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Chapter-5
Capital Budgeting Evaluation Techniques

Methods of Appraisal

Investment appraisal methods can be divided into two basic areas. One in which no time value of money is taken into consideration and one in which it is. Using time value of money while evaluating projects is known as discounting.

A. Non-Discounting Methods
   - Urgency
   - Payback Period
   - Accounting Rate of Return
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B. Discounting Methods
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Non-discounting Methods

Urgency

According to this critera, projects which are deemed to be more urgent get priority over projects which are regarded as less urgent.

The problem with this criterion is: How can the degree of urgency be determined? In certain situations, of course, it may not be difficult to identify highly urgent investments. For example, some minor equipment may have to be replaced immediately due to failure, to ensure continuity of production. Non-replacement of such equipment may mean considerable losses arising from stoppage in production. It may be futile in such a case to go into detailed analysis and delay decision.

In view of these limitations of the urgency criterion, we suggest that in general it should not be used for investment decision making. In exceptional cases, where genuine urgency exists, it may be used provided investment outlays are not significant.

Payback Period

Payback period is the most widely used technique and can be defined as the number of years required to recover the cost of the investment. This is easy to calculate, but is often calculated before tax, and always after accounting depreciation. By definition, the payback period ignores income beyond this period, and it can thus be seen to be more as a measure of liquidity than of profitability.

The payback period is the length of time required to recover the initial cash outlay on the project. For example, if a project involves a cash outlay of Rs 6,00,000 and generates cash inflows of Rs 1,00,000, Rs 1,50,000, Rs 1,50,000 and Rs 2,00,000 in the first, second, third and fourth years respectively, it payback period is four years because the sum of cash inflows during four years is equal to the initial outlay. When the annual cash inflow is a constant sum, the payback period is simply the initial outlay divided by the annual cash inflow. For example, a project which has an initial cash outlay of Rs 10,00,000 and constant annual cash inflow of Rs 3,00,000 has a payback period of Rs. 10,00,000/Rs 3,00,000 = 3.1/3 years.

According the payback criteria, the shorter the payback period, the more desirable the project. Firms using this criterian, generally specify the maximum acceptable payback period. If this is n years, projects with a payback period of n years or less are deemed worthwhile, and projects with a payback period exceeding n years are considered unworthy.

Projects with long payback periods are characteristically those involved in long range planning, and which determine a firm's future. However, they may not yield their highest returns for a number of years and the result is that the payback method is biased against the very investments that are most important to long term success.

Evaluation

A widely used investment criterion, the payback period seems to offer the following advantages.

- It is simple, both in concept and application. It does not use comlex concepts and tedious calculations and has few hidden assumptions.
- It is a rough and ready method for dealing with risk. It favours projects which generate substantial cash inflows in earlier years and discriminates against projects which bring substantial cash inflows in later years but not in earlier years. Now, if risk tends to increase with futurity - in general, this may be true - the payback criterion may be helpful in weeding out risky projects.
- Since it emphasises earlier cash inflows, it may be a sensible criterion when the firm is pressed with problems of liquidity.

The limitations of the payback criteria, however, are very serious:

- It fails to consider the time value of money. Cash inflows, in the payback calculation, are simply added without suitable discounting. This violates the most basic principle of financial analysis which stipulates that cash flows occurring at different points of time can be added or subtracted only after suitable compounding / discounting.
- It ignores cash flows beyond the payback period. This leads to discrimination against projects which generate substantial cash inflows in later years. To illustrate, consider the cash flows of two projects, A and B:

Year	Cash flow of A	Cash flow of B
0	-1,00,000	-1,00,000
1	50,000	20,000
2	30,000	20,000
3	20,000	20,000
4	10,000	40,000
5	10,000	50,000
6		60,000

The payback criteria prefers A, which has a payback period of 3 years, in comparison to B, which has a payback period of 4 years, even though B has very substantial cash inflows in years 5 and 6.

- Since the payback period is a measure of a projects' capital recovery, it may divert attention from profitability. Payback has harshly, but not unfairly, been described as the "fish bait test since effectively it concentrates on the recovery of the bait (the capital outlay) paying not attention to the size of the fish (the ultimate profitability), if any."
- Though it measures a project's liquidity, it does not indicates the liquidity position of the firm as a whole, which is more important.

Accounting Rate of Return

The accounting rate of return, also referred to as the average rate of return or the simple rate, is a measure of profitability which relates income to investment, both measured in accounting terms. Since income and investment can be measured variously, there can be a very large number of measures for accounting rate of return.

The measures that are employed commonly in practice are:

$$A : \frac{\text{Average income after tax}}{\text{Initial investment}}$$

$$B: \frac{\text{Average income after tax}}{\text{Average investment}}$$

$$C: \frac{\text{Average income after tax but before interest}}{\text{Initial investment}}$$

$$D: \frac{\text{Average income after tax but before interest}}{\text{Average investment}}$$

$$E: \frac{\text{Average income before income and taxes}}{\text{Initial investment}}$$

$$F: \frac{\text{Average income before income and taxes}}{\text{Average investment}}$$

$$G: \frac{\text{Total income after tax but before depreciation - Initial investment}}{2} \times \frac{\text{Initial investment}}{\text{Yrs.}}$$

This method is superior to the payback period, but is fundamentally unsound. While it does take account of the earnings over the entire economic life of a project, it fails to take account of the time value of money. This weakness is made worse by the failure to specify adequately the relative attractiveness of alternative proposals. It is biased against short term projects in the same way that payback is biased against longer term ones.

Evaluation

Traditionally as a popular investment appraisal criterion, the accounting rate of return has the following virtues:

- It is simple to calculate.
- It is based on accounting information which is readily available and familiar to businessmen.
- It considers benefits over the entire life of the project.
- Since it is based on accounting measures, which can be readily obtained from the financial accounting system of the firm, it facilitates post-auditing of capital expenditures.
- While income data for the entire life of the project is normally required for calculating the accounting rate of return one can make do even if complete income date is not available. For example, when due to indeterminacy of project life a complete forecast of income cannot be obtained, the accounting rate of return can be calculated on the basis of income for some typical year or income for the first three to five years.

The shortcomings of the accounting rate of return criterion seem to be considerable:

- It is based upon accounting profit, not cash flow.
- It does not take into account the time value of money. To illustrate this point, consider two investment proposals X and Y, each requiring an outlay of Rs 1,00,000. Both the proposals have an expected life of four years after which their value would be nil. Relevant details of these proposals are given below:

PROPOSAL X				
Year	**Book Value**	**Depreciation after tax**	**Profit**	**Cash**
0	1,00,000	0	0	1,00,000
1	75,000	25,000	40,000	65,000
2	52,000	25,000	30,000	55,000
3	50,000	25,000	20,000	45,000
4	0	25,000	10,000	35,000

PROPOSAL Y				
Year	**Book Value**	**Depreciation after tax**	**Profit**	**Cash**
0	(1,00,000)	0	0	(1,00,000)
1	70,000	25,000	10,000	35,000
2	50,000	25,000	20,000	45,000
3	25,000	25,000	30,000	55,000
4	0	25,000	40,000	65,000

Both the proposals, with an accounting rate of return (measure A) of 50% look alike from the accounting rate of return point of view, though project X, because it provides benefits earlier, is much more desirable. While the payback period criterion gives no weight to more distant benefits, the accounting rate of return criteria seems to give them too much weight.

- There are, as we have seen, numerous measures of accounting rate of return. This can create controversy, confusion and more confusion, and problems in interpretation.
- Accounting income (whatever particular measure of income we choose) is not uniquely defined because it is influenced by the methods of depreciation, inventory valuation, and allocation of certain costs. Working with the same basic accounting data, different accountants are likely to produce different income figures. A similar problem, though less severe, exists with respect to investment.
- The argument that the accounting rate of return measure facilitates post-auditing of capital expenditure is not very valid. The financial accounting system of a firm

is designed to report events with respect to accounting periods and for profit centres but not for individual investment.

Debt Service Coverage Ratio

Financial institutions, which provide the bulk of long-term finance for industrial projects, evaluate the financial viability of a project primarily in terms of the internal rate of return and the debt service coverage ratio.

$$DSCR = \frac{\sum_{i=1}^{n}(PAT_i + D_i + I_i)}{\sum_{i=1}^{n}(I_i + LTI_i)}$$

Debt service coverage ratio (DSCR) is defined as

where PAT_i = Profit after tax for year i

D_i = depreciation for year i

I_i = interest on long-term loans of financial institutions for year i

LRI_i = loan repayment instalment for year i.

n = period over which the loan has be repaid.

Looking at the debt service coverage ratio we find the numerator consists of a mixture of post-tax and pre-tax figures (profit after tax is a post tax figure and interest is a pre-tax figure). Likewise, the denominator consists of mixture of post-tax and pre-tax figures (loan repayment installation is a post-tax figure and interest is a pre-tax figure). It is difficult to interpret a ratio which is based on a mixture of post-tax and pre-tax figures. In view of this difficulty, we suggest two alternatives :

Alternative 1:

$$DSCR = \frac{\text{Earnings before depreciation interest and taxes}}{\dfrac{\text{Interest + Loan repayment instalment}}{\text{1 - Tax rate}}}$$

Alternative 2:

$$DSCR = \frac{\text{Profit after tax + Depreciation}}{\text{Loan repayment instalment}}$$

While alternative 1 is based on pre-tax figures, alternative 2 is based on post-tax figures.

There is one more difference. Alternative 1, assumes that the interest and loan repayment obligations are of the same order and focuses on the ability of the firm to meet these obligations jointly. Alternative 2 assumes that the interest burden is of a higher priority, and focuses on the ability of the firm to meet the principal repayment obligation, once the interest obligation is fully met.

These traditional methods of investment appraisal are misleading to a dangerous extent. A means of measuring cash that allows for the importance of time is needed. This is provided by the discounting methods of appraisal, of which there are basically two methods, both of which meet the objections to the payback period and the average rate of return methods.

Discounting Methods of Appraisal

Net Present Value

The net present value of a project is equal to the sum of the present value of all the cash flows associated with the project. One of the most important concepts originating from the time value of money, NPV is calculated by subtracting the present value of the cash outflows (investment) from the present value of the cash inflows (income).

Suppose you are making an investment of Rs 1 lac today and are expecting that you will get Rs 1.1 lacs one year from now. You will only invest if the present value of Rs 1.1 lac that you are getting one year hence is more than Rs 1 lac you have invested today. Using the table for present value of Rs 1, the multiplying factor for one year at 10% is 0.909. If we multiply Rs 1.1 lac with .909 we get approx. Rs 1 lac. This means that we are getting a return of 10% from the project.

If you again look at the same table, the value gets lowered as the interest rate increases, which means that for an interest rate of more than 10% we will be getting a present value which will be lower than the investment we are making. So if we are expecting a return of 15% for one year, we will not invest as the present value of Rs 1.1 lac at 15% discount rate is lower than the investment of Rs 1 lac we are making today.

The formula for calculating the NPV is:

where NPV = net present value

CF_t = cash flow occurring at the end of year

C0 = Initial cash out flow or investment

t = (t = 0 .....n), A cash inflow has a positive sign, whereas a cash outflow has a negative sign

n = life of the project

k = cost of capital used as the discount rate

Here C0 is the initial investment we are making into the project and the rest is the present value of the cash flows we are expecting in the future. So NPV is the difference between the two at the expected rate of return.

With NPV the acceptance rule is

NPV > 0 Accept

= 0 Indifferent

< 0 Reject

If the NPV is greater than zero we accept the project because we are getting a rate of return which exceeds our desired rate of return, if it is equal to zero we may or may not accept the project as we are getting a return which is exactly equal to our desired rate of return, and if it is less than zero we reject the project proposal because the rate of return we are getting is less than our desired rate of return.

Features of Net Present Value

Two features of the net present value method to be emphasised :

1. The NPV method is based on the assumption that the intermediate cash inflow of the project is reinvested at a rate of return equal to the firm's cost of capital.
2. The NPV of a simple project monotonically decreases as the discount rate increases; the decrease in NPV, however, is at a decreasing rate.

Evaluation

Conceptually sound, the net present value criterion has considerable merits:

- It takes into account the time value of money.
- It considers the cash flow stream in its entirety.
- It squares neatly with the financial objective of maximisation of the wealth of stockholder. The net present value represents the contribution to the wealth of stockholders.
- The net present value of various projects, measured as they are in today's rupees, can be added. For example, the present value of package consisting of two projects A and B, will simply be the sum of the net present value of these projects individually:

  NPV (A+B) = NPV (A) + NPV (B)

The additivity property of net present value ensures that a poor project (one which has

a negative net present value) will not be accepted just because it is combined with a good project (which has a positive net present value).

The limitations of the net present value criteria are:

- The ranking of projects on the net present value dimension is influenced by the discount rate. To illustrate, consider two mutually exclusive projects - A and B which have the following cash flow streams :

Year	A	B
0	-3,00,000	-3,00,000
1	60,000	1,30,000
2	1,00,000	1,00,000
3	1,20,000	80,000
4	1,50,000	60,000

The net present value of A and B for various rate of discounts is given below.

Discount rate	NPV (A)	NPV (B)
10%	36,622	29,180
12	20,390	17,658
14	5,318	6,828
15	-1,826	1,654
16	-8,702	-3,350

Looking at the behaviour of net present value, we find that : (i)when the discount rate is 12 per cent , the net present value of A is greater than the net present value of B; and (ii) when the discount rate is 14 per cent the net present value of B is greater than the net present value of A.

- The net present value measure, an absolute measure, does not appear very meaningful to businessmen who want to think in term of rate of return measures.

Profitability Index (PI)

Profitability Index relates the present value of benefits to the initial investment. It is also known as Benefit-Cost Ratio (BCR)

$$PI = \frac{PVCF}{I}$$

where , PI = Profitability Index

PVB = present value of cash flows

I = initial investment

To illustrate the calculation of these measures, let us consider a project which is being evaluated by a firm that has a cost of capital of 12 per cent.

Initial investment :	**Rs. 1,00,000**
Year 1	25,000
Year 2	40,000
Year 3	40,000
Year 4	50,000

The profitability index for this project is:

$$PI = \frac{\frac{25,000}{(1.12)1} + \frac{40,000}{(1.12)2} + \frac{40,000}{(1.12)3} + \frac{50,000}{(1.12)4}}{1,00,000} = 1.145$$

With PI the acceptance rule is

PI > 1 Accept

$= 1$ Indifferent

< 1 Reject

If PI is greater than one we accept the project because we are getting a rate of return which exceeds our desired rate of return. If it is equal to one we may or may not accept the project as we are getting a return which is exactly equal to our desired rate of return. If it is less than one we reject the project proposal because the rate of return we are getting is less than our desired rate of return.

Putting it simply PI is an adaptation of the NPV rule because through it uses the same figures it only helps in ranking of the project.

Evaluation

The proponents of profitability index argue that since this criterion measures net present value per rupee of outlay it can discriminate better between large and small investments and hence is preferable to the net present value criterion. How valid is this argument ? Theoretically, it can be very easily verified that:

(i) Under unconstrained conditions, the PI criteria will accept and reject the same projects as the net present value criteria.

(ii) When the capital budget is limited in the current period, the benefit cost ratio criteria may rank projects correctly in the order of decreasingly efficient use of capital. However, its use is not recommended because it provides no means for aggregating several smaller projects into a package that can be compared with a large project.

(iii) When cash outflows occur beyond the current period, PI criteria is unsuitable as a selection criteria.

Internal Rate of Return

When the present value of cash inflows are exactly equal to the present value of cash outflows we are getting a rate of return which is equal to our discounting rate. In this case the rate of return we are getting is the actual return on the project. This rate is called the IRR.

$$NPV = \sum_{i=1}^{n} \frac{CF_t}{(1+k)^t} - C_0$$

Using the same formula as given in the NPV above, IRR will be the return when the NPV is equal to zero as only then the present value of cash inflows will be equal to the present value of the cash outflows.

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

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

here CFt = cash flow at the end of year t

r = discount rate

n = life of the project

In the net present value calculation we assume that the discount rate (cost of capital) is known and determine the net present value of the project. In the internal rate of return calculation, we set the net present value equal to zero and determine the discount rate (internal rate of return) which satisfies this condition.

Both the discounting methods NPV and IRR relate the estimates of the annual cash outlays on the investment to the annual net of tax cash receipt generated by the investment. As a general rule, the net of tax cash flow will be composed of revenue less taxes, plus depreciation. Since discounting techniques automatically allow for the recovery of the capital outlay in computing time-adjusted rates of return, it follows that depreciation provisions implicitly form part of the cash inflow.

Internal rate of return method consists of finding that rate of discount that reduces the present value of cash flows (both inflows and outflows attributable to an investment project to zero. In other words, this true rate is that which exactly equalises the net cash proceeds over a project's life with the initial investment outlay.

If the IRR exceeds the financial standard (i.e. cost of capital), then the project is prima facie acceptable. Instead of being computed on the basis of the average or initial investment, the IRR is based on the funds in use from period to period.

The actual calculation of the rate is a hit-and-miss exercise because the rate is unknown at the outset, but tables of present values are available to aid the analyst. These tables show the present value of future sums at various rates of discount and are prepared for both single sums and recurring annual payments.

What Does IRR Mean?

There are two possible economic interpretations of internal rate of return: (i) Internal rate of return represents the rate of return on the unrecovered investment balance in the project. (ii) Internal rate of return is the rate of return earned on the initial investment made in the project.

Evaluation

A popular discounted cash flow method, the internal rate of return criteria has several virtues :

- It takes into account the time value of money.
- It considers the cash flow stream in its entirety.
- It makes sense to businessmen who want to think in terms of rate of return and find an absolute quantity, like net present value, somewhat difficult to work with.

The internal rate of return criteria, however, has its own limitations.

- It may not be uniquely defined. If the cash flow stream of a project has more than one change in sign, there is a possibility that there are multiple rates of return.
- The internal rate of return figure cannot distinguish between lending and borrowing and hence a high internal rate of return need not necessarily be a desirable feature.

The internal rate of return criterion can be misleading when choosing between mutually exclusive projects that have substantially different outlays. Consider projects P and Q

Cash Flows ---------- Period 0 1	Internal rate of return (%)	Net present value (assuming k = 12%)
P - 10,000 + 20,000	100	7,857
Q - 50,000 + 75,000	50	16,964

Both the projects are good, but Q, with its higher net present value, contributes more to the wealth of the stockholders. Yet from an internal rate of return point of view P looks better than Q. Hence, the internal rate of return criterion seems unsuitable for ranking projects of different scale.

Comparison of Discounting Methods

In ordinary circumstances, the two discounting approaches will result in identical investment decisions. However, there are differences between them that can result in conflicting answers in terms of ranking projects according to their profitability.

In formal accept/reject decisions, both methods lead to the same decision, since all projects having a yield in excess of the cost of capital will also have a positive net present value.

Example

Project A and B both require an outlay of Rs 1000 now to obtain a return of Rs 1150 as the end of year 1 in the case of A, and 1405 at the end of year 3 in the case of B. The cost of capital is 8%.

Internal rate of return	A = 15%
	B = 12%
Net present value	A = (1150 x 0.926) - 1000 = Rs.65
	B = (1405 x 0.794) - 1000 = Rs.115

Both project have rates of return in excess of 8% and positive net present value; but on the basis of the internal rate of return method, project A is superior, while on the basis of the net present value method, project B is superior.

Confusion arises because the projects have different lengths of the life, and if only one of the projects is to be undertaken, the internal rate of return can be seen to be unable to discriminate satisfactorily between them. As with any rate of return, there is no indication of either the amount of capital involved or the duration of the investment. The choice must be made either on the basis of net present values, or on the return on the incremental investment between projects.

The two methods make different implicit assumptions about the reinvesting of funds received from projects-particularly during the "gaps" between the end of one and the end of another.

The net present value approach assumes that cash receipts can be reinvested at the company's cost of capital, thereby giving a bias in favour of long-lived projects. In contrast, the internal rate of return approach assumes that cash receipts are reinvested at the same rate, giving a bias in favour of short-lived projects.

It follows that the comparison of alternatives by either method must be made over a common time period, with explicit assumptions being made about what happens to funds between their receipt and the common terminal date.

Capital Rationing

In terms of financing investment projects, three essential questions must be asked:

1. How much money is needed for capital expenditure in the forthcoming planning period?
2. How much money is available for investment?
3. How are funds to be assigned when the acceptable proposals require more money than is available?

The first and third questions are resolved by reference to the discounted return on the various proposals, since it will be known which are acceptable, and in which order of preference. The second question is answered by a reference to the capital budget. The level of this budget will tend to depend on the quality of the investment proposals submitted to top management. In addition, it will also tend to depend on:

- top management's philosophy towards capital spending (e.g., is it growth - minded or cautious:)?
- the outlook for future investment opportunities that may be unavailable if extensive current commitments are undertaken;
- the funds provided by current operations; and
- the feasibility of acquiring additional capital through borrowing or equity issues.

It is not always necessary, of course, to limit the spending on projects to internally generated funds. Theoretically, projects should be undertaken to the point where the return is just equal to the cost of financing these projects. If safety and the maintaining of, say, family control are considered to be more important than additional profits, there may be a marked unwillingness to engage in external financing and hence a limit will be placed on the amounts available for investment.

Even though the firm may wish to raise external finance for its investment programme, there are many reasons why it may be unable to do this. Examples include:

a) The firm's past record and its present capital structure may make it impossible or extremely costly to raise additional debt capital.

b) The firm's record may make it impossible to raise new equity capital because of low yields or even no yield.

c) Covenants in existing loan agreements may restrict future borrowing.

Furthermore, in the typical company, one would expect capital rationing to be largely self-imposed.

Each major project should be followed up to ensure that it conforms to the conditions on

which it was accepted, as well as being subject to cost control procedures.

Inflation and Capital Budgeting

One of the major mistakes is improper treatment of inflation in capital budgeting decisions. The capital budgeting results would be unrealistic if the impact of inflation is not correctly factored in the analysis as the cash flow estimates will not reflect the real purchasing power. In other words, cash flows would be shown at inflated sums and, to that extent, cause distortion in capital budgeting decisions. Therefore, cash flows should be adjusted to accommodate the inflation factor so that the capital budgeting decisions reflect the 'true' picture. This Section dwells on the procedure for adjusting data for inflation. Consider Example 2.2

An investment proposal P requires an initial capital outlay of Rs. 2,00,000, with no salvage value, and will be depreciated on a straight line basis for tax purposes. The earnings before depreciation and taxes (EBDT) during its 5 year life are:

Year	1	2	3	4	5
EBDT (Rs.)	70,000	76,000	80,000	60,000	52,000

Example 2.2

The corporate tax rate is 35 per cent and the company evaluates its investment projects at 12 per cent cost of capital. Advice the company whether the project should be accepted. (i) when there is no inflation and (ii) when there is inflation at the rate of 15 per cent per annum, and the stated gross earnings are also expected to grow at this rate of inflation.

Solution

Determination of NPV (No Inflation situation)

(Amount in rupees thousand)

Year	*PBDT*	*Depre-ciation (200/5)*	*Taxable Income*	*Profit After Tax (Inc.x0.65)*	*Cash Flow After Tax (PAT+Dep)*	*PV Factor*	*Present Value*
1	70	40	30	19.5	59.5	0.893	53.13
2	76	40	36	23.4	63.4	0.797	50.53
3	80	40	40	26.0	66.0	0.712	46.99
4	60	40	20	13.0	53.0	0.636	33.71
5	52	40	12	7.8	47.8	0.567	27.10
Gross present value							211.46
Less: Cash outflows							200.00
Net present value							11.46

Since the net present value is positive, the project is worth accepting in a non-inflationary scenario.

In an inflationary situation, PBDT are expected to grow at 15 per cent. PBDT can be determined (reflecting 15 per cent compound rate of growth) using the table. As amount of depreciation remains unchanged, taxable profits as well as taxes would go up as exhibited below:

Year	*PBDT*	*Compo- unding Factor At 0.15*	*Revised PBDT (PBDT X Com. Fac.)*	*Depre- ciation*	*Taxable Income*	*PAT*	*CFAT*
1	70	1.150	80.50	40	40.50	26.32	66.32
2	76	1.322	100.47	40	60.47	39.31	79.31
3	80	1.521	121.68	40	81.68	53.09	93.09
4	60	1.749	104.94	40	64.94	42.21	82.21
5	52	2.011	104.57	40	64.57	41.97	81.97

Since CFAT are inflated sums, they are to be deflated at the rate of inflation (15 per cent) to determine real cash flows. The relevant calculations are as follows:

Determination of Real Cash Flows

(Amount in thousand rupees)

Year	*CFAT*	*Discount/ deflated factor at 0.15*	*Real cash inflows (CFAT)*
1	66.32	$1/1.15 = 0.870$	57.50
2	79.31	$1/(1.15)^2 = 0.756$	59.96
3	93.09	$1/(1.15)^3 = 0.658$	61.25
4	82.21	$1/(1.15)^4 = 0.572$	47.02
5	81.97	$1/(1.15)^5 = 0.497$	40.74

The real cash flows are substantially lower than nominal cash flows. This is due to the fact that increased income (as depreciation charges do not change) is subject to higher amount of taxes. The corporate tax rate is more than twice (35 per cent) the inflation rate (15 per cent). The NPV and real cash inflows are shown in the following tables.

NPV Calculations

(Amount in thousand rupees)

Year	*Real CF*	*PV factor at 12%*	*Present Value*
1	57.70	0.893	51.53
2	59.96	0.797	47.79
3	61.25	0.712	43.61
4	47.02	0.636	29.90
5	40.74	0.567	23.10
Gross present value			195.93
Less: Cash outflows			200.00
Net present value			(4.07)

Since the NPV is negative under inflationary situations, the investment proposal is not acceptable. Thus, inflation results both in lower cash flows and lower real rates of

return. Example 2.2 highlights that firms (conscious of protecting the real purchasing power of their owners) may go for unprofitable investment projects, affecting the shareholders wealth adversely. It underlines the significance of incorporating the inflation factor in evaluating capital budgeting decisions, in particular for business firms interested in real returns.

Consistency warrants that the real cost of capital should be used to discount real cash inflows after taxes and the nominal cost of capital should be employed for nominal CFAT. This point is illustrated in Example 2.3. The investment data of Rajiv Company Ltd. Launching a new product and with 12 per cent cost of capital, is as follows:

Particular	*Amount*
Investment	Rs.7,00,000
CFAT: Year 1	5,00,000
2	4,00,000
3	2,00,000
4	1,00,000
5	1,00,000

Example 2.3

Assuming an inflation rate of 5 per cent, determine NPV of the project by using both the nominal rate of discount and the real rate of discount.

