if the cost of capital for the firm is 10% (cut off rate), should this project be accepted or not?

SOLUTION: Cash Outlays = ₹ 60,000

   Cash inflows per year = ₹ 12,500

     Economic life = 8 year

Here the cash inflows for each year are same. Hence the IRR can be computed in following steps:

Step-1: In this step we compute 'F' which may be called 'factor to be located' or 'fake payback period'. It can be computed by dividing each out flows with annual cash flows.

F = Initial Cash Outlays = 60,000= 4.8
     Annual CFAT   12,500

Step-2: In this step by using present value of annuity table, we locate the closest figures to 'F' (Here F= 4.8) against the row of number of year of the project. We will take two closest figures to 'F' (=4.8) one is more than 'F' and other one less than 'F'. Here these two closes figures are 4.968 and 4.799 in columns of 12% and 13% respectively.

The rates computed above will be used as first discount rate and second discount rate and corresponding figure will be annuity factor.

Here: First Discount rate is 12% and its annuity factor is 4.968

Second Discount rate is 13% and its annuity factor is 4.799

Step-3: Now compute NPV of project by using both discount rates:

Annual	**Annuity Factor**		**Present Value of Cash**	
CFAT	**1-8 year**		**Inflows**	
(1-8 year)	12%	13%	12%	13%
₹12,500	4.968	4.799	62,100	59,987
Less Cash Outflows			60,000	60,000
NPV				
			2,100	(13)

Step-4: Now IRR can be computed with the help of this formula: **IRR= L+ ($P1$−Q) ÷ ($P1$−$p2$) × D**

IRR = 12 + (62100-60000) ÷ (62100-59987) × 1

   = 12.99 or nearly 13%

Suggestion: Here the cost of capital of the project is 10% and IRR (13%) is higher than the cut off rate. So the project should be accepted.

(i)   When CFAT for each year are not same (uneven)

Example: Initial Investment   ₹ 2,77,000

                          Life of the Asset   4 years

                          Cost of Capital   12%

Estimated net Annual cash Flows:

	₹
1st year	60,000
2nd year	80,000
3rd year	120,000
4th year	60,000
5th year	40,000

Calculate internal rate of return.

Solution :

Step-1: Compute 'F' (Factor to be located or fake payback period) by dividing initial cash oulays with average CFAT.

Here Average CFAT = 360000/5=72000   Fake Payback Period, F = 277000/72000= 3.847

Step-2: Now Using PVAF table we find the fake payback period of 3.847 lies between 10% (3.790) and 8% (3.993) in the line of 5 years.

Year	CFAT (Rs)	DF 10%	DF8%	Present Value at 10%(Rs)	Present Value at 8%
1	60000	.909	.926	54540	55560
2	80000	.826	.857	66080	68560
3	120000	.751	.794	90120	95280
4	60000	.683	.735	40990	44100
5	40000	.621	.681	24840	27240
Total Present Values				276570	290740

IRR= L+ (*P1−Q*) ÷ (*P1−p2*) × *D*

IRR = 8+2(290740-277000) ÷ (290740-276570)

IRR = 8+2(13740) ÷ (14170)

IRR = 8+1.938= 9.94%

Suggestion: IRR 9.94% is less than cost of capital 12%. Hence the project is rejected.

Relationships Between the Internal Rate of Return, Net Present Value and the Cost of Capital		
If	**Then**	**Capital Budgeting Decision**
NPV < 0	IRR < Cost of Capital	Reject the investment from the cash flow perspective. Other factors could be important.
NPV = 0	IRR = Cost of Capital	Provides the minimum return. Probably reject from the cash flow perspective. Others factors could be important.
NPV > 0	IRR > Cost of Capital	Screen in for further analysis. Other investments may provide better returns and capital should be rationed, i.e., go to the most profitable projects. Others factors could be important.

https://maaw.info/IRRNPVandCostofCapital.htm

3.5 Risk Analysis in Capital Budgeting

Risk refers to the variations in the forecasts. With reference to capital budgeting decisions it refers to the variations in the actual returns arising from a project in its economic life in relation to the estimated return as forecast at the time of initial investment. Degree of risk is more when greater is the variation between estimated returns and actual returns and vice versa. Risk arises because of uncertainty but there is clear demarcation in uncertainty and risk. Uncertainty exist when decision maker is not in position to assign probabilities to the various outcomes (Example: cash inflows or earnings of project) due to lack of historical data whereas risk exits only when a decision maker is in position to assign probabilities to various outcomes. Risk is measured precisely by statistical techniques, namely, Standard Deviation and Coefficient of variation.