Solution

NPV Using Nominal Rate of Discount

Year	CFAT (Rs.)	PV factor at 0.12	Total PV (Rs.)
1	5,00,000	0.893	4,46,500
2	4,00,000	0.797	3,18,800
3	2,00,000	0.712	1,42,400
4	1,00,000	0.636	63,600
5	1,00,000	0.567	56,700
Gross present value			10,28,000
Less: Cash outflows			7,00,000
Net present value			3,28,000

The nominal rate of discount (n) is obtained by compounding the real rate (r) and inflation rate (i). In equations terms, it is

$$(1 + n) = (1 + r)(1 + i)$$

$$(1 + r) = (1 + n)(1 + i)$$

or

substituting the values,

$(1 + r) = 1.12/1.05 = 1.0667$

$r = 0.0667$ or 6.67 per cent.

or

Since the discount rate now to be used is the real discount rate, the CFAT should also be adjusted for inflation so that they too are expressed in real terms. In operational terms, CFAT will be deflated by the inflation rate (5 per cent). While Table 5.1 shows real/ defleted CFAT, NPV of real CFAT is provided in Table 5.2

Real Cash Flows

Year	*CFAT (Rs.)*	*Deflation factor at 0.05*	*Real CFAT (Rs.)*
1	5,00,000	1/(1.05) = 0.952	4,76,00
2	4,00,000	$1/(1.15)^2 = 0.907$	3,62,800
3	2,00,000	$1/(1.15)^3 = 0.864$	1,72,800
4	1,00,000	$1/(1.15)^4 = 0.823$	82,300
5	1,00,000	$1/(1.15)^5 = 0.784$	78,400

Table 5.1

NPV Using Real Rate of Discount

Year	*Real CFAT*	*PV factor at 6.67%*	*Total PV*
1	4,76,000	0.938	4,46,488
2	3,62,800	0.879	3,18,901
3	1,72,800	0.824	1,42,387
4	82,300	0.772	63,536
5	78,400	0.724	56,761
Gross present value			10,28,073
Less: Cash outflows			7,00,000
Net present value			3,28,073

Table 5.2

Please note that 'real cash flows discounted at the 'real' discount rate yield an identical amount of NPV that is obtained by discounting 'nominal' cash flows by the 'nominal' discount rate. When estimates of CFAT and cost of capital include inflation, they are said to be expressed in nominal terms; when such estimates exclude the impact of inflation, they are said to be shown in real terms. For correct analysis, these estimates should either be stated in nominal or real terms. It implies that capital budgeting decisions should either reckon the inflation factor in CFAT, as well as the cost of capital, or exclude it completely.

Chapter-6
Capital Budgeting under Risk and Uncertainties

Risk is used to describe the type of situation in which there are a number of possible states of nature, hence outcomes, but in which the decision maker can reasonably assess the probability of occurrence of each. Thus risk can be expressed in quantitative terms.

Under conditions of uncertainty, in contrast, it is recognised that several out-comes are possible, but the decision-maker is unable to attach probabilities to the various states of nature.

The liability is usually due to a lack of data on which to base a probability estimate. For instance, in launching a new product, the marketing manager may have an idea of what the sales in year 1 are likely to be, but he must accept that the actual level will be one of many possible levels. However, the marketing manager may be unable to specify the probability of each level being achieved, making it an uncertainty situation.

There is also, of course, the situation of complete certainty. This relates to a decision over which the decision-maker has complete control, and is thus likely to be confined to the production sphere. This is so because the existence of external agents in marketing and distribution means that knowledge is incomplete, and the creative aspect of R & D means that outcomes are unknown in advance.

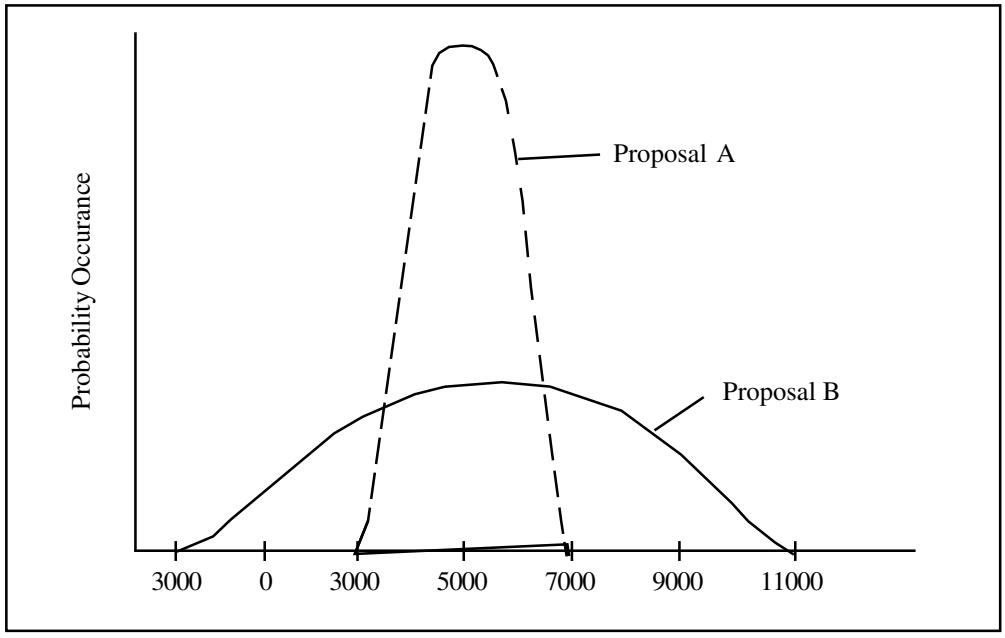
If a finance manager feels he knows exactly what the outcomes of a project would be and is willing to act as if no alternative were in existence, he will be presumably acting under conditions of certainty. Thus, certainty is a state of nature, which arises when outcomes are known and determinate. In this state each action is known to lead invariably to a .specific outcome. For example, if one invests Rs. 20,000 in five yearly central government bonds which is expected to yield 7 per cent tax free return, then the return on the investment @ 7 per cent can be estimated quite precisely. This is so because we assume the Government of India to be one of the most stable forces in this country. Thus, the outcome is known to have a probability of 1. Since we know how things are or will be, the decision strategy is deterministic, we simply evaluate alternative actions and select the best one.

Risk involves situations in which the probabilities of an event occurring are known and these probabilities are objectively or subjectively determinable. The main attribute of

risk situation is that the event is repetitive in nature and possesses a frequency distribution. It is the inability to predict with perfect knowledge the course of future events that introduces risk. As events become more predictable, risk is reduced. Conversely, as events become less predictable, risk is increased. Thus, if Rs. 10 lakhs is invested in stock of a company organised to extract coal from a mine, and then the probable return cannot be predicted with 100 per cent certainty. The rate of return on the above investment could vary from minus 100 per cent to some extremely high figure and *because* of this high variability; the project is regarded as relatively risky. Risk is then associated with project variability - the more variable the expected future returns from the project, the riskier the investment.

In contrast, when an event is not repetitive and unique in character and the finance manager is not sure about probabilities themselves, uncertainty is said to prevail. Uncertainty is a subjective phenomenon. In such situation no observation can be drawn from frequency distributions. We have no knowledge about the probabilities of the possible outcomes. It follows that if the probabilities are completely unknown or are not even meaningfully known the expected value of any decisions cannot be determined. Practically no generally accepted methods could so far be evolved to deal with situation of uncertainty while there are a number of techniques to deal with risk. In view of this, the term risk and uncertainty will be used interchangeably in the following discussion.

With the introduction of risk no company can remain indifferent between two investment projects with varying probability distributions as shown in Figure 6.1 Although each investment inflows of Rs. 5,000 in its three-year life.



A look at the Figure 6.1 will make it crystal clear that dispersion of the probability distribution of expected cash flows for proposal B is greater than that for proposal A. Since the task is associated with the deviation of actual outcome from that which was expected, proposal B is the riskier investment. This is why risk factor should be given due importance in investment analysis.

Sources of Risk

The first step in risk analysis is to uncover the major factors that contribute to the risk of the investment. Four main factors that contribute to the variability of results of a particular investment are cost of project, investment of cash flows, variability of cash flows and life of the project.

1. Size of the Investment

A large project involving greater investments entails more risk than the small project because in case of failure of the large project the company will have to suffer considerably greater loss and it may be forced to liquidation. Furthermore, cost of a project in many cases is known in advance. There is always the chance that the actual cost will vary from the original estimate. One can never foresee exactly what the construction, debugging, design and developmental costs will be. Rather than being satisfied with a single estimate, it seems more realistic to specify a range of costs and the probability of occurrence of each value within the range. The less confidence the decision maker has in his estimate, the wider will be the range.

2. Reinvestment of Cash Flows

Whether a company should accept a project that offers a 20 per cent return for 2 years or one that offers a 16 per cent return for 3 years would depend upon the rate of return available for reinvesting the proceeds from the 20 per cent, 2-year period. The danger that the company will not be able to reinvest funds as they become available is a continuing risk in managing fixed assets and cash flows.

3. Variability of Cash Flows

It may not be an easy job to forecast the likely returns from a project. Instead of basing investment decision on a single estimate of cash flow it would be desirable to have range of estimates.

4. Life of the Project

Life of a project can never be determined precisely. The production manager should base the investment decision on the range of life of the project.

Techniques for Handling Risk and Uncertainty

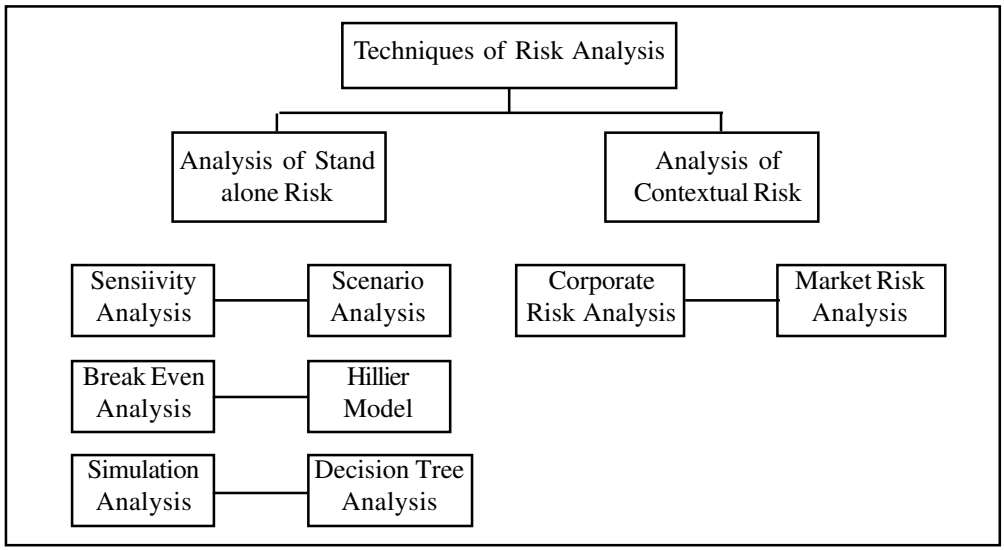
Risk analysis is one of the most complex and slippery aspects of capital budgeting. Many different techniques have been suggested and no single technique can be deemed

as best in all situations. The variety of techniques suggested to handle risk in capital budgeting fall into two broad categories: (i) Approaches that consider the stand-alone risk of a project; (ii) Approaches that consider the risk of a project in the context of the firm or in the context of the market. Exhibit 6.2 classifies various techniques into these two broad categories.

This chapter discusses different techniques of risk analysis (except market risk analysis which is covered in the chapter on Cost of Capital), explores various approaches to project selection under risk, and describes risk analysis in practice. It is divided into nine sections as follows:

- Sensitivity analysis
- Scenario analysis
- Break-even analysis
- Hillier model
- Simulation analysis
- Decision tree analysis
- Corporate risk analysis

Project selection under risk. Risk analysis in practice.



Sensitivity Analysis

Since future is uncertain, you may like to know what happens to the viability of a project when some variable like sales or investment deviates from its expected value. In other words, you would like to do sensitivity analysis. Also called "what if' analysis it answers questions like:

What happens to net present value (or some other criterion of merit) if sales are only 60,000 units rather than the expected 75,000 units9 What happens to net present value if the life or the project turns out to be only 8 years, rather than the expected 10 years?

Procedure

Fairly simple, sensitivity analysis consists of the following steps:

1. Set up the relationship between the basic underlying factors (like the quantity sold, unit selling price, life of the project, etc.) and net present value (or some other criterion of merit).
2. Estimate the range of variation and the most likely value of each of the basic underlying factors.
3. Study the effect on net present value of variations in the basic variables. (Typically one factor is varied at time.)

Illustration

Anischit Enterprises is analysing an investment proposal. The following net present value relationship has been set up:

$$NPV = \sum_{t=1}^{n} \frac{[Q(P-V)-F-D](1-T)+D}{(1+r)^t} + \frac{S}{(1+r)^n} - 1 \qquad ...(8.1)$$

where NPV = net present value of the project

Q = number of units sold annually
P = selling price per unit
V = variable cost per unit
F = total fixed cost, excluding deprecation and interest
D = annual depreciation charge
T = income tax rate
r = cost of capital
n = project life in years
S = net salvage value
I = initial cost.

The range and most likely value of each of the basic variables are given in Table 6.3

Variables Rs.	Range Rs.		Most Likely Value
Q	1,000 -	2,000	1,600
P	600 -	1,000	750
V	300 -	500	400
F	120,000 -	120,000	120,000
D	160,000 -	160,000	160,000
T	0.60 -	0.60	0.60
r	0.08 -	0.11	0.10
n	5 -	5	5
S	400,000 -	400,000	400,000
I	1,200,000 -	1,200,000	1,200,000

Given the range and most likely value of basic variables, we can study the impact of variation in each variable on net present value, holding other variables constant at their most likely levels. To illustrate the nature of this analysis we shall look at the relationship between (i) r and NPV, and (iii) P and NPV.

r and NPV The reltionship between r and NPV given the most likely values of other variables is

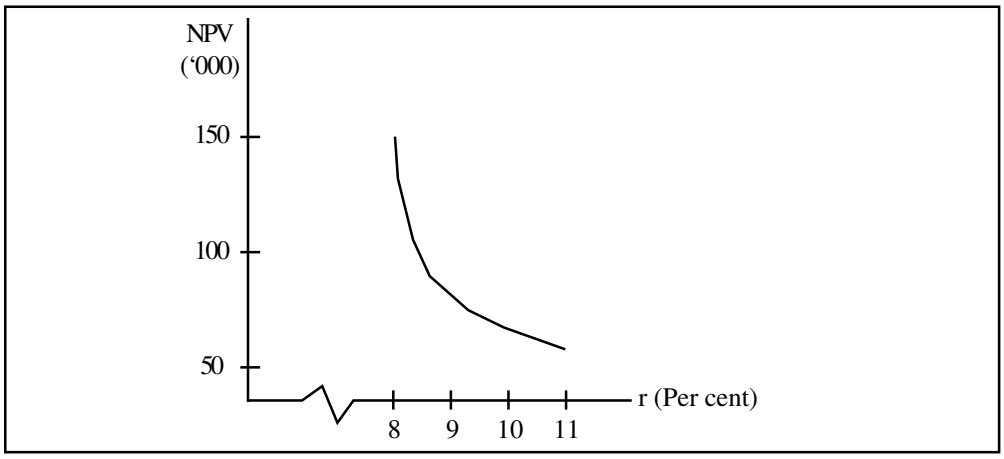
$$NPV = \sum_{t=1}^{5} \frac{[1{,}600(750-400)-120{,}000-160{,}000](1-0.6)+160{,}000}{(1+r)^t}$$

$$+\frac{400{,}000}{(1+r)^5}-120{,}000$$

$$= \sum_{t=1}^{5} \frac{272{,}000}{(1+r)^t}+\frac{400{,}000}{(1+r)^5}-120{,}000$$

The net present value for various values of r is shown below. The same relationship is shown graphically in Table 6.4

r	8%	9%	10%	11%
NPV	Rs. 158.080	118.080	79,552	42,700



P and NPV The relationship between P and NPV, given the most likely values of other factors, is:

$$NPV = \sum_{t=1}^{5} \frac{[1{,}600(P-400)-120{,}000-160{,}000](1-0.6)+160{,}000}{(1.10)^t}+\frac{400{,}000}{(1.10)^5}-1{,}200{,}000$$

$$= \sum_{t=1}^{5} \frac{640P}{(1.10)^t}-\sum_{t=1}^{5} \frac{208{,}000}{(1.10)^t}+\frac{400{,}000}{(1.10)^5}-1{,}200{,}000$$

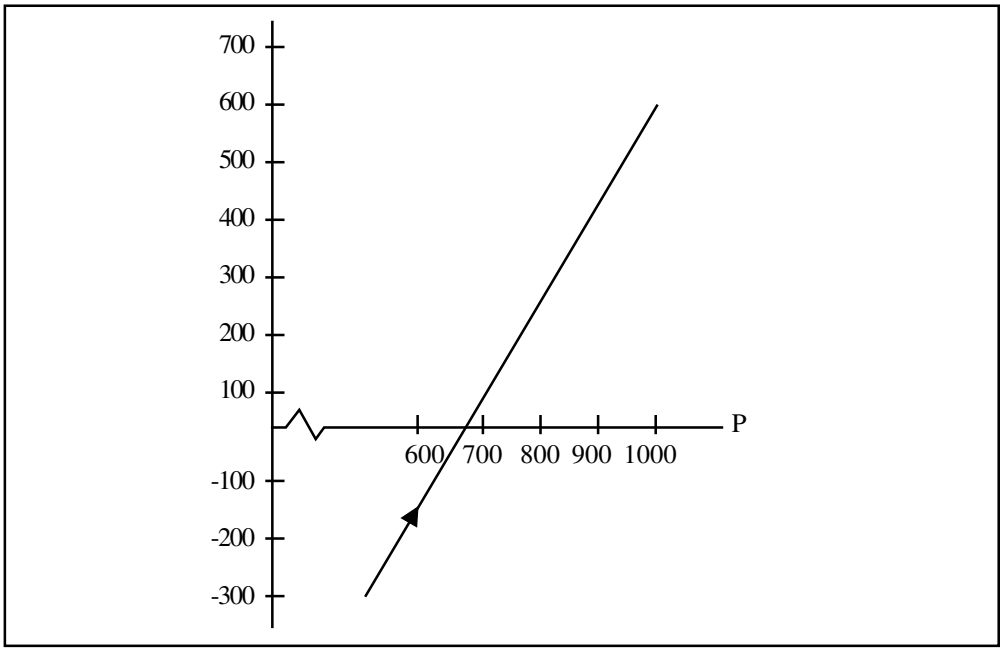
the net present value for various values of P is shown below:

P	600	700	750	800	990	1,000
NPV	Rs. 284,384	-41,769	79,552	200,864	443,488	686,112

The same relationship is shown graphically in Table 6.4

Composite Picture

A useful way of presenting the results of sensitivity analysis is to shown how net present value behaves for different percentages of unfavorable changes (from their most likely values) in the basic variables. The behavior of net present value when there is 5 per cent, 10 percent, 15 per cent, and 20 per cent unfavorable change in r, other factors remaining unchanged at their most likely levels, is shown as follows:



Percentage unfavourable variation	Value of r	Net present value
5	10.5	60,418
10	11.0	42,700
15	11.5	24,681
20	12.0	7,525

The behaviour of net present value when there is 5 percent, 10 percent, 15 percent and 20 percent unfavourable variation in P is shown as follows:

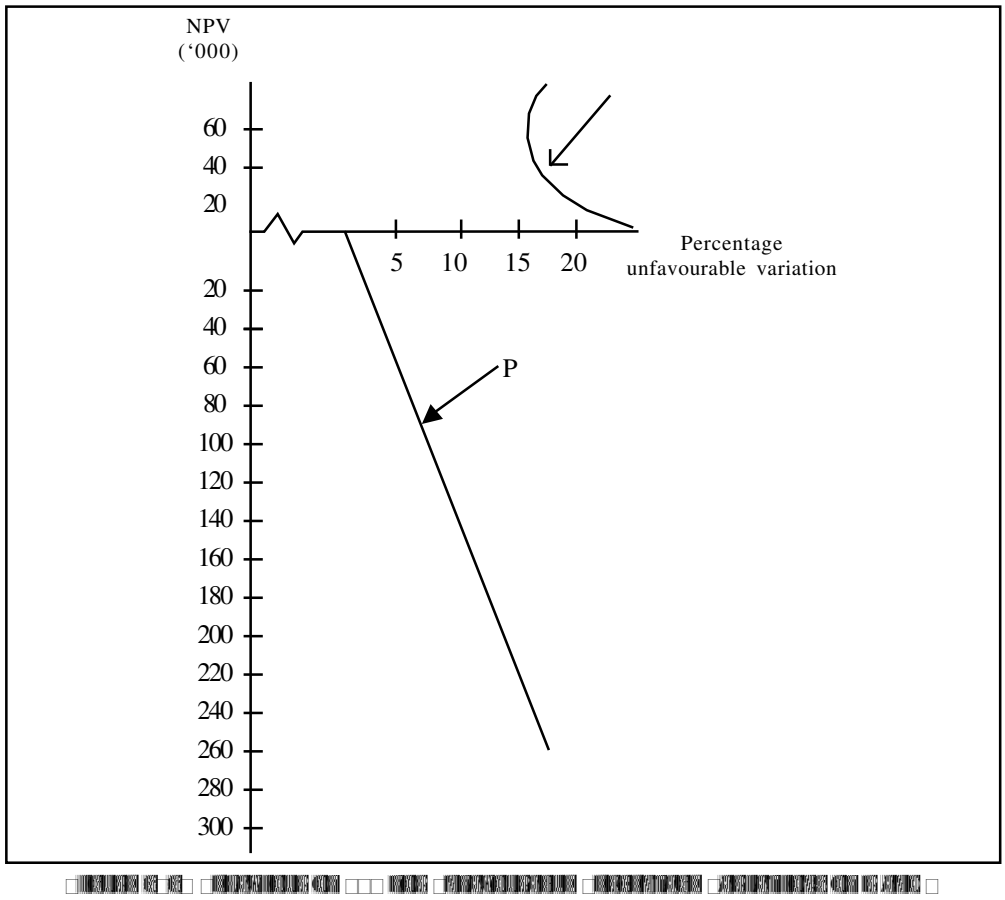
Percentage unfavourble variation	Valueof P	Net present value
5	.713	(10, 308)
10	.575	(102,500)
15	.638	(192,267)
20	.600	(284,384)

Exhibit 6.5 shows graphically the behaviour of net present value for various unfavourable percentage variations of *r* and *P.* Such a visual presentation is helpful in identifying variables, which are crucial for the success of the project.

Evaluation

Sensitivity analysis, a popular method for assessing risk, has certain merits:

- It forces management to identify the underlying variables and their inter-relationships.
- It shows how robust or vulnerable a project it to changes in the underlying variables.
- It indicates the need for further work. If the net present value or internal rate of return is highly sensitive to changes in some variable, it is desirable to gather further information about that variable.



Sensitivity analysis, however, suffers from severe limitations:

- It may fail to provide leads-if sensitivity analysis merely presents a complicated set of switching values it may not shed light on the risk characteristics of the project.
- The study of the impact of variation is one factor at a time, holding other factors constant, may "not be very meaningful when the underlying factors are likely to be interrelated. What sense does it make to consider the effect of variation in price while holding quantity (which is likely to be closely related to price) unchanged?

Scenario Analysis

In sensitivity analysis, typically one variable is varied at a time. If variables are inter-related as they are most likely to be, it is helpful to look at some plausible scenarios, each scenario representing a consistent combination of variables.

Procedure

The steps involved in scenario analysis are as follows:

1. Select the factor around which scenarios will be built. The factor chosen must be the largest source of uncertainty for the success of the project. It may be the state of the economy or interest rate or technological development or response of the market, costs.
2. Estimate the values of each of the variables in investment analysis (investment outlay, revenues, cost, project life, and so on) for each scenario.
3. Calculate the net present value and/or internal rate of return under each scenario.

Illustration

Zen Enterprises is evaluating a project for introducing a new product. Depending on the response of the market-the factor which is the largest source of uncertainty for the success of the project-the management of the firm has identified three scenarios:

Scenario 1: The product will have a moderate appeal to customers across the board at a modest price.

Scenario 2: The product will strongly appeal to a large segment of the market which is highly price-sensitive.

Scenario 3: The product will appeal to a small segment of the market which will be willing to pay a high price.

(Rs. in million)

	Scenario 1	Scenario 2	Scenario 3
Initial investment	200	200	200
Unit selling price (in rupees)	25	15	40
Demand (in units)	20	40	10
Revenues	500	600	400
Variable costs	240	480	120
Fixed costs	50	*50*	50
Deprciation	20	20	20
Pre-tax profit	190	50	210
Profit after tax	95	25	105
Annual cash flow	95	25	105
Project life	115	45	125
Salvage value	10 years	10 years	10 years
Net present value	0	0	0
	377.2	25.9	427.4
(at a discount rate of 15 per cent)			

Best and Worst Case Analysis

In the above illustration, an attempt was made to develop scenarios in which the values of variables were internally consistent. For example, high selling price and low demand typically go hand in hand. Firms often do another kind of scenario analysis called the best case and worst case analysis. In this kind of analysis the considered:

Best Scenario	High demand, high selling price, low variable cost, and so on.
Normal Scenario	Average demand, average selling price average variable cost, and so on.
Worst Scenario	Low demand, low selling price, high variable cost and so on.

The objective of such scenario analysis is to get a feel of what happens under the most favourable or the most adverse configuration of key variables, without bothering much about the internal consistency of such configurations.

Evaluation

Scenario analysis may be regarded as an improvement over sensitivity analysis because it considers variations in several variables together.

However, scenario analysis has its own limitations:

It is based on the assumption that there are few well-delineated scenarios. This may not be true in many cases. For example, the economy does not necessarily lie in three discrete states, viz., recession, stability, and boom. It can in fact be anywhere on the continuum between the extremes. When a continuum is converted into three discrete states some information is lost.

Scenario analysis expands the concept of estimating the expected values. Thus, in a case where there are 10 inputs the analyst has to estimate 30 expected values (3 × 10) to do the scenario analysis.

Break-even Analysis

In sensitivity analysis we ask what will happen to the project if sales decline or costs increase or something else happens. As a finance manager, you will also be interested in knowing how much should be produced and sold at a minimum to ensure that the project does not 'lose money'. Such an exercise is called *break-even analysis* and the minimum quantity at which loss is avoided is called the break-even point. The *break-even point* may be defined in accounting terms or financial terms.

Accounting Break-even Analysis

Suppose you are the finance manager of Naveen Flour Mills. Naveen is considering

setting up a new flour mill near Bangalore. Based on Naveen's previous experience, the project staff of Naveen has developed the figures shown in Exhibit 6.8

('000)

		Year 0	Years 1-10
1.	Investment	(20,000)	
2.	Sales		18,000
3.	Variable costs (66+% of sales)		12,000
4.	Fixed costs		1,000
5.	Depreciation		2,000
6.	Pre-tax profit		3,000
7.	Taxes		1,0000
8.	Profit after taxes		2,000
9.	Cash flow from operation		4,000
10.	Net cash flow	(20,000)	4,000

Note that the ratio of variable costs to sales is 0.667 (12/18). This means that every rupee of sales makes *a* contribution of Rs 0.333. Put differently, the contribution margin ratio is 0.333. Hence the break-even level of sales will be:

$$\frac{\text{Fixed Costs + Depreciation}}{\text{Contribution are in Ratio}} = \frac{1+2}{0.333} = \text{Rs. 9 million}$$

By way of confirmation, you can verify that the break-even level of sales is indeed Rs 9 million.

	Rs. in Million
Sales	9
Variable Costs	6
Fixed Costs	1
Depreciation	2
Profit Before Tax	0
Tax	0
Profit After Tax	0

A project that breaks even in accounting terms is like a stock that gives you a return of zero per cent. In both the cases you get back your original investment but you are not compensated for the time value of money or the risk that you bear. Put differently, you forego the opportunity cost of your capital. Hence a project that merely breaks even in accounting terms will have a negative NPV.

Financial Break-even Analysis

The focus of financial break-even analysis is on NPV and not accounting profit. At

what level of sales will the project have a zero NPV?

To illustrate how the financial break-even level of sales is calculated, let us go back to the flour mill project. The annual cash flow of the project depends on sales as follows:

1. Variable costs	: 66.67% of sales
2. Contribution	: 33.33% of sales
3. Fixed costs	: Rs. 1 million
4. Depreciation	: Rs. 2 million
5. Pre-tax profit	: (0.333 Sales) – Rs. 3 million
6. Tax (at 33.3%)	: 0.333 (0.333 Sales – Rs. 3 million)
7. Profit after tax	: 0.667 (0.333 Sales – Rs. 3 million)
8. Cash flow (4 + 7)	: Rs. 2 million + 0.067 (0.333 Sales – Rs. 3 million)
	= 0.222 Sales

Since the cash flow lasts for 10 years, its present value at a discount rate of 12 per cent is:

PV(cash flows)	= 0.222 Sales x PVIFA (10 years, 12%)
	= 0.222 Sales x 5.650
	= 1.255 Sales

The project breaks even in NPV terms when the present value of these cash flows equals the initial investment of Rs 20 million. Hence, the financial break-even occurs when

PV (cash flows)	= Investment
1.255 Sales	= Rs. 20 million
Sales	= Rs. 15.94 million

Thus, the sales for the flour mill must be Rs 15.94 million per year for the investment to have a zero NPV. Note that this is significantly higher than Rs 9 million which represents the accounting break-even sales.

Hillier Model

Under certain circumstances, the expected net present value and the standard deviation of net present value may be obtained through analytical derivation. Two cases of such analysis are discussed here: (i) no correlation among cash flows and (ii) perfect correlation among cash flows.

Uncorrelated Cash Flows

When the cash flows of different years are uncorrelated, the cash flow for year *t* is

independent of the cash flow for year *i-r*. Put differently, there is no relationship between cash flows from one period to another. In this case the expected net present value and the standard deviation of net present value are defined as follows:

$$\overline{NPV} = \sum_{t=1}^{n} \frac{\overline{A}_i}{(1+i)^t} - 1$$

...(8.2)

$$\sigma(NPV) = \sum_{t=1}^{n} \left[\frac{\sigma_t^2}{(1+i)^{2t}} \right]$$

...(8.3)

where NPV = expected net present value

$\overline{A}_t$ = expected cash flow for year t

i = risk-free interest rate

t = initial outlay

σ(NPV) = standard deviation of net present value

σ_1 = standard deviation of the cash flow for year t.

Note that in the above formulae the discount rate is the risk-free interest rate because we try to separate the time value of money and the risk factor. This risk of the project, reflected in σ (NPV) is considered in conjunction with $\overline{NPV}$ computed with the risk-free discount rate. If is computed using a risk-adjusted discount rate and then if this is viewed along with σ (NPV), the risk factor would be doubled counted.

Example: A project involving in outlay of Rs. 10,000 has the following benefits associated with it.

Year 1		Year 2		Year 3	
Net cash flow	**Probability**	**Net Cash flow**	**Probability**	**Net Cash flow**	**Probabilty**
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
3,000	0.3	2,000	0.2	3,000	0.3
5,000	0.4	4,000	0.6	5,000	0.4
7,000	0.36	6,000	0.2	7,000	0.3

Calculate and σ (NPV), assuming that i = 6 per cent

I

$$= \frac{5,000}{(1.06)} + \frac{4,000}{(1.06)^2} + \frac{5,000}{(1.06)^3} = 10,000 = 2,475$$

$$= \sigma(NPV) = \sum_{t=1}^{n} \left[\frac{\sigma_t^2}{(1+i)^{2t}} \right]$$

$$= \left[\frac{2,400,000}{(1.06)^2} + \frac{1,600,000}{(1.06)^4} + \frac{2,400,000}{(1.06)^6}\right]^{1/2} = \text{Rs. } 2,258$$

Perfectly Correlated Cash Flows

If cash flows are perfectly correlated, the behaviour of cash flows in all periods is alike. This means that if the actual cash flow in one year is *a* standard deviations to the left of its expected value, cash flows in other years will also be a standard deviations to the left of their respective expected values. Put in other words, cash flows of all years are linearly related to one another. The expected value and the standard deviation of net present value, when cash flows are perfectly correlated, are as follows:

$$\overline{NPV} = \sum_{t=1}^{n} \frac{\bar{A}_t}{(1+i)^t} - 1 \qquad ...(8.3)$$

$$\sigma(NPV) = \sum_{t=1}^{n} \left[\frac{\sigma_t}{(1+i)^t}\right] \qquad ...(8.4)$$

Example: An investment project involves a current outlay of Rs 10,000. The mean and Standard Deviation of cash flows which are perfectly correlated, are as follows:

Year	$\bar{A}_t$	σ_t
1	5000	1500
2	3000	1000
3	4000	2000
4	3000	1200

Calculate $\overline{NPV}$ and σ(NPV), assuming a risk-free interest rate of 6 per cent.

$$\overline{NPV} = \sum_{t=1}^{4} \frac{\bar{A}_i}{(1+i)^t} - I$$

$$= \frac{5,000}{(1.06)} + \frac{4,000}{(1.06)^2} + \frac{5,000}{(1.06)^3} + \frac{3000}{(1.06)^4} = 10,000 = 3121$$

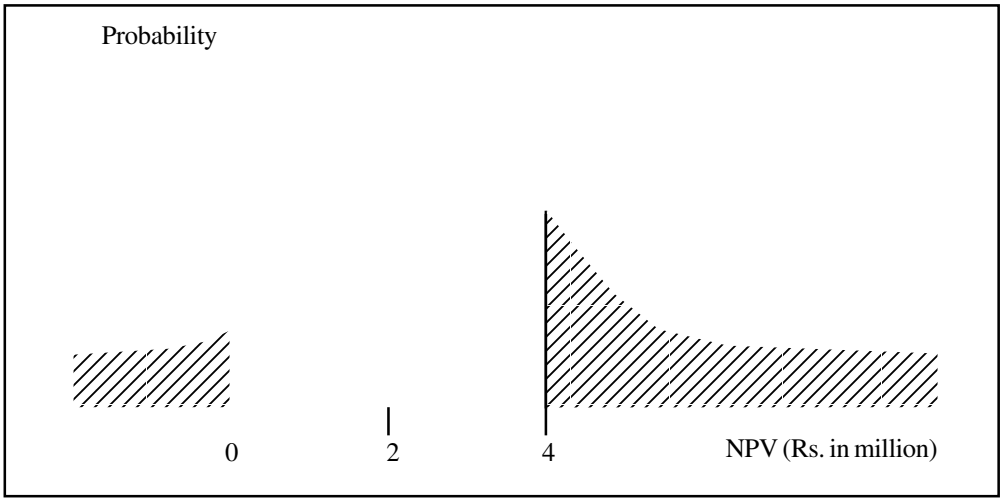
$$= \sigma(NPV) = \sum_{t=1}^{n} \frac{\alpha_i - \bar{A}_t}{(1+i)^t} - 1$$

$$= \frac{1500}{(1.06)} + \frac{1000}{(1.06)^2} + \frac{2000}{(1.06)^3} + \frac{1200}{(1.06)^4} = \text{Rs. } 4935$$

Standardising the Distribution

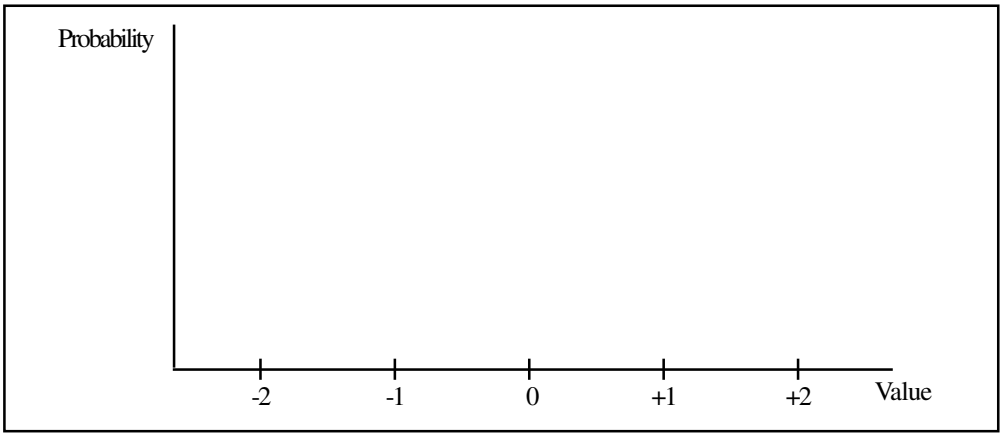
Knowledge of $\overline{NPV}$ and σ(NPV) is very useful for evaluating the risk characteristics of a project. If the NPV of a project is approximately normally distributed, we can calculate the probability of NPV being less than or more than a certain specified value.

This probability is obtained by finding the area under the probability distribution curve to the left or right of the specified value. Suppose the probability distribution of NPV is as shown in Figure 6.9. If we want to calculate the probability distribution curve to the left of 0, this is indicated by the shaded region on the left. If we are interested in finding the probability that NPV exceeds a certain value, say Rs. 4 million, we calculate the area under the probability distribution curve to the right of Rs. 4 million-this area is shown as the shaded region on the right.



How can we calculate the area to the left or right of a specified point? To calculate the area to the left or right of a specified point, we use the following procedure.

Step 1 Standardise the difference between the specified point and *NPV.* To do this the difference between the specified point and *NPV* is divided by a(NPV). The standardised difference may be referred to as Z. The purpose of standardisation is to transform the actual distribution of NPV into a standard normal distribution. The standard normal distribution *has* a mean of 0 and standard deviation of 1. Figure 6.10 shows the standard normal distribution.



Step 2 Refer to the standard normal distribution table *and* find the probability to the left (or right depending on our interest) of the Z value obtained in step 1.

To illustrate the above procedure suppose that a project's $\overline{NPV}$ and σ(NPV) are Rs 96,000 and Rs 60,000 respectively and we want to find the *probability* that *NPV* will be less than 0. This may be done as follows:

***Step* 1** The standardised difference between the specified point (NPV = 0) and NPV = 96,000 is

$$\frac{0 - 96000}{6000} = -1.6$$

***Step* 2** The cumulative probability up to Z = -1.6 as *seen* from the standard normal distribution given in Appendix A is 0.55. This means that there is a 5.5 per cent chance that NPV will be equal to or less than 0.

Simulation Analysis

Sensitivity analysis indicates the sensitivity of the criterion of merit (NPV, IRR, or any other) to variations in basic factors and provides information of the following type: If the quantity produced and sold decreases by 1 per cent, other things being equal, the NPV falls by 6 per cent. Such information, though useful, may not be adequate for decision making. The decision maker would also like to know the likelihood of such occurrences. This information can be generated by simulation analysis which may be used for developing the probability profile of a criterion of merit by randomly combining values of variables which have a bearing on the chosen criterion.

Procedure

The steps involved in simulation analysis are as follows:

1. Model the project. The model of the project shows how the net present value is related to the parameters and the exogenous variables. (Parameters are input variables specified by the decision maker and held constant over all simulation runs. Exogenous variable's are input variables which are stochastic in nature and outside the control of the decision maker).
2. Specify the values of parameters and the probability distributions of the exogenous variables.
3. Select a value, at random, from the probability distributions of each of the exogenous
4. Determine the net present exogenous variables and pre-specified parameter values.
5. Repeat steps (3) and (4) a number of times to get a large number of simulated net present values.
6. Plot the frequency distribution of the net present value.

Illustration

In real life situations, simulation is done only on the computer because of the computational medium involved. However, to give you a flavour of what goes on in simulation, we will work with a simple example where simulation has been done manually.

Zenith Chemicals is evaluating an investment project whose net present value has been modeled as follows:

$$NPV = \sum_{t=1}^{n} \frac{\text{Annual Cost Flow}}{(+\text{Risk} - \text{Free Rate})} - \text{Initial Investment} \qquad ...(8.5)$$

In the NPV model embodied in Eq. (8.5), the risk-free rate and the initial investment are parameters with the following values: risk-free rate = 10 per cent and initial investment = Rs 13,000. The annual cash flow and the life *(n)* are stochastic exogenous variables with the following distributions:

Annual Cash Flow		Project Life	
Value Rs.	**Probability**	**Value**	**Probability**
1,000	0.02	3 years	0.05
1,500	0.03	4	0.10
2, 000	0.15	5	0.30
2,500	0.15	6	0.25
3,000	0.30	7	0.15
3,500	0.20	8	0.10
4,000	0.15	9	0.03
		10	0.02

The firm wants to perform 10 manual simulation runs for this project. To perform the *simulation* runs, we have to generate values, at random, for the two exogenous variables: annual cash flow and project life. For this purpose, we have to (i) set up the correspondence between the values of exogenous variables and random numbers, and (ii) choose some random number generating device. Exhibit 8.10 shows the correspondence between various variables and two digit random numbers. Exhibit 8.11 presents a table of random digits that will be used for obtaining two digit random numbers.

Now we are ready for simulation. In order to obtain random numbers from Exhibit 8.11 we may begin anywhere at random in the table and read any pair of adjacent columns (since we are interested in a two-digit random number) and read column-wise or row-wise.

For our example, let us use the first two columns of Exhibit 8.11. Starting 8.11. Starting from the top, we will read down the column. For the first simulation run we need two-

digit random numbers, one for the annual cash flow and the other for the project life. These number are 53 and 97 and the corresponding values for annual cash flow and project life are Rs. 3,000 and 9 years respectively. We go further in this manner. Table 6.11 shows the random numbers so obtained and the results of simulation.

Annual Cash Flow				Project Life			
Value	**Probability**	**Cumulative Probability**	**Two digit random numbers**	**Value**	**Probability**	**Cumulative probability**	**Two digit random numbers**
As				Years			
1,000	0.02	0.02	00 to 01	3	0.05	0.05	00 to 04
1,500	0.03	0.05	02 to 04	4	0.10	0.15	05 to 14
2,000	0.15	0.20	05 to 19	5	0.30	0.45	15 to 44
2,500	0.15	0.35	20 to 34	6	0.25	0.70	45 to 69
3,000	0.30	0.65	35 to 64	7	0.15	0.85	70 to 89
3,500	0.20	0.85	65 to 84	8	0.10	0.95	85 to 94
4,000	0.15	1.00	86 to 99	9	0.03	0.98	95 to 97
				10	0.02	1.00	98 to 99

[illegible]

53479	81115	98036	12217	59526
97344	70328	58116	91964	26240
66023	38277	74523	71118	84892
99776	75723	03172	43112	83086
30176	48979	92153	38416	42436
81874	83339	14988	99937	13213
19839	90630	71863	95053	55532
09337	33435	53869	52769	18801
31151	58925	40823	41330	21093
67619	52515	03037	81699	17106

[illegible]

	Annual Cash Flow			Project Life	
	Run Random number flow	**Corresponding value of annual**	**Random number project file**	**Corresponding value of**	**Net present value**
1.	53	3,000	97	9	4277
2.	66	3,500	99	10	8506
3.	30	2,500	81	7	(829)
4.	19	2,000	09	4	(7660)
5.	31	2,500	67	6	(2112)
6.	81	3,500	70	7	4039
7.	38	3,000	75	7	1605
8.	48	3,000	83	7	1605
9.	90	4,000	33	5	2163
10.	58	3,000	52	6	66

[illegible]

Evaluation

An increasingly popular tool of risk analysis, simulation offers certain advantages:

- Its principal strength lies in its versatility. It can handle problems characterised by (i) numerous exogenous variables following any kind of distribution, and (ii) complex interrelationships among parameters, exogenous variables, and endogenous variables. Such problems often defy the capabilities of analytical methods.
- It compels the decision maker to explicitly consider the interdependencies and uncertainties characterising the project.
- Simulation, however, is a controversial tool which suffers from several shortcomings. It is difficult to model the project and specify the probability distributions of exogenous variables.
- Simulation is inherently imprecise. It provides a rough approximation of the probability distribution of net present value (or any other criterion of merit). Due to its imprecision, the simulated probability distribution may be misleading when a tail of the distribution is critical.
- A realistic simulation model, likely to be complex, would most probably be constructed by a management scientist, not the decision maker. The decision maker, lacking understanding of the model, may not use it.
- To determine the net present value in a simulation run the risk-free discount rate is used. This is done to avoid prejudging risk which is supposed to be reflected in the dispersion of the distribution of net present value. Thus the measure of net present value takes a meaning, very different from its usual one, that is difficult to interpret.

Decision Tree Analysis

The scientists at Vigyanik have come up with an electric moped. The firm is ready for pilot production which is estimated to cost Rs 8 million and take one year. If the results of pilot production are encouraging the next step would be to test market the product. This will cost Rs 3 million and take two months. Based on the outcome of the test marketing, a manufacturing decision may be taken. The firm may, however, skip the test marketing phase and take a decision whether it should manufacture the product or not. If the firm decides to manufacture the product commercially it is confronted with two options: a small plant or a large plant. This decision hinges mainly on the size of the market. While the level of demand in the short run may be gauged by the results of the test market, the demand in the long run would depend on how satisfied the initial users are.

If the firm builds a large plant initially it can cater to the needs of the market when demand growth is favourable. However, if the demand turns out to be weak, the plant would operate at a low level of capacity utilisation. If the firm builds a small plant, to

begin with, it need not worry about a weak market and the consequent low level capacity utilisation. However, if the market turns out to be strong it will have to build another plant soon (and thereby incur a higher total outlay) in order to save itself from competitive encroachment.

To analyse situations of this kind where sequential decision making in the face of risk is involved, decision tree analysis is a useful tool. This section discusses the technique of decision tree analysis.

Steps in Decision Tree Analysis

The key steps in decision tree analysis are:

1. Identifying the problem and alternatives
2. Delineating the decision tree
3. Specifying probabilities and monetary outcomes
4. Evaluating various decision alternatives.

Identifying the Problem and Alternatives To understand the problem and develop alternatives, information from different sources-marketing research, engineering studies, economic forecasting, financial analysis, etc.-has to be tapped. Imaginative effort must be made to identify the nature of alternatives that may arise as the decision situation unfolds itself and assess the kinds of *uncertainties* that lie ahead with respect to market size, market share, prices, cost structure, availability of raw material and power, technological changes, competitive action, and governmental regulation.

Recognising that risk and uncertainty are inherent characteristics of investment projects, persons involved in analysing the situation must be encouraged to express freely their doubts, uncertainties, and reservations and motivated to suggest contingency plans and identify promising opportunities in the emerging environment.

Delineating the Decision Tree The decision tree, exhibiting the *anatomy* of the decision *situation,* shows:

- The decision points (also called decision forks) and the alternative options available for experimentation and action at these decision points.
- The chance points (also called chance forks) where outcomes are dependent on a chance process and the and likely outcomes at these points.

The decision tree reflects in a diagrammatic form the nature of the decision situation in terms of alternative courses of action and chance outcomes which have been identified in the first step of the analysis.

A decision tree can easily become very complex and cumbersome if an attempt is *made* to consider the myriad possible future events and decisions. Such a decision tree, however, is not likely to be a very useful tool of analysis. Over-elaborate, It may obfuscate the critical issues. Hence an effort should be made to keep the decision tree somewhat simple so that the decision makers can focus their attention on major "future alternatives without being drowned in a mass of trivia. One must remember the advice

of Brealey and Myers." Decision trees are like grapevines; they are productive only if vigorously pruned.

Specifying Probabilities and Monetary Values for Outcomes: Once the decision tree is delineated, the following data have to be gathered:

Probabilities associated with each of the possible outcomes at various chance forks.
Monetary vlaue of each combination of decision alternative and chance outcome.

The probabilities of various outcomes may sometimes be defined objectively. For example, the probability of a good monsoon may be based on objective, historical data. More often, however, the possible outcomes encountered in real life are such that objective probabilities for them cannot be obtained. How can you, for example, define objectively the probability that a new product like an electric moped will be successful in the market? In such cases, probabilities have to be necessarily defined subjectively. This does not, however, mean that they are drawn from a hat. To be useful they have to be based on the experience, judgement, intuition, and understanding of informed and knowledgeable executives. Assessing the cash flows associated with various possible outcomes, too, is a difficult task. Again, the judgement of experts play an important role.

Evaluating the Altmnatives: Once the decision tree is delineated and data about probabilities and monetary values gathered, decision alternatives may be evaluated as follows:

1. Start at the right-hand end of the tree and calculate the expected monetary value at various clance points that come first as we proceed leftward.
2. Given the expected monetary values of chance points in step 1, evaluate the alternatives at the final stage decision points in terms of their expected monetary values.
3. At each of the final stage decision points, select the alternative which has the highest expected monetary value and truncate the other alternatives. Each decision point is assigned a value equal to the expected monetary value of the alternative selected at that decision point.
4. Proceed backward (leftward) in the same manner, calculating the expected monetary value at chance points, selecting the decision alternative which has the highest expected monetary value at various decision points, truncating inferior decision alternatives, and assigning values to decision points, till the first decision point is reached.

Illustration

The technique of decision tree analysis may be explained with the help of an illustration A wildcatter, evaluating a particular basin, is considering three alternatives: (i) He may drill. (ii) He may conduct a seismic experiment costing Rs 20,000 to find the nature of the underlying soil structure and decide on that basis. (iii) He may not do anything.

If he drills, he is likely to find one of the following oil-bearing states: dry, wet, or soaking. A dry well hardly yields anything; a wet well provides a moderate quantity of oil; a soaking well generates a substantial quantity of oil.

If he conducts a seismic experiment, he can learn about the underlying soil structure before deciding whether to drill or not. The underlying soil structure in this case *may* be one of the following types: no structure, open structure, or closed structure. If no structure is discovered, the prospects of finding oil are bleak, if open structure is found the prospects of finding oil are fair, and if closed structure is discovered the prospects of finding oil are bright.

The decision tree corresponding to this situation is shown in Exhibit 6.13. It may be noted that, as a convention, a decision fork is represented *by* a square and chance fork by a circle.

The decision tree delineated, the next phase of analysis calls for gathering information about probabilities and monetary values associated with various outcomes in the decision tree. The wildcatter reviews his experiences, analyses statistics relating to oil discoveries, and consults geological experts. He comes up with the following information:

Probability for Various Oil Bearing States: If he drills without conducting seismic experiments probabilities for various oil bearing states are:

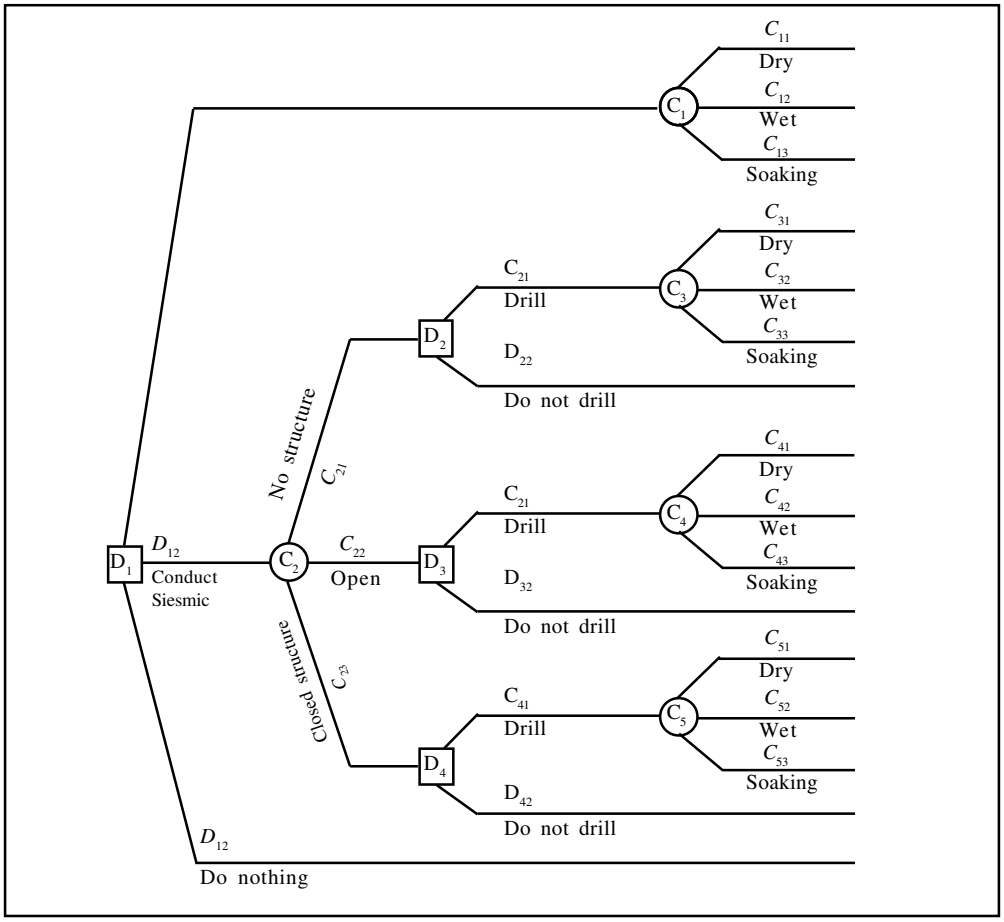
Oil bearing state	Probability
Dry	0.50
Wet	0.25
Soaking	0.25

Probabilities for Various Soil Structures: If he conducts a seismic experiment he is likely to find the underlying geological structures with probabilities mentioned against them:

Geological structure	Probability
No structure (NS)	0.40
Open structure (OS)	0.30
Closed structure (CS)	0.30

Relationship between the Underlying Structures and Oil Bearing States The relationship between the underlying geological structures and oil-bearing states expressed in terms of joint probabilities is as follows:

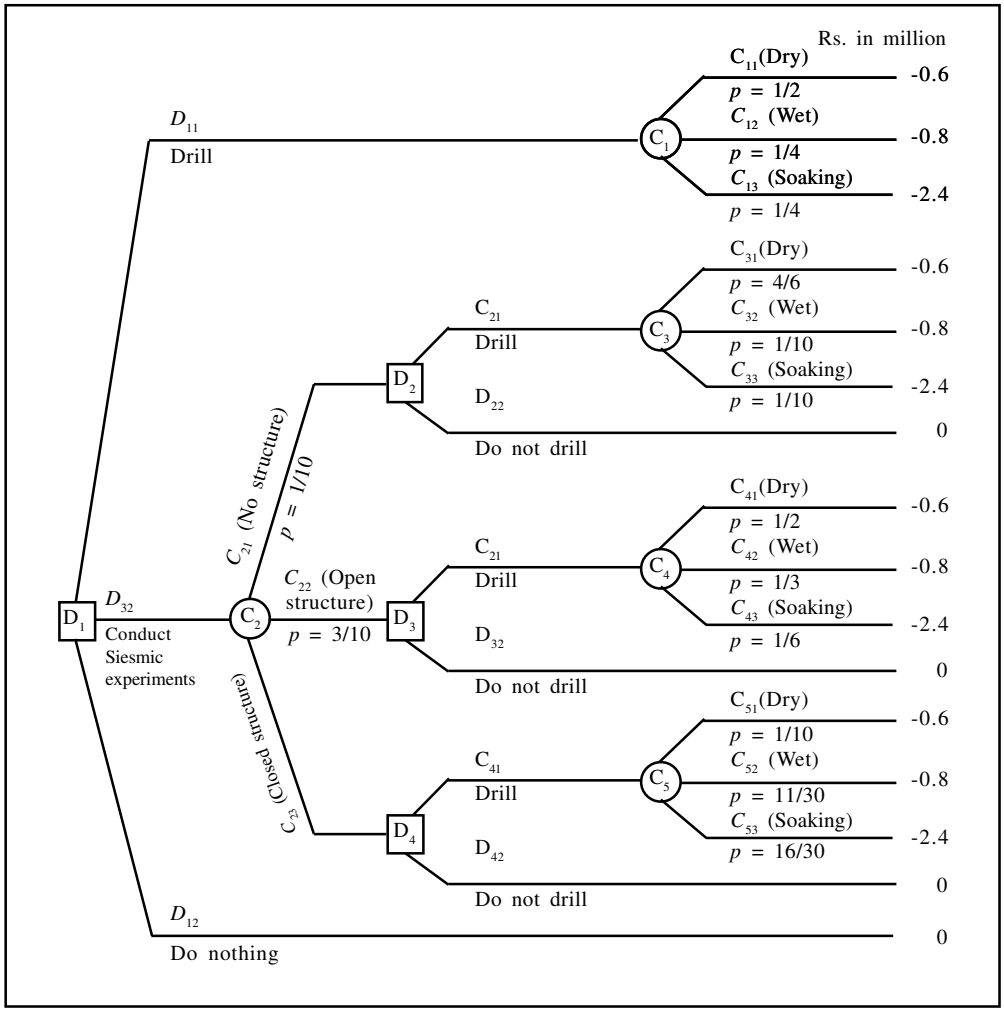
	Underlying Geological Structure			
Oil Bearing State	**No Structure**	**Open Structure**	**Closed Structure**	**Marginal Probability of State**
Dry	0.32	0.15	0.03	0.50
Wet	0.04	0.10	0.11	0.25
Marginal	0.04	0.05	0.16	0.25
Probability of geological structure	0.40	0.30	0.30	1.00



Monetary Values* of *Outcomes The net present value of cash flows, calculated at 12 per cent discount rate, associated with the three states for five years (which is the maximum duration of oil drilling) is given below:

State	Net present value (Rs. in million)
Dry	-0.6
Wet	0.8
Soaking	2.4

Exhibit 6.15 shows the decision tree incorporating information regarding probabilities and monetary values of outcomes discussed above. With this decision tree we evaluate the alternative courses of action as follows:



1. Starting at the right-hand end of the tree, the expected monetary values (EMVs) at chance forks C_1, C_3, C_4 and C_5, which come first at we proceed leftwards, are determined:

   EVM (C_1) = Rs. 0.5 million EMV (C_3) = Rs. –0.16 million

   EMV (C_4) = Rs. 0.367 million EMV (C_5) = Rs. 1.513 million

2. Given the expected monetary values the alternatives at the last stage decision points and their expected monetary values are defined as follows:

Decision point	Alternatives (Rs. in million)	Expected monetary value
D_2	D_{21} (Drill)	-0.16
	D_{22} (Do not Drill)	0
	D_{31} (Drill)	0.367
D_3	D_{32} (Do not Drill)	0
	D_{41} (Drill)	1.513
D_4	D_{42} (Do not Drill)	0

3. On the basis of the above information, the alternatives selected at the decision points D_2, D_3 and D_4 are D_2 (do not drill), D_{31} (drill), and D_{41} (drill) respectively. The values assigned to the decision points D_2, D_{31} and D_4 are 0, Rs. 0.367 million, and Rs. 1.513 million respectively.