While analysing the different techniques of capital budgeting, generally, no consideration is given towards two important elements of investment analysis, namely, risk and uncertainty. Under capital budgeting decisions, the total present value of all the future cash inflows of a particular project are compared with the present value of all the cash outflows. In case, the total present value of all the future cash inflows of a particular project exceeds the present value of net cash outflows, it is assumed that the project is profitable. While estimating the future cash flows, it is generally assumed that future conditions will remain unchanged and no substantial change will take place in the coming period. But this assumption never holds correct. In reality, the future is always uncertain and no-one can predict future correctly. In case, the future have been certain, any of the methods of capital budgeting can be

applied successfully and correct results can be achieved, consequently, the whole process would have been quite smooth and simple. There is always a lot of possibility of diversity in the prediction due to various risks and uncertainties of investment proposals. The cash inflows from the project in coming years will never be almost same as predicted by capital budgeting technique because of potential changes in the economic, social, political, and legal environment. If the cash flows related with a particular proposal are ascertained with certainty NPV, IRR or any other technique can be applied for the evaluation of the proposal. But practically cash flows can't be ascertained with certainty, so to refine the capital budgeting technique all the elements of risk and uncertainty must be given weight age to avoid misleading results. While evaluating investment proposals, it is not always necessary that the risk and uncertainty level of different alternative proposals is same. There may be quite diversities in the level of uncertainty. Hence, risk factor must be taken into consideration whole evaluating capital budgeting proposals.

3.6 Types and Sources of Risks in Capital Budgeting

1. **Project specific risk**: It is the risk that arises due to estimation of errors in earnings and cash flows or some factors that are specific to the project like quality of management etc.
2. **Competition Risk**: This risk arises out of actions of competitors that affect the company's estimated earnings and cash flow of the project in hand. Although a good project analyst always takes into consideration the actions of competitors, but sometimes the actual actions of the competitors may differ from their projected actions.
3. **Industry Specific Risk**: Here the firm's earnings and cash flows are affected due to the industry specific factors like unexpected changes in Technology, legal framework, consumer behaviour natural calamities etc.
4. **International Risk**: Risk of this type arises only in international/foreign projects whose earnings and cash flows affected due to the unexpected exchange rate risk or political risk.
5. **Market risk**: Market risk affects the earnings and cash flows all projects due to unexpected changes macro economic variables like GDP growth rate, interest rate and inflation.

3.7 Incorporation of Risk in Capital Budgeting: There are two methods to incorporate risk into capital budgeting: i) Risk-Adjusted Discount Rate Approach ii) Certainty Equivalent Approach

i) Risk-Adjusted Discount Rate (RADR) Approach: RADR is the rate of return that must be earned on a given project to compensate the firm's owners adequately. In other words it is the discount rate that is used to convert future cash inflows into present value. It is equal to risk free rate plus risk premium for investing in a project which is risky in character. It allows for both time preference and risk preference. Firms use different RADR for different types of capital budgeting. For new and high risky project high RADR, for medium risk project like expansion medium RADR and for less risky project like replacement low RADR is used.

Decision rule:

If NPV method is used Accept NPV>0,   Reject NPV<0   Consider NPV=0**:**

 If IRR method is used Accept IRR>RADR,   Reject IRR<RADR,   Consider IRR=RADR

MERITS:

1. It takes into consideration the time value of money and clearly explains the risk of the project, taking into consideration the discount rate as a result of the risk of the proposal.
2. Risk-adjusted discount rate technique helps in finding out the estimated future assets to be created by the risky project

DEMERITS:

The technique of risk-adjusted discount rate also suffers from the following defects:

1. There is no universally accepted method of calculating the required risk premium rate which is necessary for the application of this technique.

2. This technique does not adjust the future cash flows which is quite risky and uncertain. This drawback can be corrected by the application of probability distribution of cash flows.

    Example: A project is required to invest Rs 3,00,000 has the following expected returns over its estimated life of 6 years.

Years	1	2	3	4	5
Cash Flow After Tax (000) Rs	60	60	100	120	80

    Risk free rate of return 7%. But the decision makers are interested to add 3% as risk premium for the project. You are required to calculate NPV using RADR approach and suggest whether the project is acceptable or not.

Years	Cash Flow After Tax (Rs 000)	Discounting Factor (10%)	Present Values (Rs 000)
1	60	.909	54.54
2	60	.826	49.56
3	100	.751	75.1
4	120	.683	81.96
5	80	.650	52
Total Present Value minus			313.16
cash out flow			-300
NPV			13.16

    Suggestion: Project is acceptable since its NPV Rs. 13160 is greater than zero

ii) Certainty Equivalent Approach: To remove the drawbacks of the

 risk-adjusted discount rate, the technique of certainty equivalent is evolved. It incorporates risk of a project by adjusting the expected cash flows, instead of adjusting discount rate. This approach removes the problems of calculating risk adjusted discount rate, by assigning arbitrary premium for a given level of risk. Estimated cash flows can be converted in certain cash flows.