4. Proceeding leftward the expected monetary value at chance fork C_2 is calculated

   Expected monetary value at C_2.

   $= 0.4 \times b + 0.3 \times 3.67 + 0.3 + 15.13$

   = Rs. 0.564 million

5. Moving leftwards the first-state decision point is reached. The alternatives and their expected monetary values, at this decision point, are:

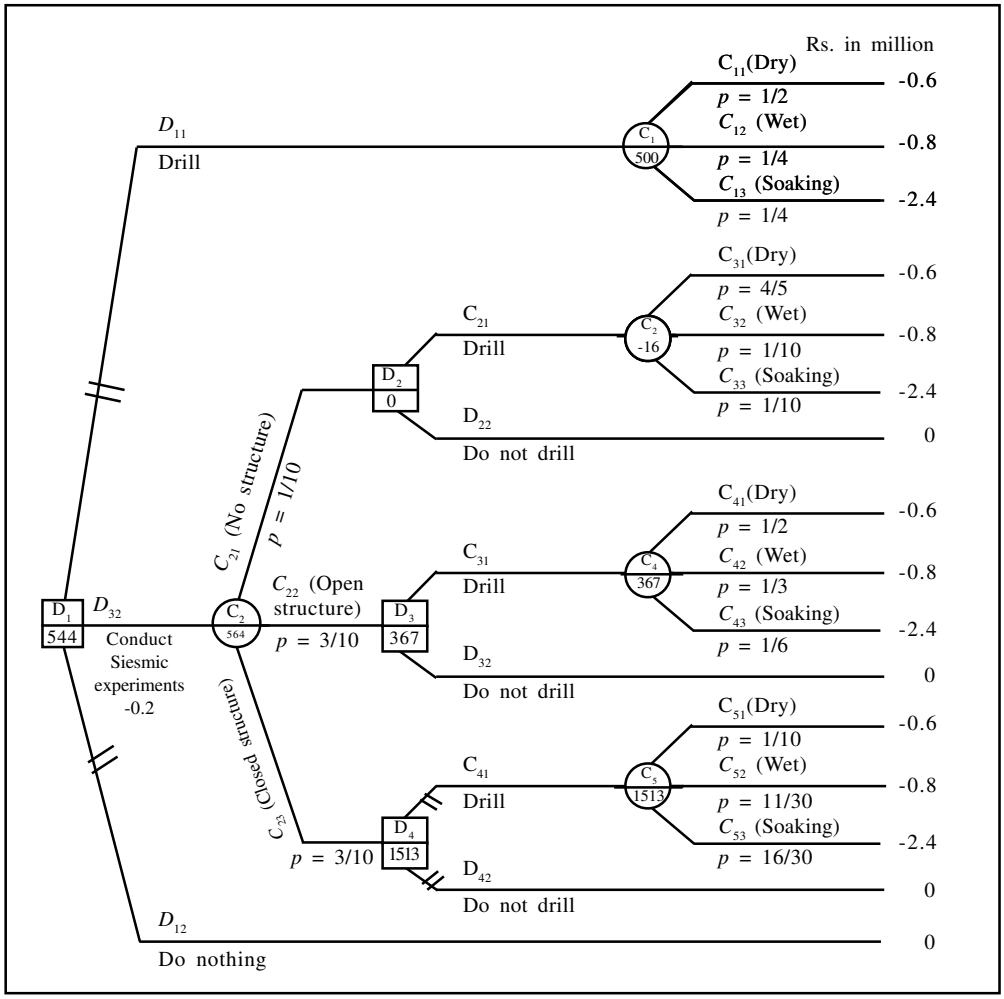
Alternatives	**Expected Monetary Value (Rs. in million)**
D_{11} (Drill)	0.5
D_{12} (conduct seismic experiments)	0.544
D_{13} (Do Nothing)	0

Looking at the expected monetary values as find that D_{12} (conduct seismic experiments) is the most desirable alternative at the first stage decision point.

Figure 6.16 shows the decision tree with expected values at chance points and decision points.

Based on the above evaluation of alternatives we find that the optimal decision strategy is as follows:

Choose D_{12} (conduct seismic experiment) at decision point D_1 and wait for the outcome at chance point C_2. If the outcome at C_2 is C_{21} (no structure), then choose C_{22} (do not drill); if the outcome at C_2 is C_{22} (open structure), then choose D_{31} (drill), if the outcome at C_2 is C_{23} (closed structure), then choose D_{41} (drill).



Following the above decision strategy, the decision maker, may, depending on the outcome at chance points, traverse paths as shown in Figure 6.17.

Path	Probability	Net present value (Rs.)
$D_{12} \rightarrow C_{21} \rightarrow D_{22}$	0.40	-20,000
$D_{12} \rightarrow C_{22} \rightarrow D_{31} \rightarrow D_{41}$	0.15	-620,000
$D_{12} \rightarrow C_{22} \rightarrow D_{31} \rightarrow D_{42}$	0.10	–780,000
$D_{12} \rightarrow C_{22} \rightarrow D_{31} \rightarrow D_{43}$	0.05	–2,380,000
$D_{12} \rightarrow C_{23} \rightarrow D_{41} \rightarrow D_{51}$	0.03	–620,000
$D_{12} \rightarrow C_{23} \rightarrow D_{41} \rightarrow D_{52}$	0.11	–780,000
$D_{12} \rightarrow C_{23} \rightarrow D_{41} \rightarrow D_{53}$	0.16	-2,380,000

Evaluation

Decision trees are useful for analysing a project that has the characteristics:

- Decision on continuing the project are made in well-defined stages.
- The outcomes at each stage fall into few broad classes.

- The probabilities and the cash flows associated with various outcomes can be specified at the beginning of the project. This means that the firm has experience of doing similar projects in the past.

Obviously, decision tree analysis requires enormous information before it can be applied. The oil drilling project is one case where the required information may be available. However, it may be much more difficult to apply decision tree analysis to a project where the product or service is new and the firm has very little information on how the market will respond to it. Decision trees are not easy to when investments are gradually made over a period of time rather than in a few well-defined stages.

Corporate Risk Anslysis

A project's corporate risk is its contribution to the overall risk of the firm. Put differently, it reflects the impact of the project on the risk profile of the firm's total cash flows.

We know that the contribution of a security to portfolio risk depends on (i) the standard deviation of its returns and (ii) the correlation of its returns with the returns on the other securities included in the portfolio. In the same way, the corporate risk of a project depends on (i) the standard deviation of its returns and (ii) the correlation of its returns with the returns on the other projects of the firm.

On a stand-alone basis a project may be very risky but if its returns are not highly correlated or, even better, negatively correlated with the returns on the other projects of the firm, its corporate risk tends to be low.

Aware of the benefits of portfolio diversification, many firms consciously pursue a strategy of diversification. Hindustan Lever Limited, for example, has a diversified portfolio comprising, in the main, the following businesses: soaps and detergents, personal care products, edible oil, and tea.

The proponents of diversification argue that it helps in reducing the firm's overall risk exposure. As most businesses are characterised by cyclicality it seems desirable that there are at least two to three different lines of business in a firm's portfolio. As someone put it vividly. "If you have three legs to your firm, you enjoy a reasonable degree of stability." This is simply another way of saying that don't put all your eggs in the same basket.

The logic of corporate diversification for reducing risk, however, has been questioned. Why should a firm diversify when shareholders can reduce risk through personal diversification. All that they have to do is to hold a diversified portfolio of securities or participate in a mutual fund scheme. Indeed, they can do it more efficiently.

There does not seem to be an easy answer. Although shareholders, can reduce risk through personal diversification there are some other benefits from corporate

diversification. Stable earnings and cash flows enable a firm to attract talent, to secure greater commitment from various stakeholders, to exploit tax shelters fully, and to check adverse managerial incentives. Hence most firms do look at the impact of investment proposals, particularly the major ones, on the overall risk profile of the firm.

Project Selection Under Risk

Once information about expected return (measured as net present value, or internal rate of return or some other criterion of merit) and variability of return (measured in terms of range or standard deviation or some other risk index) has been gathered, the next question is: Should the project be accepted or rejected? There are several ways of incorporating risk in the decision process: judgemental evaluation, payback period requirement, risk profile method, certainty equivalent method, and risk adjusted discount rate method.

Judgemental Evaluation

Often managers look at risk and return characteristic of a project and decide judgementally whether the project should be accepted or rejected, without using any formal method for incorporating risk in the decision making process. The decision may be based on the collective view of some group group like the capital budgeting committee, or the executive committee, or the board of directors. If judgemental decision making appears highly subjective or haphazard, consider how most of us make important decisions in our personal life. We rarely use formal selection methods or quantitative techniques for choosing a career or a spouse or an employer. Instead, we rely on our judgement.

Payback Period Requirement

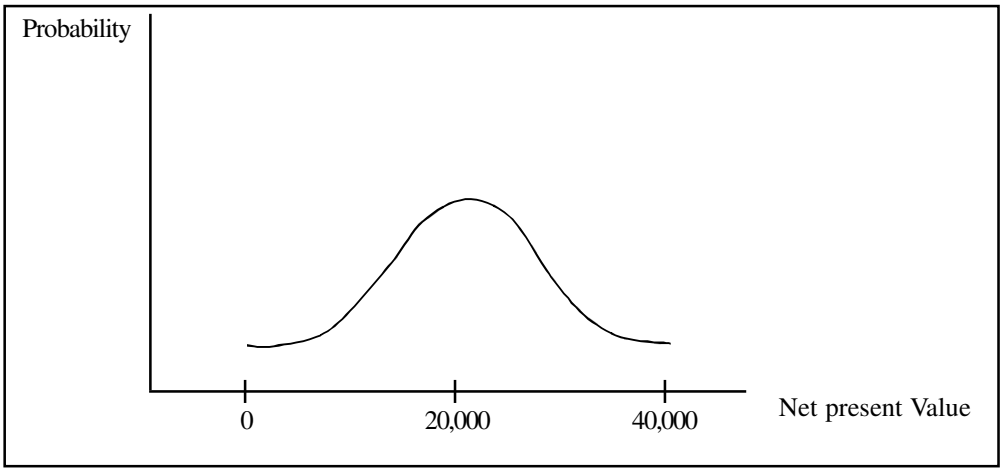
In many situations companies use NPV or IRR as the principal selection criterion, but apply a payback period requirement to control for risk. Typically, if an investment is considered more risky, a shorter payback is required even if the NPV is positive or IRR exceeds the hurdle rate. This approach assumes that risk is a function of time.

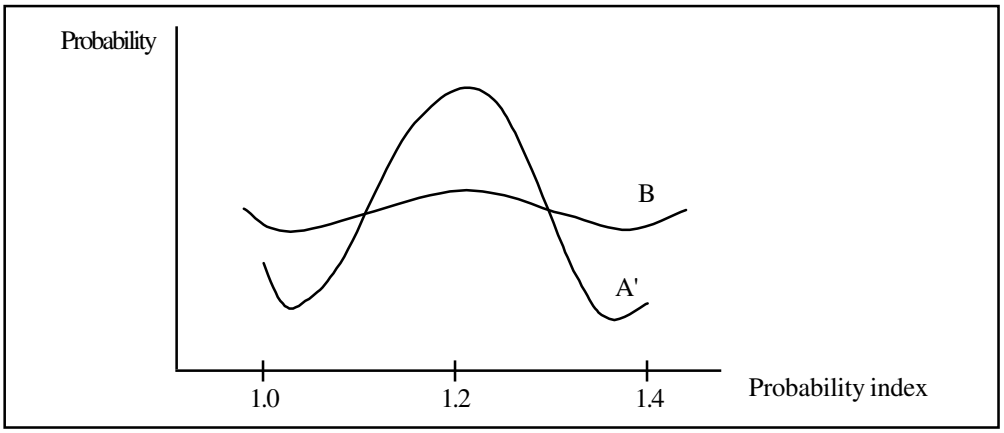
Ordinarily it is true that the further a benefit lies in future the more uncertain it is likely to be because economic and competitive conditions tend to change over time. However, risk is influenced by things other than the mere passage of time. Hence the payback period requirement may not be an adequate method for risk adjustment or control.

Risk Profile Method

To use this method, we first transform the probability distribution of net present value, an absolute measure, into the profitability distribution of profitability index, a relative measure. To illustrate this transformation, let us consider the profitability distribution of the net present value of a project, which involves an investment outlay Rs. 100,000

shown in Exhibit 6.17. Since profitability index is a linear transformation of net present value, the shape of its profitability distribution is identical to that of the probability distribution of net present value. The profitability distribution of profitability index for our project is shown in Exhibit 6.18. It should be noted that the x-axis of this exhibit shows the profitability index values corresponding to the net present values shown on the axis of Exhibit 6.18.





Having transformed the probability distribution of net present value into the probability distribution of profitability index, we compare the dispersion of the profitability index of the project with the maximum risk profile acceptable to management for the expected profitability index of the project. Suppose the maximum risk profile acceptable to management when the expected profitability index 1.20 is as shown by curve B in Exhibit 6.18. comparing the dispersion of the profitability distributions A and B shown in Exhibit 6.18 we find the risk of the project is less than the maximal risk acceptable to management for the given level of expected profitability index. Hence the project is deemed worthwile.

Note that the higher the expected value of profitability index, the greater the dispersion

that is acceptable to management. This is quite understandable. If the profitability index is high, one profitability that the net present value is negative (profitability index is less than 1) is negligible even if the dispersion is wide.

Risk Adjusted Discount Rate Method

The risk adjusted discount rate method calls for adjusting the discount rate to reflect project risk. If the risk of the project is equal to the risk of the existing investments of the firm, the discount rate used is the average cost of capital of the firm, if the risk of the project is greater than the risk of the existing investments of the firm, the discount rate used is higher than the average cost of capital of the firm; if the risk of the project is less than the risk of the existing investment of the firm the discount rate used is less than the average cost of capital of the firm. The risk adjusted discount rate is :

$$rk = i + n + dk$$

where rk = risk-adjusted discount rate for project k

i = risk-free rate of interest

n = adjustment for the firm's normal risk

dk = adjustment for the differential risk of project k

It may be noted that (1 + n) measures the firm's cost of capital dk may be positive or negative depending on how the risk of the project under consideration compares with the existing risk of the firm.

The adjustment for the differential risk of project, k quite understandably, depends on management's perception of the project risk and management's attitude towards towards risk (risk return preference). A large pharmaceutical concern, for example, uses the following riskadjusted discount for various types of investments.

Investment category	**Risk-adjusted discount rate**
Replacement investments	Cost of capital
Expansion investments	Cost of capital + 3%
Investment in related lines	Cost of capital + 6%
Investment in new lines	Cost of capital + 10%

Once the project's risk-adjusted discount rate (rk) is specified, the project is accepted if its net present value, calculated as follows, is positive.

$$NPV = \sum_{t=1}^{n} \frac{\overline{A}_t}{(1+rk)^t} - I \qquad ...(8.7)$$

where NPV = net present value of project k

$\overline{A}_t$ = expected cash flow for year t

rk = risk adjusted discount rate for project k

Example The expected cash flows of a project, which involves an investment outlay of Rs. 1,000,000, are as follows:

Year	Cash flow Rs.
1.	200,000
2	300,000
3.	400.000
4.	500.000
5.	200,000

The risk-adjusted discount rate for this project is 18 per cent. Is the project worthwhile?

The net present value of the project, using the risk-adjusted discount rate is:

$$NPV = \frac{200,000}{(1.18)} + \frac{300,000}{(1.18)^2} + \frac{400,000}{(1.18)^3} + \frac{300,000}{(1.14)^4} + \frac{200,000}{(1.18)^5} - 1,000,000$$

= -Rs. 129,440

Since the net present value is negative the project is not worthwhile.

The risk-adjusted discount rate is commonly employed in practice. Firms use different discount rates, presumably related to the factor risk, for different types of investment projects. The discount rate is generally low for routine replacement investments, moderate for expansion investments, and high for new investments.

Despite its popularity, the risk-adjusted discount rate method suffers from two serious limitations: (i) It is difficult to estimate dk consistently-often it is determined in an extremely *ad hoc* and arbitrary manner. (ii) This method assumes that risk increases with time at a constant rate. This assumption may not be very valid.

Certainty Equivalent Method

Before describing the certainty equivalent method let us understand the concept of certainty equivalent coefficient. Suppose someone presents you with a lottery the outcome of which has the following probability distribution.

Outcome Rs.	Probability Rs.
1,000	0.3
5,000	0.7

You are further asked: How much of a certain amount would you accept in lieu of this lottery? Let us say that your reply is: Rs. 3,000. This amount, Rs. 3,000 represents the certainty equivalent of the above lottery which has a expected value of Rs. 3,800 (Rs. 1,000 × 0.3 + Rs 5,000 × 0.7) and a given distribution. The factor 3,000/3,800 (=0.79)

is called the certainty coefficient. It reflects primarily two things: variability of outcomes and your attitude towards risk. Certainty equivalent coefficients transform expected values of uncertain flows into their certainty equivalents.

Under the certainty equivalent method, the net present value is calculated as follows:

$$NPV = \sum_{t=1}^{n} \frac{\alpha_1 - \overline{A}_t}{(1+i)^t} - 1 \qquad ...(8.8)$$

where NPV = net present value

$\overline{A}_t$ = expected cash flow for the year t

α_1 = certainty equivalent coefficient for the cash flow of year t

i = risk free interest rate

I = initial investment (about which it is assumed that there is no uncertainty)

Example: Vazeer Hydraulics Limited is considering an investment proposal involving an outlay of Rs. 4,500,000. The expected cash flows and certainty equivalent coefficients are:

Year	Expected Cash Flow (Rs.)	Certainty Equivalent Coefficient
1	1000000	0.90
2	1500000	0.85
3	2000000	0.82
4	2500000	0.78

The risk-free interest rate is 5 per cent. Calculate the net present value of the proposal. The net present value is equal to:

$$\frac{100000}{(1.05)} + \frac{1500000(0.85)}{(1.05)^2} + \frac{2000000(0.82)}{(1.05)^3} + \frac{2500000}{(1.05)^4} - 4500000$$

= Rs. 534570

The value of the certainty equivalent coefficient usually ranges between 0.5 and 1. A value of 1 implies that the cash flow is certain or the management is risk neutral. In industrial situations, however, cash flows are generally uncertain and managements usually risk-adverse. Hence the certainty equivalent coefficients are typically less than 1. An illustrative table of certainty equivalent coefficients for different types of investments is shown here.

	Certainty Coefficient		Equivalent	
	Year 1	Year 2	Year 3	Year 4
Replacement Investments	0.92	0.87	0.84	0.80
Expansion Investment	0.89	0.85	0.80	0.75
New Product Investment	0.85	0.80	0.74	0.68
R & D Investment	0.75	0.70	0.64	0.58

Replacement investments Expansion investments New product investments Research and development investments.

The certainty equivalent method is conceptually superior to the risk-adjusted discount rate method because it does not assume that risk increases with time at a constant rate. Each year's certainty equivalent coefficient is based on the level of risk characterising its cash flow. Despite its conceptual soundness it is not as popular as the risk-adjusted discount rate method. This is perhaps because it is inconvenient and difficult to specify a series of certainty equivalent coefficient but seemingly simply to adjust the discount rate. Notwithstanding *this* practical difficulty, the merits of the certainty equivalent method must not be ignored.

Analysis of Non Financial Aspects

Investment decisions are based on appraisal and evaluation techniques. Apart from technical and financial viability the project's economic and socio-political costs also matter.

Economic Aspects

Institutions and banks consider various economic factors before deciding to invest in a project. Various analytical tools exist to assist the decision maker in dealing with this situation. Among these tools are: cost-benefit analysis, risk-benefit analysis, risk-cost benefit analysis, project economic viability, opportunity cost and insurability limits. It is not suggested that these methods give exact results, but only that they reveal something of the nature of the underlying valuation.

For a completely satisfactory assessment of the cost and benefit aspects of the acceptability of risk, the assessment has to include evaluation of the following:

1. The total costs associated with each option.
2. The benefits in money terms associated with each option. It must be recognised that, at least initially, all the benefits may not be expressed directly in quantitative terms and there may be problems in converting qualitative statements about benefits into quantitative statements.
3. The costs in quantitative terms associated with the direct and indirect risks inherent in each option.
4. The errors and uncertainties associated with the estimates of costs and benefits.
5. The overall economic implications of the options considered.

Given the doubts about the feasibility of finding universal criteria for assessing the ranking that economic factors justify, it is suggested that for many cases ranking of acceptability of the economic factors could be made on the basis of the life cost and benefits, the calculation taking into account all direct and indirect costs and benefits. It

also has to be accepted that the calculation has to include a factor to allow for the risk of the project not being completed. Such a factor may be a compound factor, which includes allowance for all the features of the economic environment that may cause a project to fail.

It should be recognised that simply postulating a ranking criteria does not resolve the moral question of how the costs of benefits should be distributed, answer questions about the macro-economic significance of the proposal, or explain how the calculation should be made. The moral question is partly answered by assessing public reaction to a proposal and this point is discussed next under the heading of socio-political factors.

Socio-Political Aspects

When these decisions are considered from the point of view of society, they go beyond finding out cash inflows and outflows, the benefits to society are also worked out. For example, whenever a new capital intensive project is undertaken, its impact on the health of the society is seen in terms of environmental pollution, noise pollution, employment generation, etc.

Because of the nature of socio-political factors the problems involved in assessing their significance in decision making are quite different to the problems of assessing technical and economic factors. Socio-political aspects of a decision are concerned with what ought to be, and such decisions are quite different from technical judgements which are concerned with what can be done.

There are four methods for assessing acceptability of socio-political factors:

Method	Strengths	Limitation	Comment
Epidemiological studies	Relates what has already been accepted to environment of decision being considered	Past experience may not be relevant to the future. Does not represent a commitment by public involved	such studies identify past areas of concern, but do not predict present or future concerns or reaction to novel proposals
Consultation	Quick, provided appropriate machinery for consultation already exists. Can give a permanent form of contact between the public and the project and the decision makers	Those consulted may not represent the views of the whole community affected by the proposal in question. May be difficult to organise when national boundaries have to be crossed. Does not represent a commitment by the public involved	The success of this method depends upon those consulted being fully aware of the views of the community concerned and understanding the issues involved. Sometimes it can take two or three years to arrive at a view
Sampling	A sample survey can provide structured evidence about views on acceptability	Does not give every-one a chance to express their views about what is acceptable. Does not represent a commitment by	The sample surveyed must be taken directly from the population affected by the decision and for the results of

Contd...

		the public involved	the sampling process to really help the decision maker the population sampled must understand the issue involved
Voting	It is the most comprehensive way of establishing the views and wishes of a particular population	Not appropriate for all projects particularly small ones. Expensive and slow to arrange. Unless some form of compulsion is used not everyone will vote. Not necessarily binding on either party involved	If the result is clear it gives the decision maker positive guidance on the action the population consider should be taken. If the verdict is marginal the issue is not efficiently resolved for the decision maker

There are four methods for assessing acceptability of socio-political factors:

The conclusions that can be made about the problems of assessing socio-political factors are:

1. The socio-political factors related to complex decisions can be evaluated by carefully designed surveys.
2. Changes in opinion that take place over a period as short as two years can be detected by conventional survey methods.
3. Variations in views can be detected over a relatively small geographical area.
4. For an effective survey to be made the nature of the risk must be explained to the population being surveyed.
5. A sample opinion survey does not represent any kind of commitment by the people being surveyed, whereas voting procedures may be binding.
6. For the decision maker considering a major public project there may be considerable uncertainty about the viability of the assessment of public acceptability unless it is based on the results of a voting procedure.
7. For small non-conventional projects' surveys of the public's view of the acceptability of a proposal may not be justified.

Chapter-7
Working Capital Management

Concept, Need & Determinants

Working capital could be defined as the portion of assets used in current operations. The movement of funds from working capital to income and profits and back to working capital is one of the most important characteristics of business. This cyclical operation is concerned with utilisation of funds with the hope that they will return with an additional amount called Income. If the operations of a company are to run smoothly, a proper relationship between fixed capital and current capital has to be maintained.

Sufficient liquidity is important and must be achieved and maintained to provide the funds to pay off obligations as they arise or mature. The adequacy of cash and other current assets together with their efficient handling, virtually determine the survival or demise of the company. A businessman should be able to judge the accurate requirement of working capital and should be quick enough to raise the required funds to finance the working capital needs.

Working capital is often classified as Gross Working Capital and Net Working Capital. The former refers to the total of all Current Assets and the latter refers to the difference between Current Assets and Current Liabilities.

The maintenance of a sound Working Capital position is an important function of the Finance Department of the organisation. With the magnitude of business rising with globalisation, the quantum of working capital to be managed is on the increase. No wonder, working capital management is talked about more today than ever before.

Long-term investment decisions (capital budgeting) and long-term financing decisions are characterized by the facts that they (a) generally involve large amounts of money, and (b) are relatively infrequent occurrences. Decisions that come under the heading "short-term finance" are equally important, because, while typical decisions often don't involve as much money, decisions are much more frequent. This is suggested in the results of a recent survey of CFOs.

	Ranked Greatest Importance	Average Time Allocated
Financial Planning	59%	35%
Working Capital Mgmt	27%	32%
Capital Budgeting	9%	19%
Long-Term Financing	5%	14%
Total 100%	100%	

In defining short term finance, we focus on the cash flows connected with the operations of a company. Because the cash inflows and cash outflows are not synchronised, a company needs a temporary parking place for cash, which we can call a liquidity portfolio. This liquidity portfolio may consist of cash and marketable securities. Since cash flows for a company are uncertain, both in amount and timing, the amount of cash in temporary storage may not be adequate for all time periods. Thus, it is necessary to provide some backup liquidity for periods when the normal store of liquidity is insufficient.

Also there is a need to move cash from one point to another within a company. We need to have internal cash flows to connect these various inflows, outflows and sources of liquidity. The cash system of a company is the mechanism that provides the linkage between cash flows. The financial manager of the company has the responsibility, at least in part, to develop and maintain the policies and procedures necessary to achieve an efficient flow of cash for the company's operations.

Short term financial management thus encompasses decisions about activities that affect cash inflows, cash outflows, liquidity, backup liquidity, and internal cash flows. Many decisions of a company have a short term financial management aspect. For example, the decision to sell a bond issue in order to raise funds to finance an expansion in plant and equipment is clearly a long term decision. However, the decision on how to invest the proceeds from the bond issue until they are needed to pay for the construction is a short term financial decision.

The use of a 1-year time horizon to separate short term and long term decisions is arbitrary and, in some cases, ambiguous. To refine the definition of short term finance, it is helpful to examine the differences and interrelationships between the decisions that are classified as short term finance and those that are considered long term finance. Decisions usually classified as long term are difficult to reverse and essentially determine the basic nature of the business and how it will be carried out. Short term financial policies take the results of these decisions as a starting point and concentrate on how they can be efficiently and economically carried out. We can think of short term decisions as being more operational. Once implemented they are easier to change

Importance of Working Capital Management

Working capital management includes a number of aspects that make it an important topic for study, and we will now consider some of them.

Surveys indicate that the largest portion of a financial manager's time is devoted to the day –by- day internal operation of the firm; this may be appropriately subsumed under the heading "working capital management." since so much time is spent on working capital decisions, it is appropriate that the subject be covered carefully in managerial finance courses.

Characteristically, current assets represent more than half the total as-sets of a business firm. Because they represent a large investment and because this investment tends to be relatively volatile, current assets are worthy of the financial manager's careful attention.

Working capital management is particularly important for small firms. A small firm may minimize its investment in fixed assets by renting or leasing plant and equipment, but there is no way it can avoid an investment in cash, receivables, and inventories.' Therefore, current assets are particularly significant for the financial manager of a small firm. Further, because a small firm has relatively limited access to the long – term capital markets, it must necessarily rely heavily on trade credit by increasing current liabilities.

Relationship between Sales, Growth and current Assets

The relationship between sales growth and the need to finance current assets is close and direct. For example, if the firm's average collection period is 40 days and if its credit sales are 1,000 a day it will have an investment of 40,000 in accounts receivable. If sales rise to 2,000 a day' the investment in accounts receivable will rise to 80,000. Sales increases produce similar immediate needs for additional inventories and, perhaps, for cash balances. All such needs must be financed, and since they arise so quickly, it is imperative that the financial manager keep himself aware of developments in the working capital segment of the firm. of course, continued sales increases will require additional long- term assets, while must also be financed. However, fixed asset-investments, while critically important to the firm in a strategic, long –run sense do not generally have the same urgency as do current asset investment

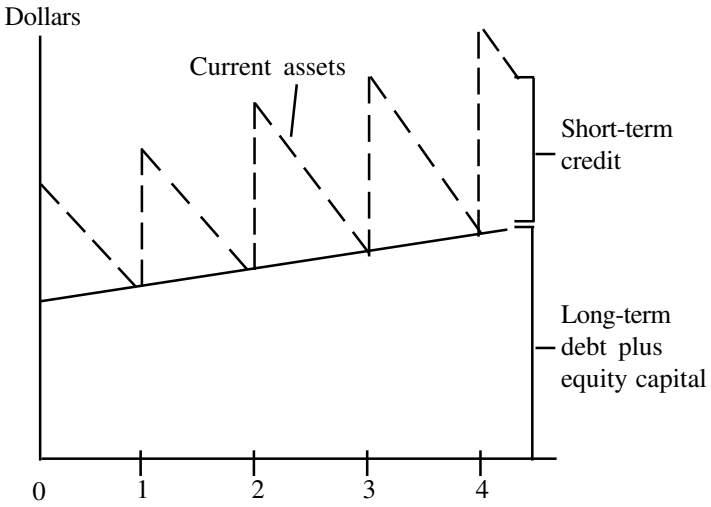
Original Concept of Working Capital

The term " working capital " originated at a time when most industries were closely related to agriculture. Processors would buy crops in the fall, process them, sell the finished product, and end up just before the next harvest with relatively low inventories. Bank loans with maximum maturities of one year were used to finance both the purchase and the processing costs, and these loans were retired with the proceeds from the sale of the finished products.

The situation is depicted in Figure 1. There fixed assets are shown to be growing steadily over time, While current assets jumps at harvest season, then decline during the year, ending atzero just before the next crop

is harvested. Short-term credit is used to finance current assets, and fixed assets are financed with long-term funds. Thus the top segment of the graph deals with working capital.

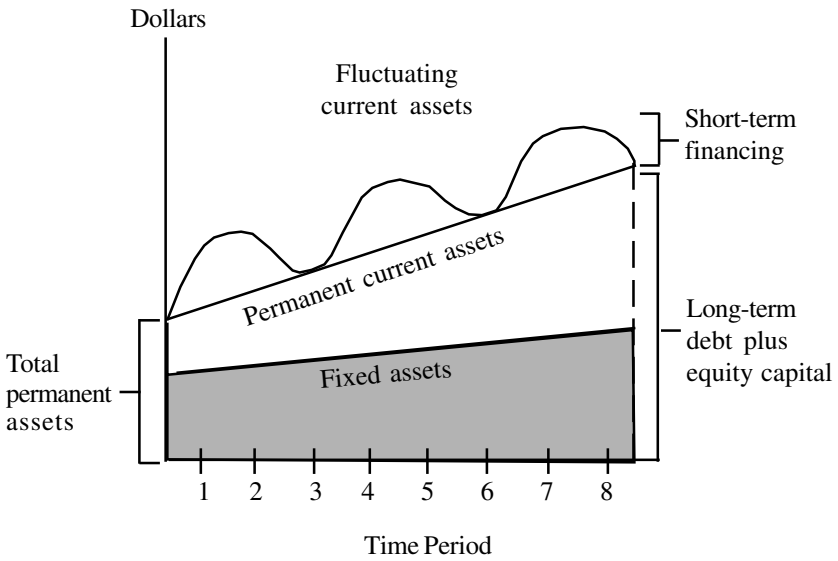
The figure represents, of course, an idealized situation- current assets build up gradually as crops are purchased and processed, inventories are drawn down less regularly, and ending inventory balances do not decline to zero. Nevertheless , the example does illustrate the general nature of the production and financing process, and working capital management consists of decisions relating to the top section of the graph-managing current assets and arranging the short-term credit used to finance them.



Extending The Working Capital Concept

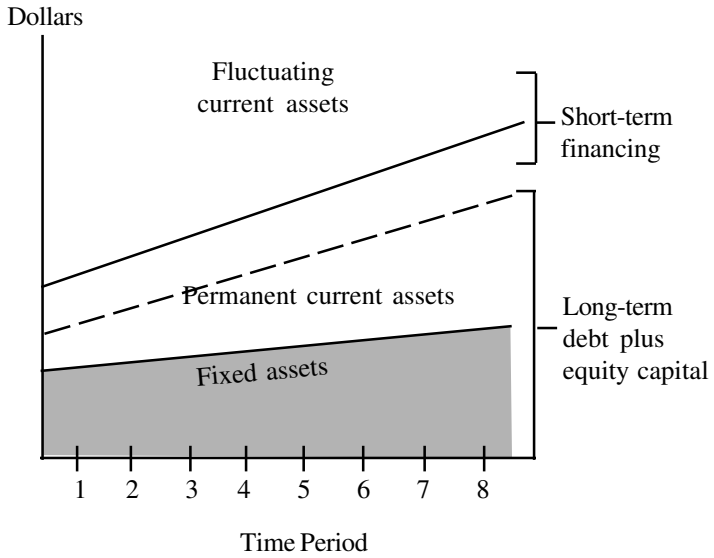
As the economy became less oriented toward agriculture, the production and financing cycles of " typical" business changed. Althought seasonal patterns still existed, and business cycles also caused asset requirements to fluctuate, it became apparent that current assets rarely, if ever , dropped to zero. This realization led to the development of the idea of' permanent current assets," diagrammed in Figure –2. As the figure is drawn, it maintains the traditional notion that permanent assets should be financed with long –term capital, while temporary assets should be financed with short-term credit.

The pattern shown in Figures -1 and -2 was considered to be desirable because it minimizes the risk that the firm maybe unable to pay off its maturing obligations To illustrate, suppose a firm borrows on a one-year basis and uses the funds obtained to build and equip a plant. Cash flows from the plant (profit plus deprecation) are not sufficient to pay of lone at the end of the year. So the loan, then the firm has problems had the plant been financed with long term debt, however, cash flows would have been sufficient to retire the loan, and the problem of renewal would not have arisen .Thus, if a firm finances long-term assets with permanent capital and short-term assets with temporary capital, its financial risk is lower than it would be if long-term assets were financed with short-term debt.

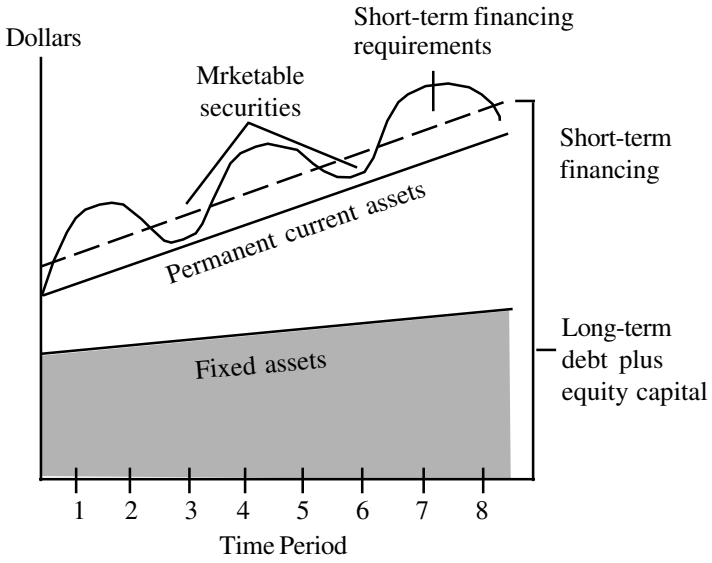


At the limit, a firm can attempt to match the maturity structure of its assets liabilities exactly. A machine expected to last for five years could be financed by a five-year loan ;a 20-year building could be financed by a 20-year mortgage bond; inventory expected to be sold in 20 days could be financed by a 20-day bank loan ;and so forth. Actually, of course, uncertainty about the lives of assets prevents this exact maturity matching . We will examine this point in the following sections.

Figure-2 shows the situation for a firm that attempts to match asset and liability maturity exactly. Such a policy could be followed, but firms may follow other maturity-matching policies if they desire. Figure-3, for example, illustrates the situation for a firm that finances all its fixed assets with –term capital but part of its permanent current assets with short-term credit.



The dashed line could have even been drawn below the line designating fixed assets , indicating that all the current assets and part of the fixed assets are financed with short-term credit ; this would be a highly aggressive, non-conservative position, and the firm would be very much subject to potential renewal problems.



Alternatively, as in Figure-4, the dashed line could be drawn above the lien designating permanent current assets, indicating that permanent capital is being used to meet seasonal demands. In this case, the firm used a small amount of short-term credit to meet its peak seasonal requirements, but it also meets a part of its seasonal needs by'' storing liquidity'' in the form of marketable securities during the off-season. The humps above the dashed line represent short-term financing, the troughs below the dashed line represent short–term security holdings.

Longer term versus Short-term Debt

The larger the percentage of funds obtained from long-term sources, the more conservative the firm's working capital policy. The reason for this, of course, is that during times of stress the firm may not able to renew its short-term debt. This begin so, why firms ever use short–term.

Concepts of Working Capital

There are two concepts of working capital- gross and net.

- ***Gross working capital*** refers to the firm's investment in current assets. Current assets are the assets which can be converted into cash within an accounting year (or operating cycle) and include cash, short-term securities, debtors, (accounts receivable or book debts) bills receivable and stock (inventory).
- ***Net working capital*** refers to the difference between current assets and current

liabilities. Current liabilities are those claims which are expected to mature for payment within an accounting year and include creditors (accounts payable), bills payable, and outstanding expenses. Net working capital can be positive or negative. A positive net working capital will arise when current assets.

The two concepts of working capital- gross and net – are not exclusive, rather they have equal significance from the management viewpoint The gross working capital concept focuses attention on two aspects of current assets management; (a) How to optimise investment in current assets? (b) How should current be financed?

The consideration of the level of investment in current assets should avoid two dangers points- excessive and inadequate investment in current assets. Investment in current assets should be just adequate, not more not less, to the needs of the business firm. Excessive investment in current assets should be avoided because it impairs the firm's profitability, as idle investment earns nothing. On the other hand, inadequate amount of working capital can threaten solvency of the firm because of its inability to meet its current obligation. It should be realised that the working capital needs of the firm may be fluctuating with changing business activity. This may cause excess or shortage of working capital frequently. The management should be prompt to initiate an action and correct imbalances.

Another aspect of the gross working capital points to the need of arranging founds to finance current assets. Whenever a need of working capital funds arises due to the increasing level of business activity, or for any others reason, financing arrangement should be made quickly. Similarly, if suddenly, some surplus funds arise they should be allowed to remain idle, but should be invested in short-term securities. Thus the financial manager should have a knowledge of the sources of working capital funds as well as investment avenues where idle funds may be temporarily invested.

Net working capital is a qualitative concept. It indicates the liquidity position of firm and suggests the extent to which working capital needs may be financed by permanent sources of funds. Current assets should be sufficiently in excess of current liabilities to constitute a margin or buffer for maturing obligations within the ordinary operating cycle of a business. In order to protect their interests, short-term creditors always like a company to maintain current assets at a higher level than current liabilities. It is a conventional rule to maintain the level of current assets twice the level of current liabilities. However, the quality of current assets should be considered in determining the level of current assets vis'-a-vis' current liabilities. A weak liquidity position poses a threat to the solvency of the company and makes it unsafe and unsound. A negative working capital means a negative liquidity, and may prove to be harmful for the company's reputation. Excessive liquidity is also bad. It may be due to mismanagement of current assets. Therefore, prompt and timely action should be taken by management improve and correct the imbalances in the liquidity position of the firm.

Net working capital concept also covers the question of judicious mix of long-term and short-term funds for financing current assets. For every firm, there is a minimum amount of net working capital which is permanent. Therefore, a portion of the working capital should be financed with the permanent sorces of funds such as equity share capital, debentures, long-term debt, preference share capital or retained earnings. Management must, therefore, decide the extent to which current assets should be financed with equity capital and/or borrowed capital.

In summary, it may be emphasised that both gross and net concepts of working capital are equally important for the efficient management of working capital. There is no precise way to determine the exact amount of gross, or net working capital for any firm. The data and problems of each company should be analysed to determine the amount of working capital. There is no specific rule as to how current assets should be financed. It is not feasible in practice to finance current assets by short-term source only. 'Keeping in view the constraints of the individual company, a judicious mix of long and short-term finances should be invested in current assets. Since current assets involve cost of funds, they should be put to productive use.

The common definition and its implications

The most common definition of net working capital is *the difference between a firm's current assets and current liabilities.* As long as firm's current assets exceed its current liabilities, it has net working capital. Most firm must operate with some amount of net working capital; now much depends largely on the industry. Firms with very predictable cash flows, such as electric utilities, can operate with negative net working capital; however, most firms must maintain positive levels of net working capital.

The theoretical underpinning for the use of net working capital to measure a firm's liquidity is the belief that the greater the margin by which a firm's current assets cover its short-term obligations (current liabilities) the more able it will be to pay its bill as they come due. However, a problem arises because each current asset and current liability has a different degree of liquidity associated with it. Although the firm's current assets may not be converted into cash at precisely the point in time when it is needed the greater the amount of current assets present the more likely it is that some current asset will be converted into cash in order to pay a debt that is due.

It is the nonsynchronous nature of a firm's cash flows that makes net working capital necessary. The firm's cash outflows resulting from payment of current liabilities are relatively predictable. It generally learns when bills are due when an obligation is incurred. For instance, when merchandise is purchased on credit, the credit terms extended to the firm require payment at a known point in time. The same predictability is associated with notes payable and accruals, which have stated payment dates. What is difficult to predict are the firm's cash inflows. Predicting when current assets other

than cash and marketable securities will be converted into cash is quite difficult. The more predictable these cash inflows are the less net working capital a firm requires. It is because an electric utility has a very predictable pattern of cash inflows that it can operate with little or no net working capital. Firms with more uncertain cash inflows must maintain levels of current assets adequate to cover current liabilities.

It is the inability of most firms to match cash receipts and cash disbursements that makes sources of cash receipts, (current assets) that will more than cover current liabilities necessary. For example, if the GHI Company has the current position given in Table 1, the following situation may exist. All $600 of the firm's accounts payable, plus $200 of its notes payable and $100 in accruals, are due at the end of the current period. That this $900 in outlays must be made is certain; how the firm will cover these outlays is not certain,. The firm can be sure that $700 will be available since it has $500 in cash and $200 in marketable securities, which can be easily converted into cash. The remaining $200 must come from the collection of an account receivable and/or the sale of inventory for cash. The firm cannot be sure when either a cash sale or the collection of an account receivable will occur. More uncertainty is associated with the collection of accounts receivable than with a cash sale. Although customers who have purchased goods on credit are expected to pay for them by the date specified in the credit arrangement, quite often they will not pay until a later date. Thus the cash flows associated with the purchases will not occur at the point in time they were expected.

[illegible]

Current assets		*Current liabilities*	
Cash	$500	Accounts payable	$600
Marketable securities	200	Notes payable	800
Accounts receivable	800	Accruals	200
Inventory	1,200	Total	$1,600
Total	$2,700		

Of course, some solution to this dilemma must exist. In order to have a higher probability of having sufficient cash to pay its bills, a firm should attempt to make sales, since in many cases they will result in the immediate receipt of cash and in other cases they will result in accounts receivable which will eventually be converted into cash. A level of f inventory adequate to satisfy the probable demand for the firm's products should be maintained. As long as the firm is generating sales and collecting receivables as they come due, sufficient cash should be forthcoming to satisfy its cash payment obligations. The GHI Company can increase the probability of its being able to satisfy its obligations by maintaining of some of these items into cash. The more accounts receivable and inventories there are on hand, the greater the probability that some of these items will be turned into cash. As a rule a certain level of net working capital

is often recommended in order to ensure that a firm will be able to pay bills. The GHI Company has $1,100 of net working capital ($2,700-$1,600) which will most likely be sufficient to cover al its bills. Its current ratio of 1.69 ($2,700/$1,600), should provide sufficient liquidity as long as its accounts receivable and inventories are relatively liquid.

An alternate definition of net working capital

An alternate definition of net working capital is *that portion of a firm's current assets financed with long-term funds.* This definition can best be illustrated by a special type of balance sheet, like that for the GHI Company presented in Figure 5. The vertical axis of the balance sheet is a dollar scale on which all the major items on the firm's balance sheet are indicated.

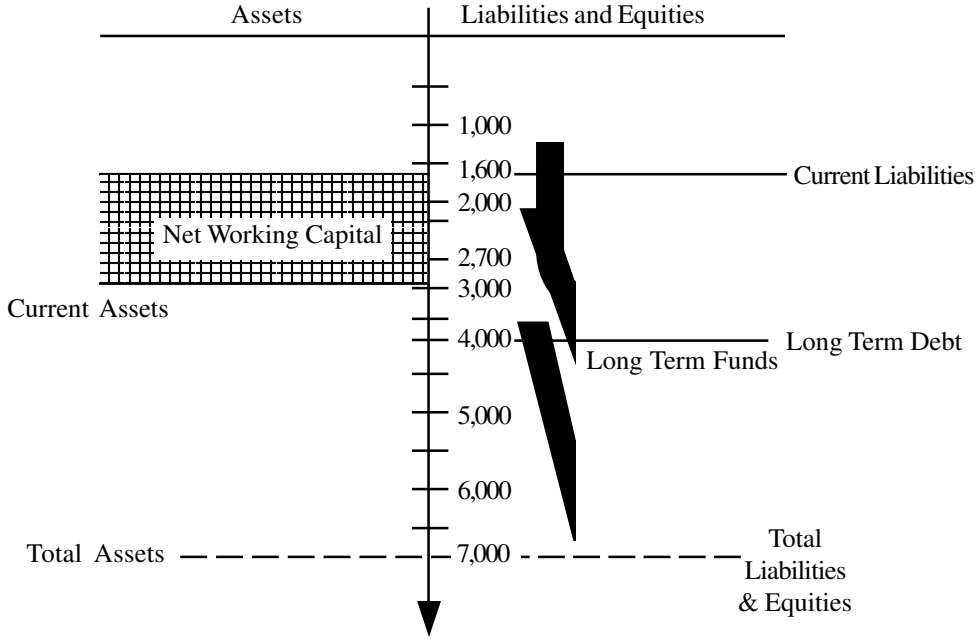


Figure 5 shows that the firm has current assets of $2,700, fixed assets of 4,300 and total assets of $7,000. It is also shows that the firm has current liabilities of $1,600, long-term debts of $2,400 ($4,000-$1,600), and stockholders' equity of $3,000 ($7,000-$4,000). A firm's long-term debt plus its stockholders' equity represents its sources of long-term funds; the GHI Company's long-term funds equal $5,400. The portion of the firm'' current assets that was financed with long-term funds has been labeled "net working capital" in Figure 5. Analysis of this figure should enable the reader to better understand why a firm's net working capital can be thought of as the portion of current assets financed with long-term funds. Since current exceed current liabilities the amount of the excess must be financed with longer-term funds. The usefulness of this alternate definition will become more apparent in a later section of the chapter.

The Trade-off between Profitability and Risk

A trade-off exists between a firm's profitability and risk. *Profitability*, in this context, is measured by profits after expenses, while *risk* is measured by the probability that a firm will become technically insolvent (i.e., unable to pay bills as they come due). A firm's profits can be increased in two ways: (1) by increasing sales or (2) by decreasing costs. Both methods are discussed in the following pages. Costs can be reduced by paying less for an item or a service or by using existing resources more efficiently. Any reduction in costs should increase a firm's profits. Profits can also be increased by investing in more profitable, assets, which are capable of generating higher levels of sales. An understanding of how profits are increased and reduced is critical to grasping the idea of a profitability-risk trade-off.

The risk of becoming technically insolvent is most commonly measured using either the amount of net working capital or the current ratio. In this chapter the amount of net working capital is used as a measure. It is assumed that *the greater the amount of net working capital a firm has, the less risky the firm is.* In other words, the more net working capital the more liquid the firm and, therefore, the less likely it is to become technically insolvent. The opposite is also considered to be true; lower levels of liquidity (i.e., net working capital) are associated with increasing levels of risk on the part of the business firm. The relationship between liquidity, net working capital, and risk is such that if either net working capital of liquidity increases the firm's risk decreases.

Some basic assumptions

In talking about a profitability-risk trade-off, a number of basic assumptions, which are generally true, must be made. The first concerns the nature of the firm being analyzed, the second concerns the basic differences in the earning power of assets, and the third concerns differences in the cost of various methods of financing. Each of these assumptions will be discussed separately.

The nature of the firm: The kind of firm we are talking about in this chapter is a *manufacturing firm,* not some type of merchandising or service organization. As we stated earlier in the text, the emphasis in this book is generally on manufacturing firms since they provide the best laboratory for investigating most of the basic principles of managerial finance.

The earning power of assets: A manufacturing firm is expected to be able to earn more on its fixed assets than on its current assets. Fixed assets represent the true earning assets of the firm. Plants, machines, and warehouses all enable the firm to generate finished products that can ultimately be sold for a profit. The firm's current assets, except for marketable securities, are not generally earning assets. Rather, they provide a buffer that allows the firm to make sales and extend credit. The importance

of current assets to the firm's operation was indicated in the preceding section; but without fixed assets to generate finished products that can be converted into cash, marketable securities, accounts receivable, and inventory, the firm could not operate. If the firm could earn more money by purchasing its inventory than by producing it or by investing its money in marketable securities then it should not be in the manufacturing business. In other words, if a firm cannot make more on fixed-asset investments than it makes on current-asset investments, it should sell all its fixed assets and use the proceeds to purchase current assets. In the following discussion it is assumed that *the firm can earn more on fixed assets than current assets.*

The cost of financing: The firm can obtain its required financing from either of two source: (1) current liabilities or (2) long-term funds. Current liabilities are sources of short-term funds; long-term debts and equity are sources of long-term funds. Since current liabilities generally consist of accounts payable, notes payable, and accruals, they are typically a cheap source of funds. Of the basic current liabilities, only notes payable normally have a stated cost. This is because notes payable represent the only *negotiated* form of borrowing. Accounts payable and accruals are cheaper sources of funds than notes payable since they do not normally have any type of interest payment associated with them.

Historically, in general, short-term funds cost less than long-term funds. In the recent past, interest rates have been increasing and people have expected higher interest rates in the future. Lenders with such expectations will typically provide short-term funds at rates below those charged for longer-term funds. They do this because short-term loans mature in less than a year, and they will get their money back in time to relend it at higher rates if interest rates do increase over the year. If interest rates are expected to increase in the future, a lender will charge a high enough rate of interest on a longer-term loan to compensate himself for tying up his money for a long period and losing future opportunities to lend money at increased rates.

Whenever lenders believe that future interest rates will rise, short-term borrowing rates are less than long-term rates. When future rates are expected to decline from a currently high rate, long-term rates are most often below short-term rates. Since increasing interest rates have prevailed in the most recent past, it is assumed in the following discussion that short-term funds are cheaper than longer-term funds. The fact that short-term sources of funds include not only notes payable but also accounts payable and accruals makes it much easier to accept this assumption, since accounts payable and accruals are virtually interest-free. The cheapest form of financing for the business firm is, therefore, short-term funds.

The nature of the trade-off between risk and profitability

If a firm wants to increase its profitability, it must also increase its risk. If it wants to

decrease risk, it must decrease profitability. The trade-off between these variables is such that regardless of how the firm increases its profitability through the manipulation of working capital the consequence is a corresponding increase in risk as measured by the level of net working capital. The effects of changing current assets and changing current liabilities on the firm's profitability-risk trade-off will be discussed separately prior to integrating them into an overall theory of working capital management.

Current assets The effects of the firm's level of current assets on its profitability-risk trade-off can be illustrated using a simple ratio—the ratio of the firm's current assets to its total assets. This ratio indicates what percentage of the firm's total assets are current. It may increase or decrease.

Effects of an increase As the ratio of current assets to total assets increases, both the firm's profitability and its risk decrease. Its profitability decreases because current assets are less profitable than fixed assets. The risk of technical insolvency decreases because, assuming that the firm's current liabilities do not change, the increase in current assets will increase its net working capital.