Process to be applied:

    (i)   Estimation of future cash flows of the project

    (ii)   Calculation of certainty equivalent factor for various years. This factor depicts that proportion of future cash flows for which the finance management will get prepared to accept the exchange for future cash flows.

    (iii)   The estimate cash flows of different years as calculated under step 1 are multiplied with respective certainty equivalents and resultant figure would be certainty equivalent cash flow.

MERITS:

1. It is easy to calculate.

2. This technique involves risk after adjusting those cash flows which are risky.

3. This technique is considered better than the time discount rate technique since it adjusts the cash flows in place of adjusting the discount rate which seems more logical.

DEMERITS:

1. Cash flows involve risk; hence, it is necessary to adjust these cash flows. This requirement is over and above the discount rate. But certainty equivalent approach involves the determination of OE factors which is a boring exercise.

2. There are practical difficulties in its application. Despite all these drawbacks, the certainty equivalent technique is considered theoretically better than the risk-adjusted discount rate technique.

Example: Vishu has asked you to analyze two mutually exclusive projects. You use certainty equivalents (αt) approach to evaluate these projects. From the following information pertaining to these projects, advice Vishu as to which project should be taken up by him:

Year	Proposal X Cash Flow (₹)	αt	Proposal Y Cash Flow (₹)	αt
0	(40,000)	1.00	(30,000)	1.00
1	20,000	0.90	15,000	0.95
2	18,000	0.80	12,000	0.80
3	12,000	0.80	10,000	0.75
4	10,000	0.60	5,000	0.70

The risk-free borrowing and lending rate is **8%**.

Solution: X Project

Year	CFAT (₹)	αt	Adjusted CFAT(₹)	PV factor @8%	Total PV (₹)
0	(40,000)	1.00	(40,000)	1.000	(40,000)
1	20,000	0.90	18,000	0.9260	16,668.00
2	18,000	0.80	14,400	0.8573	12,345.12
3	12,000	0.80	9,600	0.7938	7,620.48
4	10,000	0.60	6,000	0.7350	4,410.00
					41043.60

Total NPV(Rs) Proposal X = 41043.60-40000=1,043.60

Y Project

Year	CFAT (₹)	αt	Adjusted CFAT(₹)	PV factor @8%	Total PV (₹)
0	(30,000)	1.00	(30,000)	1.000	(30,000)
1	15,000	0.95	14,250	0.9260	13,195.50
2	12,000	0.80	9,600	0.8573	8,230.08
3	10,000	0.75	7,500	0.7938	5,953.50
4	8,000	0.70	5,600	0.7350	4,116.00
					31495.08

Total NPV(Rs) Proposal Y = 31,495.08-30000=1495.08

NPV being higher for Proposal Y, this should be preferred and accepted.

3.8 Decision Tree Approach

Chronologically available alternative decisions at different proposals may be known as a decision tree. The estimated cash flows are multiplies with the expectation of the probability of happening of events. Thereafter, values of all the probable events are aggregated. Decision tree approach is a technique to evaluate any risky investment proposal which is used when decisions are sequentially taken and the present decision is effected by the past decisions or present decisions effect the future decisions of the firm. Acceptance or rejection decisions are taken in several situations for the evaluation of projects in capital budgeting. Despite of taking decisions once only, decisions are taken in different positions and in certain parts. There may be more than one alternative in decisions are taken in different positions and in

certain parts. There may be more than one alternative in each and every situation and the firm has to decide every time which alternative must be selected in a particular situation. This decision represents in the form of a picture of a tree and indicates about the quantum of all probable decisions, probability and inters relationship. Steps to be taken in Decisions Tree Approach:

1. The project is divided into clearly defined situations. In some situation, the action is quite simple.

2. In each situation, a list is prepared for possible outcomes. On the basis of available information, the probability of every outcome in each situation is specified. This activity becomes complicated on the increase of more situations.

3. The effect of every outcome on estimated cash flow from the project is specified.

4. In every situation of decision tree, an evaluation of optimum activity is specified.

5. In the very first situation, the estimation of optimum activity is undertaken with the consideration of estimated cash flows of the total projects and potential outcomes of cash flows.

3.9 Capital Rationing: Capital rationing implies such a condition under which a business concern has limited available funds for new investments and many profitable and financially viable proposals exist, but they can't be taken up due to insufficiency of funds. Capital rationing refers to the choice of investment proposal under financial constraints in terms of a given size of capital expenditure budget. The objective of capital rationing is to select the combination of projects that would maximize the total NPV. The project selection under the capital rationing involves two stages i) Identification of the acceptable projects ii) Selection of the combination of projects. The acceptability of projects can be based either on profitability index or IRR

Objectives of capital rationing

a) To make the maximum use of resources available for investment.

b) Selection of the combination of projects that will yield maximum NPV by using the available resources.

Approaches to Capital Rationing: Capital rationing can be of two types: i) Hard rationing and ii) Soft rationing. **Hard Rationing:** refers to the situation when a business firm cannot raise required finance to execute all potential available profitable investment projects. **The soft rationing** is internal to the firms that the different divisions/units of a firm are allocated fixed amount of capital budget each year. Soft rationing is primarily used as a means of control on the capital spending of divisional managers. It does not imply that the firm, as a whole has paucity of funds. In other words the firm can raise required funds if it so desire. The fault of soft rationing is that the firm eventually is deprived of the profitable investment projects (in case divisions happen to have such projects). As a result the imposition of soft rationing is in conflict with the basic goal of the firm of maximization of wealth/value.

3.10 Capital Budgeting Under Capital Rationing:

i) Projects have to be ranked in the order of NPV, profitability index or internal rate of return.

ii) Taking into consideration the objective of maximising the worth of the enterprise and adopting the descending order of profitability of project, go on selecting till the budgetary allocation totally exhausted.

i) Capital Rationing for Divisible Projects: The method of selecting investment project under capital rationing depends upon whether the project is divisible or indivisible. A divisible project can be accepted or rejected in part or whole and indivisible project can be accepted or rejected entirety.

 Example: A company has **Rs.14** crores for its investment disposal. It has evaluated below mentioned options with positive NPV. All these investments proposals are divisible. You are required to advise the management which investment proposal be selected.

Investment Proposals	Initial Outlays(Rs. Crores)	NPV (Rs. Crores)	Profitability Index
A	6	1.2	1.2
B	4	1	1.25
C	5	3	1.6
D	12	3.6	1.3

Solution:

Ranking of Projects in Descending Order of Profitability Index

Ranking of Investment Proposals	Initial Outlays(Rs. Crores)	NPV (Rs. Crores)	Profitability Index
C 1	5	3	1.6
D 2	12	3.6	1.3
B 3	4	1	1.25
A 4	6	1.2	1.2

Suggestions: Accept Investment Proposal C in full and D in part (Rs. 9 crore) as it will maximize the NPV

2. Capital Rationing of Mutually Exclusive Project: Mutually-exclusive projects refer to a set of projects out of which only one project can be selected for investment. One project from mutually exclusive projects excludes all other projects from consideration. A decision to undertake the projects depend upon their NPV. If the NPV/PI of one project is greater than the NPV/PI of the other project, accept the project with the higher NPV/PI.

Example: A firm has Rs. 2.5 lakhs for capital expenditure in a particular year. The profitability index (PI) of eight mutually exclusive investment proposals is provided to you for rendering advice to accept the projects.

Projects	Initial Outlay (in Rs. '000)	Profitability Index (PI)
P_1	25	1.12
P_2	40	1.20
P_3	50	1.15
P_4	70	1.30
P_5	60	1.25
P_6	20	0.98
P_7	30	1.19
P_8	20	0.95

Solution: The basis of selection of the projects in given example is profitability under PI method and rank is assigned accordingly, subject to maximum utilization of available funds:

Projects	Initial Outlay Rs.	Profitability Index (PI)	Rank
P_4	70,000	1.30	1
P_5	.60,000	1.25	2
P_2	40,000	1.20	3
P_7	30,000	1.19	4
P_3	. 50,000	1.15	5
	2,50,000		
P_1	25,000	1.12	6
	2,75,000		

Suggestion: It is clear from the descending order of PI index that the first projects should be selected as the optimum mix since they will completely utilize the available funds amounting to Rs. 2,50,000. Projects P_6 and P_8 are not included in above as their PI is less than unity, hence, are to be rejected.

Self Assessment Questions

1. Briefly discuss the techniques of capital budgeting with their merits and limitations.

2. Compare and contrast NPV with IRR.

3. Describe the traditional techniques of capital budgeting evaluation.

4. Write notes on:- Profitability index, capital rationing Payback period, Risk adjusted discount rate, Certainty equivalent approach, Decision tree analysis.

5. What is capital rationing? Explain the various approaches to capital rationing.

6. Distinguish between capital budgeting and capital rationing.

7. Why capital budgeting decisions are crucial?

Suggested Book Readings:

1. Financial Management:- By M Y Khan and P K Jain, Tata McGraw Hill Education Private Limited.

2. Financial Management:- By I M Pandy, Vikas Publishing House PVT. LTD.

3. Financial Management:- By G Sudarsana Reddy, Himalya Publishing House.

4. Financial Management:- By Shashi K Gupta and R K Sharma, Kalyani Publishers