Effects of a decrease A decrease in the ratio of current assets to total assets will result in an increase in the firm's profitability since the firm's fixed assets, which "There have been periods when short-term rates have exceeded long-term rates, but these periods have been exceptions rather than the norm. The second quarter of 1974 through the first quarter of 1975 was a period during which the short-term were above long-term rates increase, generate higher returns than current assets. However, risk will also increase since the firm's net working capital will decrease with- the decrease in current assets. The consequences of a decrease in the ratio of current to total assets are exactly the opposite of the results of an increase in the ratio.

Example

The balance sheet for the GHI Company presented in Figure 5 indicated the following levels of assets, liabilities, and equity:

Assets		Liabilities and equity	
Current assets	$2,700	Current liabilities	$1,600
Fixed assets	4,300	Long-term debts	2,400
Total	$7,000	Equity	3,000
		total	$7,000

If the GHI Company earns approximately 2 percent on its current assets and 12 percent on its fixed assets, the current balance sheet configuration will allow it to earn approximate $570 [(2% . $2,700) + (12% . $4,300)1 on its total assets. The firm's net working capital is currently $1,100 ($2,700 - $1,600). Its ratio of current assets to total assets is approximately.386 ($2,700 ÷ $7,000).

If the firm decreases this ratio by investing $309 more in fixed assets (and thus $300 less in current assets), the new ratio of current to total assets is.343 ($2,400 s $7,000). The firm's profits on its total assets will then be $600, [2% · ($2,400)+ 12% ($4,600)].

Its net working capital will be-$800, ($2,400 — $1,600). These results are tabulated in Table 2.

	Initial value	Value after change
Ratio of current to total assets	.386	.343
Profits on total assets	$570	$600
Net working capital	$1,100	$800

As Table 2 indicates, as the firm's ratio of current to total assets decreases from .386 to .343 its profits on its total assets increase from $570 to $600. Its risk, measured by the amount of net working capital, increases since its net working capital, and thus its liquidity, is reduced. This supports our earlier conclusions concerning the profitability-risk trade-off as related to the firm's current assets.

Current liabilities The effects of changing the level of a firm's current liabilities on its profitability-risk trade-off can also be demonstrated using a simple ratio—in this case, the ratio of the firm's current liabilities to its total assets. This ratio indicates the percentage of the firm's total assets that have been financed by current liabilities. It can either increase or decrease.

Effects of an increase As the ratio of current liabilities to total assets increases, the firm's profitability increases; but so does its risk. Profitability increases due to the decreased costs associated with using more short-term financing and less long-term financing. Since short-term financing involving accounts payable, notes payable, and accruals is less expensive than long-term financing, the firm's costs decrease, driving its profits higher. Assuming that the firm's current assets remain unchanged, its net working capital will decrease as its current liabilities increase. A decrease in net working capital means an increase in overall risk.

Effects of a decrease A decrease in the ratio of current liabilities to total assets will decrease the profitability of the firm, since a larger amount of financing must be raised using the more expensive long-term instruments. There will be a corresponding decrease in risk due to the decreased level of current liabilities, which will cause an increase in the firm's net working capital. The consequences of a decrease in the ratio of current liabilities to total assets are exactly the opposite of the results of an increase in this ratio.

Example

The balance sheet for the GHI Company in the preceding section can be used to show the effects of an increase in the firm's current liabilities. Initially the ratio of current liabilities to total assets is .229 (%1,600 ÷$7,000). Assume that the firm's current liabilities cost approximately 3 per cent to maintain while the average cost of its ions-

term funds is 8 percent. Ignoring the changes made in the preceding example, the effect of shifting $300 from long-term funds into current liabilities will increase current liabilities to $1,900 ($1,600 + $300) and decrease long-term funds to $5,100 ($5,00 – $300). The new ratio of current liabilities to total assets will be .271 ($1,900 ÷ $7,000). The result of this change will be a decrease in costs from the current level of $480 [(3% · $1,600) + (8% · $5,400)1 to $465 [(3% · %1,600) + (8% · $5,100)]. The firm's net working capital will decrease from the initial level of $1,100 to $800 ($2,700 – $1,900). These results of the increase in the ratio of current liabilities to total assets are tabulated in Table .3.

	Initial value	Value after change
Ratio of current liabilities to total assets	.229	.271
Cost of finanace[a]	$480	$465
Net working capital	$1,100	$800

[a]A decrease in any of the firm's costs is equivalent to an increase in profitability by the same amount.

Table 3 illustrates that as the firm's ratio of current liabilities to total assets increases from .229 to .271, the firm's profits increase by $15 (since its costs drop from $480 to $465). Meanwhile, the firm's risk, measured by the level of net working capital, increases since its net working capital, or liquidity, decreases. This example illustrates only the effects of an increase in the ratio of current liabilities to total assets; a decrease would have an opposite effect.

Combined effects The combined effects of changes in current assets and changes in current liabilities can be measured by considering them simultaneously. In the preceding two examples, the effects of a decrease in the ratio of current to total assets and the effects of an increase in the ratio of current liabilities to total assets were illustrated. Both changes, considered independently, were shown to increase the firm's profitability while increasing its risk. Logically, then, the combined effect of these actions should be to increase profits and risk and decrease net working capital. Table 4 illustrates the effects of combining the changes in current assets and current liabilities presented in Tables 2 and 3.

	Change in profits	Change in net working capital
Decrease in ratio of current to total assets	+ $30	-$300
Increase in ratio of current liabilities to total assets	+$15	-$300
Net Effect	+$45	-$600

The value in Table 4 illustrate that the net effect of the two changes illustrated earlier is an increase in profits of $45 and a decrease in net working capital (liquidity) of $600. The trade-off here is obvious; the firm has increased its profitability by increasing its risk.

Table 4 shows that the firm's net working capital has been reduced from its initial level of $1,100 to $500. The firm's initial net profit can be thought of as the difference between the initial profits on total assets and the initial cost of financing. The initial profit on total assets was $570, and the initial cost of financing was $480. The initial net profit was therefore $90 ($570 – $480). After the changes in current assets and current liabilities, the firm's profits on its total assets increased to $600 while the cost of financing decreased to $465. Its net profits, therefore, increased to $135 ($600 – $465)..

Finance Mix for working capital

The finance mix for workng capital is as follows:

- Current Assets (in descending order of liquidity):
    1. Cash
    2. Bank Balance
    3. Short term investments
    4. Trade Debtors
    5. Inventory
- Finished Goods
- Work in process
- Raw materials
- Stores & Spares
    6. Pre-payments (Insurance, advances etc.)
- Current Liabilities:
    1. Trade Creditors
    2. Bank Overdraft or Cash Credit
    3. Short Term Borrowings
    4. Provision for taxes
    5. Provision for dividends

If current assets is the source from which current liabilities are to be met (as and when they fall due) during the course of business operations, then their strengths or weaknesses

will have significant bearing on the short run liquidity of the company. The importance of preserving this short term liquidity need not be emphasised and hence the need to manage the working capital.

Working parameters of a company influence the composition mix of various components of working capital. Whether the company is single product or multiple product? Whether the company does made-to-order work or it keeps stock in inventory? Whether it is a manufacturing company or a trading company? Whether it extends credit to its customers or does not? Whether it gets credit from its suppliers or does not? These are some of the questions that the company has to answer before it can really decide what levels of working capital that the company needs.

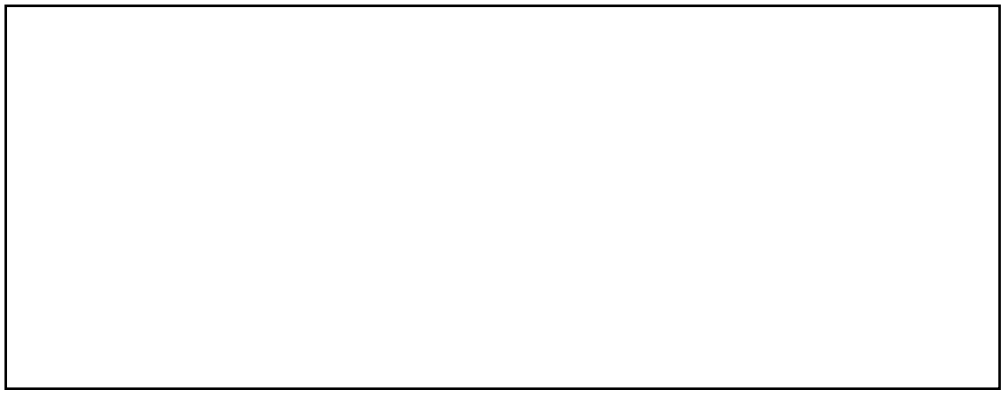
Single product companies normally operate with a lower quantum of working capital than a multi-product or multi-process companies. Trading operations, which get the payments in cash everyday, will necessarily have to manage their funds in a different way than a defence contractor who gets his payment after six months of the completion of the job. The management of funds will be altogether different for an infrastructure contractor whose payment terms are divided over a number of years.

Estimating working capital needs

The size of the company's investment in current assets is determined by its short-term financial policies. There are three types of policies that the company can use: 1) Flexible policy, 2) Restrictive policy and 3) A compromise policy that lies between the two.

1) A company keeping a flexible working capital policy means that the company is very liberal in its trade terms and has invested a large amount of funds in its operations. Flexible policy actions include:
   - Keeping large cash and securities balances
   - Keeping large amounts of inventory
   - Granting liberal credit terms
2) A company keeping a restrictive working capital policy is basically investing the lowest amount possible in the operations. for Restrictive policy actions include:
   - Keeping low cash and securities balances
   - Keeping small amounts of inventory
   - Allowing few or no credit sales
3) A company keeping a compromise working capital policy is realistically investing the money in the operations, neither has very large amount of cash nor runs always short of it like the restrictive policy does.

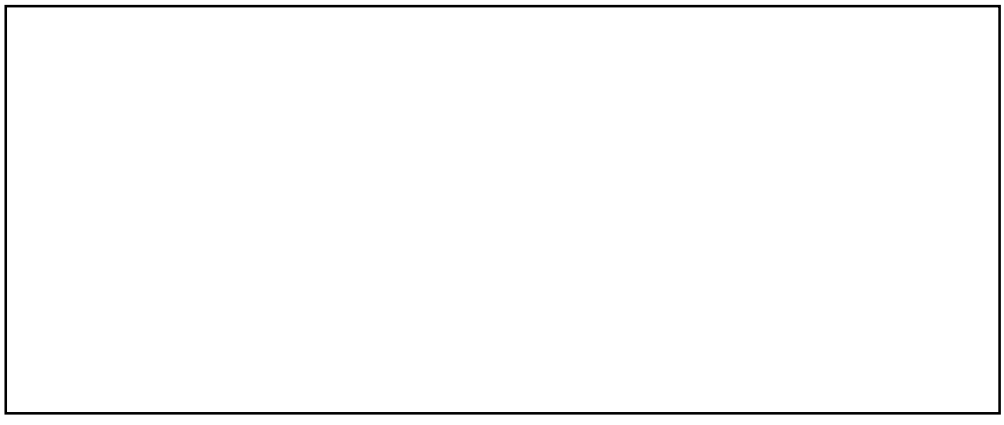
The three types of policies are shown in figure 6:



As you can see in the figure 18.1, a company that keeps a flexible policy keeps enough liquid assets that are sufficient to finance its peak requirements of working capital. This means that the company invests the excess money that it has when there is less than the peak demand. A company with a restrictive policy keeps enough liquid assets that are sufficient to meet the lowest level of working capital requirements. This means that the company borrows as the seasonal needs grow to fund its working capital needs. With a compromise policy, the firm keeps a reserve of liquidity which it uses to initially finance seasonal variations in current asset needs. Short-term borrowing is used when the reserve is exhausted.

A restrictive policy is associated with higher risk and higher expected profitability. A conservative policy ensures higher liquidity and cover risk but is always accompanied by lower profitability. The policy to be adopted is based on managements' perception of the risk with a view to maximise the utility value of the funds used in the working capital management. This means that the risk-return trade-off is to be kept in mind while formulating the WC policy.

Flexible policy means that the company is carrying excess cash and hence bearing higher carrying costs than the other two policies. Restrictive policy means that the company is out of cash many times and hence carries shortage costs like loss of orders, etc. This is depicted in the figure 3.2 below:



As the level of working capital increases, shortage costs go down while the carrying costs increase. This means that there would be a point where the sum total of carrying costs and the shortage costs would be the lowest. This is the optimum level of current assets that the company should keep.

In addition to the working parameters peculiar to a company that determine the quantum of required working capital, the following factors are also equally important:

1. **Profit levels:** A company earning huge amounts of profits can add to the working capital pool a larger quantum of funds. Such companies should, however, guard against the temptation of expanding beyond necessity and tying up the funds in unproductive capital expenditure or allow unnecessary increase in overheads. Generally it is seen that companies with high profit levels become lax in management of funds and usually mismanage by blocking funds excessively in stocks or debtors.

2. **Tax Levels and Planning:** Income Tax laws provide for payment of advanced tax in instalments. Excise and sales tax are payable at time of despatch of goods from the factory premises and the point of sales respectively. Any working capital management must make adequate and timely provision for the same as all of them involve cash outlays.

3. **Dividend Policies and Retained Earnings:** Dividend policy and retained earnings are directly related. There has to be a proper balance between the need to preserve cash resources and the obligation to satisfy shareholder expectations. Sometimes reserves are sacrificed for consistent dividends. Dividends once declared become a short time liability which has to be paid for in cash and this impact should be recognised in the working capital budget. On the other hand, it would be of little satisfaction to the general body of the shareholders to enjoy a liberal dividend at the expense of ploughing back the same for the growth of the company. Reserves in the form of retained earnings is a very important source of augmenting working capital.

4. **Depreciation Policy:** The extent to which depreciation provision is made during the course of making the financial statements has a direct bearing on the dividend policy and retained earnings. This so because a higher quantum of depreciation would leave lesser profits resulting in reduced retained earnings and dividends. The quantum of depreciation can be made to vary by choosing different methods to provide for the use of assets. As provisions for depreciation are actually only book entries and represent no cash flow at that time, they will have no bearing on working capital except to the extent they may hold back distribution of dividends.

5. **Expansion/Diversification Plans:** Addition of fixed assets to produce new

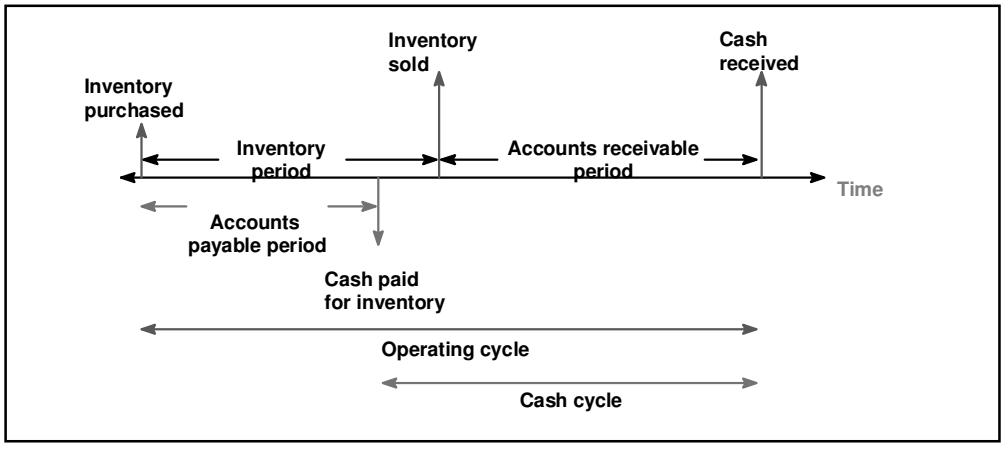
products, resorting to multiple shifts, or marginally adding to the plant and machinery are some of the common known ways to expand or diversify. Either of them represent an increase in production which calls for a higher quantum of spending of current assets, e.g. , you buy more raw material when you produce more and so on. In such situations, it is unwise to strain the internal resources for avoiding external funding.

6. **Price level changes in raw material and finished goods:** Inflation has got a direct bearing on the working capital. It depends to a large extent on the companies ability to readjust its own prices to cover the increase in the cost. In case the product or service requires government approval or is administered as far as the price is concerned, inflation may have a very significant bearing on the working capital needs. Inflation could be either recessive or expensive. During recessive inflation the companies are unable to sell more products due to lack of demand which results in the reduction of production. Inventories pile up and fixed expenses need a drastic reduction.

7. **Operating Efficiency of the company:** Operating efficiency of a company plays a major role in working capital management. An efficient company will have a shorter manufacturing period, long credit terms available from suppliers and minimal customers credit outstanding. If this is achieved then the quantum of working capital required will be naturally reduced.

The Working Capital Cycle

The Working Capital Cycle (or operating cycle) is the length of time between a company's paying for material entering into stock and receiving the inflow of cash from sales. The movements in the cycle are different for different types of companies and are dependent on the nature of the company.



The operating cycle is the time period from inventory purchase until the receipt of cash. (Sometimes the operating cycle does not include the time from placement of the order until the arrival of stock.) The cash cycle is the time period from when cash is paid out, to when cash is received.

Computation of Working Capital

The two components of working capital (WC) are current assets (CA) and current liabilities (CL). They have a bearing on the cash operating cycle. In order to calculate the working capital needs, what is required is the holding period of various types of inventories, the credit collection period and the credit payment period.

Working capital also depends on the budgeted level of activity in terms of production/ sales. The calculation of WC is based on the assumption that the production/sales is carried on evenly throughout the year and all costs accrue similarly. As the working capital requirements are related to the cost excluding depreciation and not to the salt price, WC is computed with reference to cash cost. The cash cost approach is comprehensive and superior to the operating cycle approach based on holding period of debtors and inventories and payment period of creditors. Some problems have been solved, however, using the operating cycle approach also. The steps involved in estimating the different items of CA and CL are as follows:

Estimation of Current Assets

Raw Materials Inventory The investment in raw materials inventory is estimated on the basis of Eq. l.

$$\frac{\text{Budgeted production (in units)} \times \text{Cost of raw material(s) per unit} \times \text{Average inventory holding period (months/days)}}{\text{12 months/365 days}} \quad (1)$$

Work-in-Process (W/P) Inventory The relevant costs to determine work-in-process inventory i are the proportionate share of cost of raw materials and conversion costs (labour and manufacturing overhead costs excluding depreciation).' In case, full unit of raw material is required in the beginning, the unit cost of work-in-process would be higher, that is, cost of full unit + 50 per cent of conversion cost, compared to the raw material requirement throughout the production cycle; W/P is normally equivalent to 50 per cent of total cost of production. Symbolically,

$$\frac{\text{Budgeted production (In units)} \times \text{Estimated work in-process cost per unit} \times \text{Average time span of work-in-progress inventory (months/days)}}{\text{12 months/365 days}} \quad (2)$$

Finished Goods Inventory Working capital required to finance the finished goods inventory is given by factors summed up in Eq. 3.

Budgeted production (in units)	×	Cost of goods produced per unit (excluding depreciation)	Finished goods holding period (months/days)	
		12 months/365 days		(3)

Debtors The WC tied up in debtors should be estimated in relation to total cost price (excluding depreciation, Symbolically,

Budgeted credit sales (in units)	×	Cast of sales per unit excluding depreciation	×	Average debt collection period (months/days)	
		12 months/365 days			(4)

Cash and Bank Balances Apart from WC needs far financing inventories and debtors, firms also find it useful to have some minimum cash balances with them. It is difficult to lay down the exact procedure B of determining such an amount. This would primarily be based on the motives for holding cash balances of the business firm, attitude of management toward risk, the access to the borrowing sources in times of need and past experience, and so on.

Estimation of Current Liabilities

The working capital needs of business firms are lower to the that extent such needs are met through the current liabilities (other than bank credit) arising in the ordinary course of business. The important current liabilities (CL), in this context are, trade-creditors, wages and overheads:

Trade Creditors

Budgeted yearly production (in units)	x	Raw material requirement per unit	x	Credit period allowed by creditors (months/days)	
		12 months/365 days			(5)

Note: Proportional adjustment should be made to cash purchases of raw materials.

Direct Wages

Budgeted yearly production (in units)	× (months/days)	Direct labour cost per unit	×	Average time-lag in payment of wages	
		12 months/365 days			(6)

The average credit period for the payment of wages approximates to a half-a-month in the case of monthly wage payment: The first days' monthly wages are paid on the 30th day of the month, extending. credit for 29 days, the second day's wages are, again,

paid on the 30th, extending credit for 28 days, and so on. Average credit period approximates to half a month.

Overheads (Other than Depreciation and Amortisation)

$$\frac{\text{Budgeted yearly production (in units)} \times \text{Overhead cost per unit} \times \text{Average time-lag in payment of overheads (months/days)}}{\text{12 months/365 days}} \quad (7)$$

The amount of overheads may be separately calculated for different types of overheads. In the case of selling overheads, the relevant item would be sales volume instead of production volume.

The computation of working capital is summarised in following format

Format 7: Determination of Working Capital

(I) **Estimation of Current Assets:**	Amount
(a) Minimum desired cash and bank balances	
(b) Inventories	
Raw material	
work-in-process	
Finished Goods	
(c) Debtors	
Total Current Liabilities:	
(II) **Estimation of Current Liabilities:**	
(a) Creditors**	
(b) Wages	
(c) Overheads	
Total Current Liabilities	
(III) **Net Working Capital (I-II)**	
Add margin for contingency	
(IV) **Net Working Capital Required**	

* If payment is received in advance, the Item would be listed in CL.

** If advance payment is to be made to creditors, the item would appear under CA. The same would be the treatment for advance payment of wages and overheads.

Examples

1. X & Y Ltd is desirous to purchase a business and has consulted you, and one point on which you are asked advise them. is the average amount of working capital which will be required in the first year's working.

You are given the following estimates and are instructed to add 10 per cent to your computed figure to allow for contingencies.

	Amount for the year
(i) Average amount backed up for stocks:	
Stocks of finished product	Rs 5,000
Stocks of stores and materials	8,000
(ii) Average credit given:	
Inland sales, 6 weeks' credit	3,12,000
Export sales, 1.5 weeks' credit	78,000
(iii) Average time lag in payment of wages and other outgoings:	
Wages, 1.5 weeks	2,60,000
Stocks and materials, 1.5 months	48,000
Rent and royalties, 6 months	10,000
Clerical staff, 0.5 month	62,400
Manager, 0.5 month	4,800
Miscellaneous expenses, 1.5 months	48,000
(iv) Payment in advance:	
Sundry expenses (paid quarterly in advance)	8,000
Undrawn profits on an average throughout the year	11,000

Set up your calculations for the average amount of working capital required.

Solution

Statement to determine Net Working Capital for X a Y Ltd

(a) Current assets:		
(i)	Stock of finished product	Rs 5,000
(ii)	Stock of stores and materials	8,000
(iii)	Debtors:	
	Inland sales (Rs 3,12,000 × 6/52)	36,000
	Export sales, (Rs 78,000 × 3/104)	2,250
(iv)	Advance payment of sundry expenses (Rs 8,000 × 1/4)	2,000
Total investment in current assets		53,250
(b) **Current liabilities:**		
(i)	Wages (Rs 2,60,000 × 3/104)	7,500
(ii)	Stocks/materials, (Rs 48,000 × 3/24)	6,000
(iii)	Rent, royalties, (Rs 10,000 × 6/12)	5,000
(iv)	Clerical staff (Rs 62,400 × 1/24)	2,600

(v)	Manager (Rs 4,800 × 1/24)	200
(vi)	Miscellaneous expenses (Rs 48,000 × 3/24)	6,000
Total estimate of current liabilities		27,300
(c) **Net working capital:**		
(i)	Current assets-Current liabilities (A-B)	25,950
(ii)	Add 10 per cent contingency allowance	2,595
Average amount of working capital required		28,545

Assumptions

(i) A time period of 52 weeks/12 months has been assumed in year.

(ii) Undrawn profit has been ignored in the working capital computation for the following reasons:

(a) For the purpose of determining working capital provided by net profit, it is necessary to adjust the net profit for income tax and dividends/drawings, and so on.

(b) Profit need not always be a source of financing working capital. It may be used for other purposes like purchase of fixed assets, repayment of long-term loans, and so on; Since the firm does not seem to have such uses, Rs 11,000 may be treated as source of working capital. But the WC will not change.

(iii) Actual working capital requirement would be more than what is estimated here as the cash component of current assets is not known.

2. A Proforma cost sheet of a company provides the following particulars:

	Amount per unit
Elements of cost:	
Raw materials	Rs 80
Direct labour	30
Overhead	60
Total cost	170
Profit	30
Selling price	200

The following further particulars are available:

Raw materials in stock, on average, one month; Materials in process (completion stage, 50 per cent), on average, half a month; Finished goods in stock, on average, one month.

Credit allowed by suppliers is one month; Credit allowed to debtors is two months;

Average time-lag in payment of wages is 1.5 weeks and one month in overhead expenses; one-fourth of the output is sold against cash; cash in hand and at bank is desired to be, maintained at Rs 3,65,000.

You are required to prepare a statement showing the working capital needed to finance a level of activity of 1,04,00 units of production. You may assume that production is carried on evenly throughout the year, and wages and overheads accrue similarly.

Solution

Statement showing Determination of Net Working Capital

(A) **Current assets:**		
(i)	Stock of materials for 1 month: (1,04,000 x Rs 80 × 4/52)	Rs 6,40,000
(ii)	Work-in-progress for 0.5 month:	
	(a) Material (1,04,000 x Rs 80 × 2/52) × 0.50	1,60,000
	(b) Labour (1,04,000 x Rs 30 × 2/52) × 0.50	60,000
	(c) Overheads (1,04,000 x Rs 60 × 2/52) × 0.50	1,20,000
(iii)	Finished goods for 1 month: (1,04,000 × Rs 170 × 4/52)	13,60,000
(iv)	Debtors for 2 months (78,000 × Rs 170 × 8/52)	20,40,000
(v)	Cash in hand and at bank	3,65,000
	Total investments in current assets	47,45,000
(B) **Current liabilities:**		
(i)	Creditor8, 1 month's purchase of raw materials, (i.e. 1,04,000 x Rs.80 x 4/52)	6,40,000
(ii)	Average time-lag in payment of expenses	
	(a) Overheads (1,04,000 × Rs 80 × 4/52)	4,80,000
	(b) Labour (1,04,000 × Rs 30 × 3/104)	90,000
	Total estimate of current liabilities	12,10,000
(C) **Net working capital** = Current; assets - Current liabilities(A-B)		35,36,000

Working notes and assumptions

(i) 26,000 units have been sold for cash. Therefore, credit sales pertain to 78,000 units only.

(ii) Year has 52 weeks.

(iii) All overheads are assumed to be variable. Presence of depreciation element in overheads will lower the working capital requirement.

3. While preparing a project report on behalf of a client you have collected the following facts. Estimate the net working capital required for that project. Add 10 per cent to your compacted figure to allow contingencies:

	Amount per unit
Estimated cost per unit of production is:	
Raw material	Rs 80
Direct labour	30
Overheads (exclusive of depreciation, Rs 10 per unit)	60
Total cash cost	170

Additional information:

Selling price, Rs 200 per unit

Level of activity, 1,04,000 units of production per annum

Raw materials in stock, average 4 weeks

Work in progress (assume 50 per cent completion stage in respect of conversion costs and 100 per cent completion in respect of materials), average 2 weeks

Finished goods in stock, average 4 weeks

Credit allowed by suppliers, average 4 weeks

Credit allowed to debtors, average 8 weeks

Lag in payment of wages, average 1.5 weeks

Cash at bank is expected to be, Rs 25,000.

You may assume that production is carried on evenly throughout the year (52 weeks) and wages and overheads accrue similarly. All sales are on credit basis only.

Solution

Net Working Capital Estimate of a Project

(A) **Current assets:**		
(i)	Raw materials in stock, (1,04,000 × Rs 80 × 4/52)	6,40,000
(ii)	Work-in-progress	
	(a) Raw material (1,041000 × Rs 80 × 2/52)	3,20,000
	(b) Direct Labour (1,04,000 × Rs 15 × 2/52)	60,000
	(c) Overheads (1,04,000 × Rs 30 × 2/52)	1,20,000
(iii)	Finished goods stock: (1,04,000 × Rs 170 × 4/52)	13,60,000
(iv)	Debtors: (1,04,000 × Rs 170 × 8/52)	27,20,000
(v)	Cash at bank	25,000
Total investment in current assets		52,45,000

(B) **Current liabilities:**	
(i) Creditors, average 4 weeks: (1,04,000 × Rs 80 × 4/52)	6,40,000
(ii) Lag in payment of wages (1,04,000 × Rs 30 × 3/104)	90,000
Total current liabilities	7,30,000
(C) **Net working capital:** Current assets - Current liabilities	45,15,000
Add 10 per cent contingencies	4,51,000
	Rs 49,66,500

Working notes

A full unit of raw material is required at the beginning of the manufacturing process and, therefore, total cost of the material, that is, Rs 80 per unit has been taken into consideration, while in the case of expenses, viz. direct labour and overheads, the unit has been finished only to the extent of 50 pet cent. Accordingly, Rs 15 and Rs 30 have been charged for direct labour and overheads respectively in valuing work-in-process.

4. A newly formed company has applied for a loan to a commercial bank for financing its working capital requirements. You are requested by the bank to prepare an estimate of the requirements of the working capital for the company. Add 10 per cent to your estimated figure to cover unforeseen contingencies. The information about the projected profit and loss account of this company is as under:

Sales		Rs 21,00,000
Cost of goads sold		5,30,000
Gross profit		5,70,000
Administrative expenses	Rs 1,40,000	
Selling expenses	1,30,000	
		2,70,000
Profit before tax		3,00,000
Provision for tax		1,00,000
Note: Cost of goods sold has been derived as follows:		
Materials used		8,40,000
Wages and manufacturing expenses		6,25,000
Depreciation		2,35,000
		17,00,000
Less stock of finished goods (10 per cent-nor yet sold)		1,70,000
		15,30,000

The figures given above relate only to the goods that have been finished and not to work in progress goods equal to 15 per cent of the year's production (in terms of physical units) are in progress on an average, requiring full materials but only 40 per cent of other expenses. The company believes in keeping two months consumption of material in stock; Desired cash balance, Rs 40,000.

Average time-lag in payment of all expenses is 1 month; suppliers of materials extend 1.5 months credit; sales are 20 per cent cash; rest ate at two months credit; 70 per cent of the income tax has to be paid in advance in quarterly instalents.

You can make such other assumptions as you deem necessary for estimating working capital requirements.

Solution

Net Working Capital Estimate of a Company

(A) Current assets:			
(i)	Raw material in stock =: (Rs 8,40,000 × 2/12)		Rs 1,40,000
(ii)	Work-in-progress:		
	(a) Raw material (Rs 8,40,000 × 15/100)		1,26,000
	(b) Wages and manufacturing expenses =: (Rs 6,25,000 × 0.4 × 15/100)		37,500
(iii)	Stock of finished goods: [Rs 1,70,000 - Rs 23,500 (0.10 × Rs 2,35,000, depreciation)		1,46,500
(iv)	Debtors		
	(a) Cost of goods sold	Rs 15,30,000	
	Less depreciation (Rs 2,35,000 × 0.9)	2,11,500	
		13,18,500	
	(b) Administrative expenses	1,40,000	
	(c) Selling expenses	1,30,000	
Total		15,88,500	
Credit sales (4/5 of Rs 15,88,500) = Rs 12,70,800 (12,70,800 × 2/12)		2,11,800	
(v)	Cash required	40,000	
Total investment in current assets		7,01,800	
(B) **Current liabilities:**			
(i)	Average time-lag in payment of expenses:		
	(a) Wages and manufacturing expenses	6,25,000	

(b) Administrative expenses	1,40,000	
(c) Selling expenses	1,30,000	
	8,95,000/12	74,583
(ii) Creditors (Rs 8,40,000 × 3/24)		1,05,000
Total current liabilities		1,79,583
(c) Net working capital: Current assets – Current liabilities (A-B) 5,22,217		
Add 10 per cent contingencies		52,222
		5,74,439

Assumptions and working notes

(i) Depreciation is not a cash expense and, therefore, excluded from cost of goods sold for the purpose of determining work-in-progress, finished goods and investment in debtors.

(ii) Since profit is not taken into consideration in our calculation as a source of working capital, income tax has been

5. From the following projections of XYZ & Ltd for the next year, you are required to determine the working capital required by the company.

Annual sales, Rs 14,40,000

Cost of production (including depreciation of Rs 1.20,000), Rs 12,00,000

Raw material purchases, Rs 7,05,000

Monthly expenditure, Rs 30,000

Estimated opening stock of raw materials, Rs 140,000

Estimated closing stock of raw materials, Rs 1,25,000

Inventory norms:

Raw materials, 2 months

Work-in-process, 1/2 month

Finished goods, 1 month

The firm enjoys a credit of half-a-month on its purchases and allows one month credit on its supplies. On sales orders, the company receives an advance of Rs 15,000.

You may assume that production is carried out evenly throughout the year and minimum cash balance desired to be maintained is Rs 35,000.

Solution

Statement showing determination of net working capital

(A) **Current assets:**		
Cash balance		Rs 35,000
Inventories:		
Raw materials: Opening stock	Rs 1,40,000	
Add purchases	7 05,000	
Less closing stock	1,25,00	
Annual consumption	7,20,000	
Two months requirement: (Rs 7,20,000 × 2/12)		1,20,000
Work-in-process: (Rs 10,80,000 × 1/24)		45,000
Finished goods: (Rs 10,80,000 × 1/12)		90,000
Debtors: (Rs 10,80,000 × 1/12)		90,000@
Total current assets		3,80,000
(B) **Current liabilities:**		
Trade creditors: (Rs 7,05,000 × 1/24)		29,375
Advance received from debtors		15,000
Total current liabilities		44,375
(C) **Net working capital** (A-B)		3,35,625

@ It is assumed that there is neither opening nor closing stock of finished stock and, therefore, cost of sales is Rs 10,80,000 excluding depreciation.

Monthly expenditure is excluded as the cost of production includes it (Rs 7.2 lakh, raw materials + Rs 3.6 lakh, other expenses @ Rs 30,000 per month).

Chapter-8
Cash Management and Marketable Securities

A thorough understanding of why and how a firm holds cash requires an accurate conception of how cash flows into and through the enterprise. Figure depicts the process of cash generation and disposition in a typical manufacturing setting. The arrows in the Jingle show the flow is, whether the cash balance is being increased or decreased.

The firm experiences irregular increases in its cash holdings from several external sources. Funds can be obtained in the financial markets from the sale of securities, such as bonds, preference shous and equity shares or through debt contracts with lenders such as commercial banks. These irregular cash inflows do not occur on a daily basis. They tend to be episodic, in that the financing arrangements that give rise to them are effected at wide intervals. The reason is that external financing contracts usually involve huge sums of money stemming from a major need identified by the company's management, and these needs do not occur every day. For example, a new product might be in the process of launched, or a plant expansion might be required to provide added productive capacity.

In most organisations the financial officer responsible for cash management also controls the transactions that affect the firm's investment in marketable, securities. As excess cash becomes temporarily available, marketable securities will be purchased. When cash is in short supply, a portion of the marketable securities portfolio will be liquidated.

Whereas the irregular cash inflows are from external sources, the other main sources of cash to the firm arise from internal operations and occur on a more regular basis. Over long periods the largest receipts will come from accounts receivable collections and to a lesser extent from direct cash sales of finished goods. Many manufacturing concerns also generate cash on a regular basis through the liquidation of scrap or obsolete inventory. In the automobile industry large and costly machines called chip cruisers grind waste metal fine scrap that brings considerable revenue to the major producers. At various times fixed assets may also be sold, thereby generating some cash inflow. This is not a large source of funds except in unusual situations where, for instance, a complete plant renovation may be taking place.

Apart from the investment of excess cash in near-cash assets, the cash balance will experience reductions for three key reasons. First, on an irregular basis withdrawals will be made to (1) pay cash dividends on preferred and common shares, (2) meet

interest requirements on debt, (3) repay the principal borrowed from creditors, (4) buy the firm's own shares in the financial markets for use in executive compensation plans or as an alternative to paying a cash dividend, and (5) pay tax. Again, by an "irregular basis" we mean items not occurring on a daily or highly frequent schedule. Second, the company's capital expenditure program will designate that fixed assets be acquired at various intervals. Third, inventories will be purchased on a rather regular basis to ensure a steady flow of finished goods off the production line. Note that the investment in fixed assets with the inventory account does involve depreciation. This indicates that a portion of the cost of fixed assets in charged against the product coming of the assembly fine. This cost is subsequently recovered through the sale finished goods inventory, as the product selling price will be set by management to cover all of the costs of production, including depreciation.

The variety of influences we have mentioned that constantly affect the cash balance held by the firm can be synthesized in terms of the classic motives for holding cash, as identified in the literature of economic theory.

Motives for Holding Cash

In a classic economic treatise John Maynard Keynes segmented the firm's or any economic units demand for cash into three categories: (1) the transactions motive, (2) the precautionary motive, and (3) the speculative motive.

Transactions Motive

Balances held for transactions purposes allow the firm to dispense with cash needs that arise in the ordinary course of doing business. Transactions balances would be used to meet the irregular outflows as well as the planned acquisition of fixed assets and inventories.

The relative amount of transactions cash held with be significantly affected by the industry in which the firm operates. If revenues can be forecast to fall within a tight range of outcomes, then the ratio of cash and near cash to total assets will be less for the firm than if the prospective cash in flows might be expected to very over a wide range. In this regard, it is well known that utility concerns can forecast cash receipts quite accurately, owing demand for their services arising from their quasi-monopoly status. This enables them to stagger their billings throughout the month and to time to coincide with their planned expenditures. Inflows and outflows of cash are thereby synchronised. Thus, we would expect the cash holdings of utility firms relative to sales or assets to be less than those associated with a major retail chain that sells groceries. The concern experiences a large number of transactions each day, almost all of which involve an exchange of cash.

The Precautionary Motive

Precautionary balances are a buffer stock of liquid assets. This motive for holding cash related to the maintenance of balance to be used to satisfy possible, but as yet indefinite, needs.

In our discussion of transactions balances we saw that cash flow predictability could affect a firm's cash holdings through synchronisation of receipts and disbursements. Cash flow predictability also has a material influence on the firm's demand for cash through the precautionary motive. The airline industry provides a typical illustration. Air passenger carriers are plagued with a very high degree of cash flow uncertainty. The weather, rising fuel costs, and continual strikes by operating personnel make cash forecasting a most difficult activity for any airline company. The up short of this problem is that because of all the things that might happen, the minimum cash balances desired by the management of the air carriers tend to be large.

In addition to cash flow predictability the precautionary motive for holding cash is affected by the firm's access to external funds. Especially important are those cash sources that can be tapped on short on short notice. Book banding relationships and established lines of credit can reduce the firm's need to keep cash on hand. This unused borrowing power will obviate somewhat the need to invest in precautionary balances.

In actual business practice the precautionary motive to a large extend by the holding of a portfolio of liquid assets, not just cash. In large corporate organisation, funds may flow either into or out of the marketable securities portfolio on a daily basis. Because actual rate of return can be earned on the near-cash assets, compared with a zero rate of return available on cash holding, it is logical that the precautionary motive will be met in part by investment in marketable securities.

The Speculative Motive

Cash is held for speculative purposes in order to take advantage of hoped for, profit making situations. Construction firms that erect private dwellings will at times accumulate cash in anticipation of a significant drop in lumber costs. If the price of building supplies does drop, the companies that build up their cash balances stand to profit by purchasing materials in large quantities. This will reduce their cost of goods sold and increase their net profit margin. Generally, the speculative motive is the least important component of a firm's preference for liquidity. The transactions and precautionary motive account for most of the reasons why a company holds cash balances.

Decisions that concern the amounts of liquid assets to hold rest with the financial officer responsible for cash management. A number of factors that can be expected to influence the financial officer's investment in cash and near cash have just been reviewed. Not

all of these factors affect every firm. Moreover, factors that do affect many companies will do so in differing degrees. Since the executives responsible for the ultimate cash management choices will have different risk-bearing preferences, we might expect that liquid asset holding among firms would exhibit considerable variation.

Cash Management Objectives and Decisions

Risk Return Trade off

A company wide cash management must be concerned with minimising the firm's risk of insolvency. In the context of cash management the term insolvency is used to describe the situation where the firm is unable its maturing liabilities on time in case the company is technically insolvent in that it lacks the necessary liquidity to make prompt payment on its current debt obligations. This problem could be met quite easily by carrying large cash balances to pay the bills that come due. Production, after all, would soon come to halt should payments for raw material purchases be continually late or omitted entirely. The firm's suppliers would cut off further shipments. In fact, the fear of irritating a key supplier by being past due on the payment of a trade payable does cause some financial managers to invest in too much liquidity.

The management of the company's cash position, though, is one of those major problem areas where you are criticized if you don't and criticized if you do. True, the production process will eventually be halted should too little cash be available to pay bills. If excessive cash balances are carried, however, the value of the enterprise in the financial marketplace will be suppressed of the large cost of Income forgone. The explicit return earned on idle cash balances is zero.

The financial manager must strike an acceptable balance between holding too much cash and too little cash. This is the focal point of the risk-return tradeoff. A large cash investment minimises the chances of insolvency but penalises company profitability. A small cash investment frees excess balances for investment in both marketable securities and longer-lived assets; this enhances company profitability and thereby the value of the firm's common shares but increases the chances of running out of cash.

Objectives

The risk-return tradeoff can be reduced to two prime objectives for the firm's management system:

1. Enough cash must be on hand to dispense effectively with the disbursal needs that arise in the course of doing business.

2. The firm's investment in idle cash balances must be reduced to a minimum.

Evaluation of these operational objective, and a conscious attempt on the part of management to meet them, gives rise to the needs for some typical cash management decisions.

Decisions

Two conditions would allow the firm to operate for extended periods with cash balances near a level of zero: (1) a completely accurate forecast of net cash flows over the planing horizon and (2) perfect synchronisation of cash receipts and disbursements.

Cash flow forecasting is the initial step in any effective cash management programme. This is usually accomplished by the finance function's evaluation of data supplied by the marketing and production functions in the company. The device used to forecast the cash flows over the planning period is the cash budget. Cash-budgeting procedure are explained in the latter part of new chapter it is emphasized though, that the net cash flows pinpointed in the formal cash budget are mere estimates, subject to considerable variation. Thus, a totally accurate cash flow projection is only an ideal, net a reality.

Our discussion of the cash flow process depicted in Figure 1 showed that cash inflows and outflows are not synchronised. Some inflows and outflows are irregular; other are more continual. Some finished goods are sold directly for cash but more likely the sales will be on account. The receivables, then will have to be collected before a cash inflow is realised raw materials have to be purchased, but several suppliers are probably used, and each may have its own payment date further, no law of doing business collections to coincide with raw material payments dates. So the second criterion that would permit operation of the firm with extremely low cash balances is not met in actual practice either.

Given that the will as a matter, of necessity, invest in some cash balances, certain types of decisions related to the size of those balances dominate the cash management process. These include formulation of answers to the following questions:

1. What can be done to speed up cash collections and show down or better control cash outflows?
2. What should be the composition of our marketable securities portfolio?
3. How should our investment in liquid assets be split between actual cash holdings and marketable securities?

Cash Forecasting

One objective of cash management is clearly to ensure that the business does not run short of cash. There must always be enough cash available to meet liabilities as they fall due. Equally the business should not have much more cash than what it requires. The financial manager must be alert for opportunities to make use of any cash temporarily in excess of current needs.

To ensure that these aims are met, it is necessary to know in advance as accurately as possible when cash shortages or cash surpluses are likely to occur, so that action can be planned to deal with these eventualities. Cash management depends on cash forecasting.

The most convenient type of cash forecast for this purpose is the receipts and payment forecast, because it built up in the same form as that used for recording actual transactions in the books of account. A typical form of receipts and payment forecast is illustrated below, and it covers a period of three months with monthly rests.

The first item, collection of debts, is derived from two sources:

- The outstanding debtors list at the commencement of the forecast period. Such lists should be under continuous review as part of the company's credit control procedure, and it should be possible to enter the expected collections under the various future months;
- Estimates of sales invoicing over the next three months. The invoice estimates will be converted into collection estimates using the company's normal credit period, with adjustments for any major items to which special credit terms apply, or where delays may be anticipated. The collaboration of the sales department is needed in developing these forecasts.

Other cash receipts may include cash sales (probably extrapolated from past experience), interest receivable at known due dates, and dividends receivable so far as these can be forecast.

A major item of cash outflow will be payments to suppliers. It will be convenient for control if all items that are dealt with through the purchase ledger are grouped together, though various managers will be involved in forecasting transactions of different types. Basically the purchasie manager must be required to prepare a forecast of purchase orders due to be placed month by month.

FORM OF RECEIPTS AND PAYMENTS FORECAST

Company…….. Receipt and Payment Forecast
One Year……..19…….

(figures in Rs. thousands)	Quarter Total	1st Month	2nd Month	3rd Month
Collection of Debt				
Due Now				
Future Invoicing by Quarter				
Other Income				
Total Income				
Payments				
Creditors Now				
Future Purchases by Quarter				
Quarterly Payroll				
Petty Cash Payments				
Periodic Payments				
Bank Charges				
Other Payments				
Total Outstandings				
Bank Overdraft – Opening				
-- Closing				

Similar to the debtors forecast, the payments to creditors forecast will start with a list of accounts payable outstanding at the commencement of the forecast period. This and the purchases forecast will have to be converted into a forecast of payment due dates, using the credit terms agreed by the purchasing manager.

The remaining payments will be forecast under the headings most suitable for comparison with source documents, for example:

- net wages and salaries for comparison with payrolls;
- petty cash items in total for comparison with the petty cash book;
- special cheque payments and bank standing orders (analysed by type of expense to ensure the none is forgotten), which will probably be compared with analysis column in the main cash book.

Each month the net cash flow inwards or outwards is calculated and adjusted on the previous month's cash balance to give the new month-end balance. It is thus possible to see whether at any time surplus funds will be available. If, on the other hand, the forecast shows excess demands which cannot be met from the available cash overdraft facilities, then it will be necessary to review the forecast and to make plans for modifying the timing of particular cash flows so as to restore an acceptable balance.

A monthly control report should be prepared. This will have the same line analysis as the forecast, and will set out the forecast and actual cash movements on each line and the variances between them. These variances must be analysed by cause and responsible factors so that action can be taken to improve cash control for the future.

The Cash Budget

When a cash forecast shows unsatisfactory cash balance throughout, it will probably be necessary to consider ways of obtaining additional capital. But as cash shortages are forecast only as short-term features within a general satisfactory trend, each item in the forecast should be scrutinised for possible modification to either:

a) timing: or

b) amount.

The possibility of changes in amount should be dealt with first, because an improvement in total collectibles or a reduction in total payables is of greater benefit to the business than the mere shifting of an item from one time period to another.

In relation to sales income, forecast sales quantities and prices could be reviewed, but care must be taken that this leads to a new figure which is genuinely expected to occur, and is not just a change from a moderate to an optimistic forecast.

Because of the variety of possibilities (and often their relatively small amounts), miscellaneous receivables may have been ignored by and it is possible that in total they could have a significant effect on the cash position. Three particular examples are:

- Sales of scrap, possibly after sorting and cleaning;
- Disposals of underutilised fixed assets;
- Sales of surplus stock.

In each case the potential sales proceeds have to be compared with the opportunity cost of relinquishing the assets.

In attempting to reduce the amount of proposed expenditure a good starting point is to classify the various items between those that are essential to current operations and those that are discretionary. Discretionary expenses may include such items as

subscriptions and donations, books and publications, advertising and publicity. Such expenditure can be reduced without causing short-term damage to the business.

There is nothing like shortage of cash (real or induced) to get every manager reviewing the effectiveness of his expenditure (though there must be strong central co-ordination to ensure that short-term savings do not lead to longer-term losses):

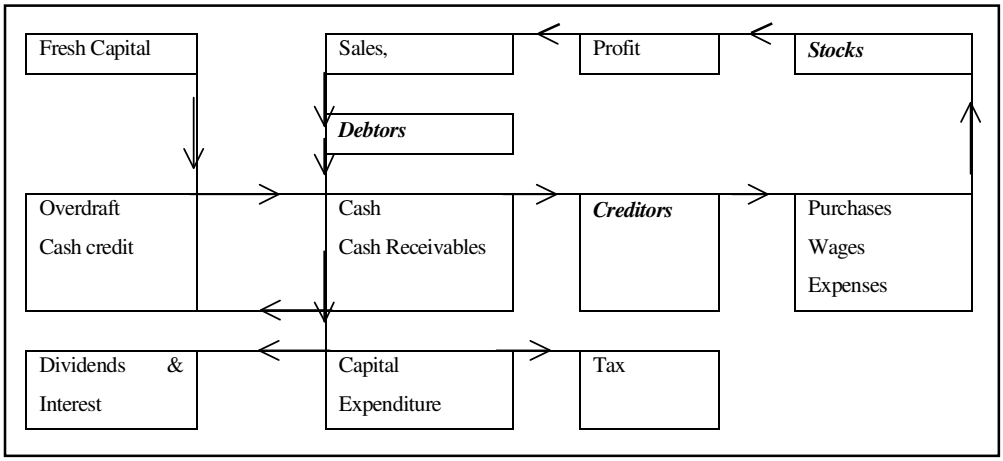
- Ensuring that responsibilities have been allocated for rigorous progress action on over-due or disputed customer accounts, and that the cash forecast incorporates the collection of such items at target dates;
- Scheduling the essential payments in such a way that the cash balance is preserved with the least impairment of good relations with the creditors.

Once we have the cash back, we have to manage it too till the time it is utilised in paying for the purchases and other expenses.

The primary purpose of cash in business is to make possible those transactions necessary to set up the business and run it day by day. Before discussing the control of cash, therefore, it is helpful to look at the various transactions in respect of which cash will be received or disbursed. We shall refer to this several times, but for our immediate purpose the important features are as follows:

- The total cash available in hand or in the bank at any time is represented by the large box left-centre of the diagram;
- The cash balance with which the business was first established will have been obtained by an injection of capital as shown in the top left-hand corner of the chart;
- During the course of the normal trading, manufacturing or service operations of the business, cash will be paid out for the purchase of goods, materials and supplies, for wages and salaries, and for various other expenses such as travelling, postage, insurance and so on;
- The marketable items or services emerging from this expenditure will be sold to customers who will pay for them and thus reinstate the cash balance;
- If this cycle of events happened instantaneously, then so far as operating transactions were concerned there would never be any shortage of cash.

Business Cash Flows



The net effect of these delays will have been mitigated because one must hope that sales values will have been in excess of the relevant outlays; i.e., they will have a mark-up for profit. This profit, however, has to cover three further items, listed below:

- The majority of businesses will require fixed assets-land, building, plant, machinery, motor vehicles, etc. (The outlay on these is shown at the bottom right of the chart as capital expenditure.) This disbursement has to be made before profits can be earned, and will only be recouped over a prolonged of time, the recovery being represented by a 'depreciation' charge in arriving at the profit mark-up. Although it is not shown on the chart it is possible to impose a delay factor on acquisition of fixed assets in various ways.
- Profit, after allowances for capital expenditure, will give rise to demand for tax. The tax payment will probably occur sometime after a profit has been earned, but will be eventually be a complete loss to the cash system of the business;
- The suppliers of capital to the business must be remunerated. Interest payments will be required periodically and regularly, although dividend payments will be made only if the profits are considered sufficient to justify them. But both types of payments will again be losses to the cash system.

Cash flows will be managed, therefore, by controlling:

1. Working capital the control of debtors, stock and creditors
2. Profit margins;
3. Capital expenditure
4. Taxation - tax management is a highly specialised subject outside the scope of this study

5. Interest and dividends dependent on the capital structure of the company.

The first and the biggest component of cash management is the level of cash which is supposed to come in. Cash forecasting was discussed earlier. Its importance in cash management cannot be undermined. Once we have forecasted the level of cash that is supposed to come in over the next few periods, then we can look at what is the base level we need for our operations.

Managing Collections and Disbursements

The size up our problem of cash management let us examine the flow of cash through a firm's accounts. It is useful to think of the process as cycle in which cash is used to purchase materials, from which are produced goods, which are then sold to customers, who later pay their bills. The firm receives cash from its customers and the cycle repeats.

Opportunities to improve efficiency in collecting and disbursing funds centre on flows through the current section of the balance sheet. Let us assume that XYZ Corporation orders raw materials at point A and receives them 14 days later at B. Terms of 2/10, net 30 are offered, so the firm pays the invoice 10 days later C. However, it takes 2 days for the cheque to clear, and XYZ's bank account is not changed until point D. XYZ turns its inventory six times per year, so 60 days after the materials are received, the product is sold and the customer is billed, the collection period is 30 days, 28 for the customer to pay and 2 for the cheque to arrive by mail(G). XYZ processes the payment and deposit it 2 days later at H. Another 2 days elapses while XYZ's bank collects the funds from the customer's bank.

The firm's total financing requirements is affected by the total time lag from point B to point J. The firm itself can control some factors that determine the various lags, but some it cannot. Some of the lags affect the cash balance, while others affect other components of working capital such as accounts receivable and inventory. In addressing ourselves to Cash management, we are concerned with time periods BCD and FGHJ. Time period AB is beyond the firm's control and does not directly affect its financial statements, although it may affect production schedules. Time period DE is determined by the firm's production process and inventory policy, and affects the total investment in inventory. Time period EF is determined by the firm's credit terms and the payment policies of its customers, and affect the total investment in accounts receivable we will examine the management of inventory and accounts receivable in the next chapter.

Our present task is to examine what can be done to improve the efficiency of a firm's cash management. We will focus on three areas: concentrating working balances speeding collections, and controlling disbursements.

Concentrating Banking

Many firms need only a single bank account. Larger firms that operate over wide geographical areas usually need more than one, sometimes dozens. Where many accounts are needed, concentration accounts can be used to minimise the total requirement for working balances. Suppose a company has a number of branch offices, each with a local bank account. Branches collect accounts receivable and make deposits in their local accounts. Each days, funds above a certain predetermined minimum are transferred to a central concentration account, usually at the firm's headquarters. The daily transfer of funds can be made either by a depository transfer check or by wire transfer; the latter is faster but more expensive.

The funds transferred to the concentration account are available for disbursement for other purpose. As we will see later, the more variable a firm's cash flows, the higher the requirement for working cash balances.

By pooling its funds for disbursement in single account, the aggregate requirement for working balances is lower than it would be if balances were maintained at each branch office. Concentration in short, permits the firm to "store" its cash more efficiently.

Speeding Collections

Another means of conserving cash is to reduce the lag between the time the customer mails the cheque and the time the funds become collected, that is, from points F to J of the 6 days lag, 2 days are due to mail time, 2 days are due to processing time within XYZ Corporation, and 2 days are due to collection time within bank. We will have more to say later about collection within the banking system. Let us now focus on the 4 days lag from F to H.

Small firms that operate in limited geographical areas often can do little to reduce mail time. However, improvements often can be made in processing time within the firm. Suppose XYZ Corporation has credit sales of Rs 5 crore per year. With approximately 250 working days per year, XYZ's collections average Rs 20,000 per working day. If XYZ could reduce it by Rs 20,000, (XYZ's borrowing cost was 9 per cent) saving of about Rs 1,800 per year would be realised. These potential saving could be compared to the cost of faster processing to determine whether the change in processing should be made. We can conclude that internal processing should be speeded up to the point at which the costs of further improvement exceed the savings.

A second step that may be advantageous is to establish a lock-box system, which often can reduce mail and processing time still further. The firm first establishes a number of collection points, taking account of customer locations and mail schedules. At each location, the firm rents a post office box and instruments its customers to remit to the

box. The firm's local bank is authorised to pick up mail directly from the box. The bank does so, perhaps several times a day and deposits the cheque in the firm's account. The bank made a record of names and amounts and other data needed by the firm for internal accounting purpose, and immediately enters the cheques for collections.

The lock-box system results in two benefits to the firm: First, the bank performs the clerical tasks of handling the remittances prior to deposit, services which the bank may be able to perform at lower cost. Second, and often more important, the process of collection through the banking system begins immediately upon receipt of the remittance and does not have to wait until the firm completes its processing for internal accounting purpose. In the activity represented by HJ now takes place simultaneously with GH. The firms processes remittances for internal accounting purpose using data supplied by the bank and can schedule this processing at any time without delaying collection. Using a lock-box system as much as 4 days in mailing and processing time can be reduced.

Banks change for their services in connection with a lock-box plan either via fees or compensating balance requirements. Whether the savings will outweigh the costs for a particular company depends mainly on the geographical dispersion of customers the rupee amount of the average remittance, the firm's cost of financing.

We see that a major advantage of speeding collections is the free cash and thereby reduce the firm's total financing requirement. There are other advantages as well. By transferring clerical functions to the bank, the firm may reduce its costs, improve internal control, and reduce the possibility of fraud. By getting cheque to banks on which they are written sooner, the incidence of cheques dishonoured for insufficient funds may be reduced.

Collection Time in the Banking System

We have made several references to the time required to collect a cheque through the banking system but we have made no proposals to shorten it. Let us be more specific about what is involved. Suppose a customer in New Delhi, purchases electronics equipment from a firm in Mumbai, and remits with a cheque drawn on a New Delhi Bank. The seller deposit the cheque in a bank in Mumbai, but the funds are not available for use until the cheque has been presented physically to the New Delhi bank, a process that depends on mail service between the two cities and may take several days. A very extensive clearing network has been established in India that involves the commercial banks and the RBI. In the majority of cases, clearing times has been reduced to 2 days or less using the facilities of the direct inter-bank clearing. In the matter of cheque clearing, the banks are the experts, and firms usually can rely on their banks to minimise the time requirements.

Controlling Disbursements

Just as speeding collections turns accounts receivable into cash and thereby reduces the firm's financing requirements. Slowing disbursements does the same. In earlier chapter, we discussed trade credit as a source of funds. There we conclude that the proper policy was to pay within the terms agreed upon taking cash discounts when offered. We conclude also that is no point in paying sooner than agreed. By waiting as long as possible, the firm maximises the extent to which accounts payable are used as a source of funds, a source which requires no interest payment.

Firms with expense-generating activities that over a wide area often find it advantageous to make disbursements from a single central account. In that way, schedules can be tightly controlled and disbursements can be made on exactly the right day. An alternate arrangement is to disburse from decentralised locations, but to wire transfer the exact amount needed in each local account for all disbursement scheduled that day.

Some firms find it advantageous to exploit the "cheque book float", which is the time between the writing of a cheque and its presentation for collection, represented by CD . If this lag can be exploited, it offsets at least partially the lag in the other direction in collecting cheques from customer (HJ). Because of lag CD, a firm's balance on the bank's books is higher than in its own cheque book. Knowing this, a firm may be able to reduce its working cash requirements. Banks understand cheque book float also, and can be expected to set compensating balances and fees based on balances on their (the banks) books. If a firm exploits cheque book float too far, it increases the likelihood of cheques being dishonoured for insufficient funds and the accompanying displeasure of both bank and payee.

Determining the Appropriate Working Cash Balance

Let us assume the firm now is collecting, and disbursing its cash as efficiently as possible. Given its long-term financial structure fixed assets long-term liabilities, and equity its total cash position at any time is determined by its operating plan. Suppose total cash is more than the firm needs for operating purposes, if disbursements are made according to plan.

The Neptune Company projected a total cash balance as high as Rs 4,89,000 in November. Should all these funds be kept in Neptune's current account? Since current accounts earn no interest, it is to Neptune's advantage to leave only the amount necessary to operate, and to invest the remainder temporarily in interest-bearing liquid assets until needed.

Our problem, then, is to determine how much cash a firm should maintain in its current account as a working balance. We will address this question here, and in the next section discuss the investment of amounts above the working balance.

The working balance is maintained for transaction purposes for paying bills and collecting payments on accounts receivable. If the firm maintains too small a working balance, it runs out of cash. It then must liquidate marketable securities if available, or borrow.

Liquidating marketable securities and borrowing both involve transaction costs. If, on the other hand, the firm maintains too high a working balance, it foregoes the opportunity to earn interest on marketable securities, that is, it incurs what economists refer to as an opportunity cost. Thus, the answer we seek is the optimal working balance, rather than the minimum. Finding the optimum involves a tradeoff of transaction costs against opportunity costs. If a firm tries to keep its working balances low, it will find itself selling securities (and later repurchasing securities) more often than if it aims at a higher level of working balances, that is, transaction costs fall as the working balance level rises. Opportunity costs, on the other hand, rise as the level of working balances rises. There is one point where the sum of the two costs is at a minimum. This is the point efficient management should try to find.

Compensating Balance Requirements

If a firm uses bank credit as a source of financing, the question of the optimal current account balance may have a simple answer: it may be dictated by its compensating balance requirements to compensate for various services such as processing cheques and standby commitments to lend.

In some cases, a firm may determine with very little analysis that it optimal working balance is below the bank's compensating balance requirement. In such cases, the latter figure becomes the firm's minimum current account balance. In other cases, where the answer is not so clear or where compensating balances are not required. We must put pencil to paper to determine the appropriate working balance.

Finding the Optimal Working Balance

Having done all we can to improve our collection and disbursement procedures, let us now take the pattern of receipts and disbursement as given. Over any time period, a firm's beginning and ending cash balances are related as follows:

Ending balance = Beginning balance + Receipts – Disbursement

If receipts and disbursements we constant each day, we would know with certainty what each would be each day and our problem would be simple. Since receipt always would exceed disbursements by the same amount, we count withdraw the ending balance each day and use it for other purposes. In practice, we have two problems: variability

and uncertainty. In most firms, receipts and disbursements vary both over the month and over the year. Over a month, receipts and disbursements for current operating expenses are likely to show some variation, perhaps in a regular pattern. In seasonal firm, the amounts also will vary over the year less frequent outlays. Such as those for capital expenditure, taxes, and dividends, introduce still more variability. Some of this variability may be predictable, but some probable is not. Let us examine these two problems variability and uncertainty separately.

Variability

Suppose receipts and disbursements both vary and are not synchronised, but the variations are completely predictable. Determining the appropriate working balance in the face of non-synchronous but predictable cash flows is a problem of minimising total costs. If we set the balance too low, we incur high transaction costs; one might say we make too many trips to the bank. If we set the balance too high, we lose too much interest on marketable securities.

The determination of the optimal working balance under conditions of certainty can be viewed as an inventory problem in which we balance the costs of too little cash (transaction costs) against the costs of too much cash (opportunity costs). If the cash shortage becomes severe enough, we may begin to forego cash discounts on purchases, adding another element of opportunity cost.

Formal models of the cash balance problem have been developed using inventory theory. Inputs to such a model are the total net cash outflow over the period of time in question, the transaction costs of replenishing the cash balance by selling securities or borrowing, and the interest rate that can be earned on securities. The answer given by the model tells us how often and in what amounts funds should be transferred to the checking account from other sources.

Uncertainty

Receipt and disbursements are very seldom completely predictable. If we go to the opposite extreme and assume receipts and disbursements for the difference between them) to be completely random, a different kind of model can be developed using the technique of control theory. In addition to information on transaction costs and interest rates on securities, we need a measure of the variability of net cash flows. Using these data, we can determine the optimal maximum and minimum balances in the firm's checking account, denoted by levels X and Y.

In the firm's working cash balance fluctuates randomly in response to random inflows and outflows. At time t_1, the balance reaches the upper control limit Y. At that

point, (Y – X) money is transferred out of the cash account and into marketable securities. The balance continues to fluctuate, falling to zero at t_2, at which time X value of marketable securities are sold and the proceeds transferred to the working balance. The control limit model thus gives an answer in terms of maximum and minimum balances and provides a decision rule, rather than a fixed schedule of transfers as did the simple inventory mode. One of the important insight of the control limit model is that, where cash flows are uncertain, the greater the variability the higher the minimum balance .

Using Mathematical Models

Formal mathematical models such as those mentioned above are useful for increasing our understanding of the cash management problem and providing insights and qualitative guidance. The models tell us which factors are important and make the tradeoffs explicit. We see, for example, that transaction costs play a central role. If transaction costs were zero, the firm would require no working cash balance at all; it simply would sell securities or borrow to pay every bill.

Are formal mathematical models also useful for quantitative applications? In practice, the cash flow patterns of most firms are partly predictable and partly random. Neither the inventory model nor the control limit model is strictly applicable. By combining the insights from formal models with the techniques of cash budgeting and pro forma analysis, many firms can arrive at reasonable answers by experience and experiment. In deciding how far to go in analysing the problem, we must consider the cost of the analysis. Except in the case of very large firms, quantitative solutions to the cash balance problem using formal mathematical models are likely to be uneconomical. Often, the cost of obtaining the necessary input data and operating the model exceeds the savings over solutions that can be attained by experience and experiment. As always, we must keep an eye on the cost of our analytical techniques as well as on the benefits.

Planning Cash Requirement

In most cases, to search for the optimal working cash balance probably overstates our capabilities; we must be content to get reasonably close. Perhaps we should substitute the word "appropriate" for "optimal."

The current account balance that the firm should maintain is the compensating balance requirement, or the optimal working balance. Whichever is greater. Some firms, especially those with seasonal sales patterns, may find that the appropriate working balance varies somewhat over the year. As a firm grows, the appropriate working cash balance also will grow, although probably not proportionally.

Once we have settled on the appropriate balance to be maintained in the current account,

we can integrate cash management into the financial planning process. The projected current account balance goes into the pro forma balance sheet. Any excess cash over that figure then may be invested in interest-bearing assets.

Investing Idle Cash

Cash in excess of requirements for working balances normally is invested in interest–bearing assets that can be converted readily to cash. A firm might hold excess cash for two principal reasons; First, the firm's working capital requirement may very over the year, perhaps in a fairly predictable manner if the variation is due to recurring seasonal factors. From the pro forma balance sheet, it was apparent that excess cash would build up during seasonal lows in accounts receivable and inventory, and would be needed later to finance a re-expansion of receivables and inventory during the next seasonal high. We can view the excess cash as a part of the firm's transaction balances. Even though the cash is temporarily idle, there is a predictable requirement for it later.

Second, excess cash may be held to cover unpredictable financing requirements. In a world of uncertainty, cash flows can never be predicted with complete accuracy. Competitors act, technology changes, products fail, strikes occur, and economic conditions vary. On the positive side, attractive investment opportunities may suddenly appear. A firm may choose to hold excess cash to finance such needs if and when they occur. We noted earlier that cash held for such purposes is referred to as a precautionary balance and usually in invested in interest-bearing assets until needed.

An alternative exists to the holding of excess cash for either of the two purposes described above. The firm can simply borrow short-term to finance variable requirements as they arise. Under such a policy, the firm would never hold excess cash. A firm's choice between short-term borrowing versus liquid assets as a means of financing variable requirements will depend on policy decisions with respect to the firm's long-term financial structure, particularly the mix of short-term and long-term funds. We will discuss overall financial structure and the relationship between maturity structure and liquidity later. Here, we take as given the long-term structure and the amount available for investment in interest-bearing assets.

Investment Criteria

A firm might invest excess cash in many types of interest-bearing assets. To choose among the alternatives, we must establish criteria based on our reasons for investing excess cash in the first place. We are investing either temporary transaction balances or precautionary balance or both. When we need the cash, we want to be able to obtain it-all of it-quickly. Given these objectives, we can rule out equity share and other investments with returns that are not contractual and with prices that often vary widely.

Debt securities, with a contractual obligation to pay, are our best candidates. In selecting among debt securities, there are three principal characteristics we should examine: default risk, maturity and marketability.

Default risk refers to the possibility that interest or principal might not be paid on time and in the amount promised. If the financial markets suddenly perceive a significant risk of default on a particular secular security. The price of the security is likely to fall substantially, even though default may not actually have occurred. Investors in general are averse to risk, and the possibility of default is sufficient to depress the price. Given our purposes in investing excess cash, we want to steer clear of securities that stand any significant chance of defaulting. In an uncertain world, there is no guarantee that is absolutely certain. With its capacity to create money. However, there are securities available with default risk that is sufficiently low to be almost negligible. In selecting securities, we must keep in mind that risk and return are related, and that low-risk securities provide the lowest returns. We must give up some return in order to purchase safety.

Maturity refers to the time period over which interest and principal payments are to be made. A 20 years bond might promise interest semiannually and principal at the end of the twentieth year. A 6-month bank certificate of deposit would promise interest and principal at the end of the sixth month.

When interest rates vary, the prices of fixed-income securities vary. A rise in market rates produces a fall in price, and vice versa. Because of this relationship, debt securities are subject to a second type of risk. Interest rate risk, in addition to default risk. A government bond, though free of default risk, is not immune to interest rate risk. The longer the maturity of a security, the more sensitive its price is to interest rate changes and the greater its exposure is to interest rate risk. For this reason, short maturities are generally best for investing excess cash.

Marketability refers to the ease with which an asset can be converted to cash. With reference to financial assets, the terms marketability and liquidity often are used synonymously. Marketability has two principal dimensions-price and time-that are interrelated. If an asset can be sold quickly in large amounts at a price that can be determined in advance within narrow limits, the asset is said to be highly marketable or highly liquid. Perhaps the most liquid of all financial assets are Treasury Bills. On the other hand, if the price that can be realised depends significantly on the time available to sell the asset, the asset is said to be illiquid. The more independent the price is of time, the more liquid the asset. Besides price and time, a third attribute of marketability is low transaction costs.

Yields

All the characteristics we discussed above-default risk, maturity, and marketability-affect yield. In general, the lower the default risk and the better the marketability, the lower the yield. Securities with these desirable characteristics have higher prices, and since price and yield are inversely related, lower yields.

The relationship between maturity and yields is more complex and changes over time. On an average, short maturities yields less, other factors being equal, because they are subject to less interest rate risk. Rates on short maturities, however, are more volatile than those on longer maturities, and at times exceed the latter.

At any point in time, rates on the major types of money-market securities discussed above are fairly close to one another. For equal maturities, the differentials usually are small and are due to small differences in default risk and marketability.

Over time, the entire structure of short-term rates varies significantly. Such variations are related to the business and monetary cycles, the demand for funds by individuals and firms, and the credit policies of the RBI.

Collection & Disbursement Systems

Primary objective of a collection system is to receive value from the buyer as quickly as possible. Secondary objective is to receive and process information associated with the payment. The longer the delays the more the funds that will be tied up in it.

If we define the system in terms of the linear programming model, the objective function that we need to minimise is:

Objective function:

Minimise
– Cost of collection float
– Value of payment information
– Value of relationship with payers
+ Collection system costs
+ Cost of losses through theft/ fraud
+ means that the function is to go with the objective (i.e., here to minimise) and - means that it has to go against the stated objective (i.e., to maximise rather than minimise in this case)

What is a float?

Float could be defined as the amount of funds represented by checks that have been issued but not yet collected.

OR

It could be defined as the time between the deposit of checks in bank and its payment.

Due to the time difference, many firms are able to "play the float," that is, to write checks against money not presently in the firm's bank account.

There are different kinds of floats that the firm has to encounter. These include:

Collection Float

Time taken to realise the money after the company has received the cheque from the debtors.

Mail Float

Time that elapses from the mailing of the cheque until its receipt.

Processing Float

Processing time after the cheque is received and before it is deposited with the bank.

Availability Float

Time taken from the deposit of the cheque to the funds being available in the bank.

The last two items together make up deposit float and all the three items make up the collection float.

Float measurement

Float is usually measured in rupee-days, which are calculated by multiplying the time lag in days by the rupee amount being delayed. Float can be measured either on each item that is processed or on an average daily basis.

Cost of Collection Float

The cost is determined by the following formula:

money in float * no. of days * daily interest rate * frequency of payment

Value of Payment Information

Matching payments to accounts in a timely and accurate manner. The biggest utilisation is to update the systems so that actual positions of funds in the accounts are available.

Value of Relationship with Payee

Delays in posting may send wrong information to customers. Could also cause delays

in shipments as you may be withholding shipments for the payments.

Collection System Costs

Costs of receiving the money from the customers till the time the payments reach the office and the cost of processing in the office.

Cost of losses from Fraud and Theft

Cash collection could involve frauds and thefts which could negate the effect of excellent collection systems.

Techniques of Cash Management and Marketable Securities

Cash Concentration Systems

There are three basic tasks of the cash concentration systems:

1. Receive Deposits
2. Transfer funds to disbursal banks
3. Serve as focal point of short term investments and credit transactions

Objective function

Minimise	Opportunity cost of excess balance
	+ Transaction costs
	- Savings on dual balances
	+ Administration costs
	+ Control costs

Disbursement Systems

Many times the cash is collected from several places where the customers are there but is disbursed from the factory premises or the corporate headquarters. So the objective function would be to maximise the disbursement floats available without straining the relationships with the suppliers.

Objective function:

Maximise	+ Value of disbursement float
	- Loss of discounts for early payment
	- Cost of excess balances in disbursement accounts
	- Transaction costs
	+ Value of payee relations
	+ Value from dual balances

- Administration, information and control costs

Required Cash Balance

The question may be designed as whether it is possible to define the amount of cash which out to be held at any time? Cash is needed for three reasons:

1. To finance transactions (which was the main theme of the previous paragraphs):
2. As a precaution - a safeguard against the inaccuracies in cash forecasts - bearing in mind that every forecast, by its very nature, will be inaccurate.
3. For speculative purposes - to take advantage of any profitable opportunities that arise.

What average cash balance then should be held to finance normal transaction, including any necessary margin of safety? The word 'normal' is important because it may be assumed that small deviation from the norm will be covered by overdraft facilities.

This is a question closely akin to one we shall be asking about stockholdings in the next unit. Attempts are sometimes made to establish a equation based on:

- The 'holding cost' of cash (i.e., the opportunity cost of keeping the cash un-invested;
- The 'procurement cost' of cash (.i.e., the transaction cost of converting securities into cash, or otherwise obtaining new funds).

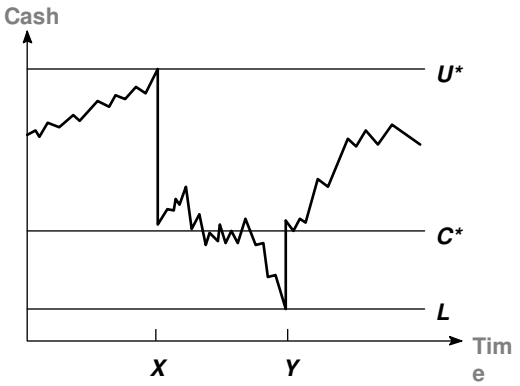
The estimates used in such calculations are likely to be suspected, and the model to which they give rise is only applicable when the demand for cash is reasonably consistent from period to period.

There are two models used. The first one is Baumol Model which works exactly on the lines of inventory model and that is its biggest shortcoming. The second one is Miller-Orr model which specifies a minimum and a maximum level of cash in the system and expects the cash levels to move between the two.

Let us look at Miller-Orr model in slightly more detail. Figure below gives you the basic functioning of Miller-Orr model. We can see that The company has established upper and lower limits within which it allows the cash levels to operate. If the cash level touches the upper level, the company converts extra cash into securities so as to bring it to the target cash balance. It follows the same procedure for the lower limit where it sells securities instead of buying it. This makes it easy for the company to manage cash as the levels of cash is difficult to predict very accurately.

Note that the target cash balance point is at one-third of the distance between the lower and upper level, from the lower level instead of half-way between the two because

the company wants to minimise the cash it is holding. Their studies have shown that this level is the optimum level.



*U** is the upper control limit. *L* is the lower control limit. The target cash balance is *C* [which is 1/3(U*-L) +L].* As long as cash is between *L* and *U**, no transaction is made.

Other mathematical models, too, have been suggested by various authors, but they tend to be mainly of academic interest only.

A simpler approach to the definition of the required cash balance is by the use of ratios.

One such measure is the ratio between the sales of a period and the opening cash balance:

$$\text{Cash turnover} = \frac{\text{Sales for period}}{\text{Initial cash balance}}$$

This is sometimes called the cash velocity. (The resemblance to the stock turnover ratio will be obvious.)

As with all management ratios one is looking for consistency period by period within the company, or a trend of improvement which, in this case, would be higher sales per unit of cash held. If, for example, the cash velocity last period was:

$$\text{Cash turnover} = \frac{\text{Rs.}18{,}000}{\text{Rs.}\,9{,}0000} = 20\text{x}$$

Then an increase of sales to Rs.2,25,000 without a change in cash holding would increase the velocity to 25x. In other words, the cash balance would have been kept to Rs.9,000 instead of rising to Rs.2,25,000/20 = Rs.11,250, so there would be saving of interest or a gain at the opportunity cost rate into Rs.2,250.

Again, like other ratios this ratio cannot be used in isolation. An increase in sales without an increase in cash balance might mean that the company had become less able to pay its debts as they fell due, possibly signifying that it was over-trading. It might be possible

to use this ratio for comparison with an average for the industry, but probably not with individual firms within the industry, since special factors might affect the balance held by a particular firm at its year-end date (especially if the businesses were seasonal, or if the firm under review were accumulating cash for a specific project).

A second ratio quite often found is that between the cash balance and the total current assets:

$$\text{Proportion of cash held} = \frac{\text{Cash balance}}{\text{Cash Assets}}$$

A wide range of figures between different industries will be found. Based on transaction analysis or past trends, the company could set a minimum proportion of cash holdings to current assets with the objective not of using this as an absolute limit but as an opportunity for reviewing the reasons for any deviation from the norm.

In general the use of simple ratios has a limited value in cash planning. There is no adequate substitute for detailed cash forecasts, possibly linked with a financial model of the business as a whole.

For an outside observer, and to some extent for the board of a company, useful information can be derived from a trend of liquidity ratios incorporating not merely cash but also those elements of working capital which are readily convertible into cash. This concept of liquidity was built into the source and application of funds statement described above.

Investing Surplus Funds

If the cash forecast for a business shows surplus funds becoming available, then plans should be made for putting them to use. However, the surpluses may be transitory, either because they are being accumulated deliberately for some purpose such as the purchase of plant or the payment of taxes, or because the business is seasonal and the funds will eventually be required to finance off-peak activities.

It is important to schedule in detail, with frequent reviews, how much money will be available for various period of times, so that it can be put to the best possible use. Small amounts which are required to be kept liquid are probably best placed on deposit with a clearing bank or other finance house. The rate of interest will be low, but only short notice is required for withdrawal. When large sums are available there is a greater range of investment alternatives.

Loans to local authorities or merchant banks or local authority bonds, have various terms from days upto five years, so they can be matched to the availability of funds, however, they are not readily negotiable. Negotiable certificates of deposit issued by the commercial banks overcome this disadvantage, offer a higher rate of interest and can cover a wide range of maturities from three months upwards.

The purpose of this type of investment is to squeeze extra profit out of money which is normally in use in the operations of the business. It does not give full scope for portfolio planning, which is essential when funds are available for investment over a long period.

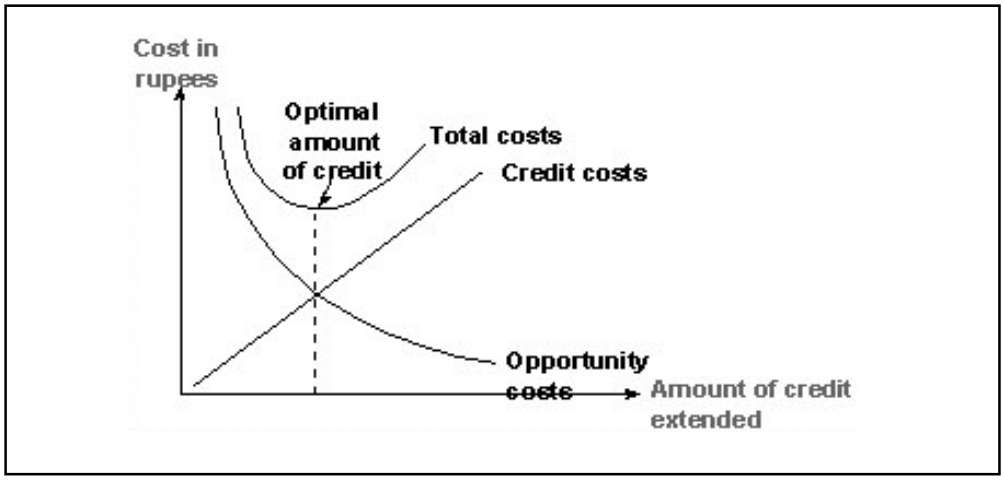
The main principle involved in planning the investment of short-term cash surpluses is to match investment maturities with cash needs. Before considering investment, therefore, it is necessary to have reliable cash movements forecast, so that one knows with reasonable certainty how much cash will be spare for what period of time.

The second principle is to invest for as long as possible, because interest rates are higher for long periods. Opposed to this principle is the need to have a margin of safety, this may be a bank overdraft facility or may take the form of slightly more liquidity in the investment portfolio than the forecast strictly requires.

The size of the fund available for investment will have an effect on how profitably it can be used, both because large funds can bear the cost of a professional investment manager and because such funds can be placed directly on the money market rather than through the company's bank.

Cost of Holding Cash

Trading costs are increased when the firm must sell securities to establish a cash balance. Opportunity costs are increased when there is a cash balance because there is no return to cash. The tradeoff between the two results in an optimum point of holding cash, which becomes their target cash balance as depicted in figure**.**



Cash Management in a Group of Companies

Within a group of companies it is often considered desirable for cash to be managed by a central department which will:

- Gather in all surplus funds from the various companies and redistribute them in accordance with the investment opportunities which best serve the group objectives;
- Dictate the dividend distributions of the subsidiary companies to ensure that funds are retained where they are needed within the group;
- Arrange the investment outside the business of funds which are temporarily surplus to group needs;
- Negotiate centrally any bank overdraft facilities, and the raising of new long-term capital.

With regard to internal investment it sometimes appears that priority is given to projects from those companies which are already profitable (since they are able to show better incremental returns than those which are currently less successful); and it is argued that the loss-making companies may well have the greater need for operations.

In relation to overdraft facilities, the argument for Group central negotiation is that only one banker (or a lead banker) will be involved who will be well informed on the whole of the group's activities, and that all the resources of the group will be available as security. This does, however, put the whole group at risk if credit facilities are reduced. If the various companies have a good local relationship with the banks they have used individually in the past, it can happen that the total of locally negotiated overdrafts is greater than could have been obtained centrally. While the withdrawal of one facility still leaves the other companies untouched.

The payment of creditor accounts centrally is easier to arrange, though it may involve delays in payment if involves first to be approved by local offices. Whether centralised purchasing is beneficial will depend on whether the advantages of standardised specifications and the negotiation of build discounts are offset by a loss of specialised purchasing skills for a diverse range of products and by delays in the procurement of urgently needed supplies.

The majority of the foregoing comments will apply equally to a single company having divisional profit centre in scattered locations.