Module 3

Capital Budgeting

3.1. CAPITAL BUDGETING

3.1.1. Introduction

Keeping in view the business objectives of an organisation, it is required to make investments from time to time in connection with the acquisition of new fixed assets or replacement of the existing ones. Such investments may be made out of the own funds of the business enterprise or from the borrowed funds. In either case, it is a very crucial decision to be taken by the management as to the selection of the best investment proposal out of the available options. Such decisions are taken after examining the pros and cons of each proposal in detail, quantum of capital outlay, estimated future return likely to accrue, etc. The entire process of 'Investment Decisions' is also known as **'Capital Budgeting' or 'Capital Expenditure Decision'.**

In any proposal under consideration of 'Capital Budgeting', the capital outlay (outflow of funds) is generally instant, whereas the benefits generally starts pouring in after a long gap of time (generally after one year).

3.1.2. Concept of Capital Budgeting

Investment decision pertaining to long-term assets for the purpose of generating revenue for the business entity (and not for sale such as land, building, machinery, furniture, etc.) is termed as **'Capital Budgeting'**. It involves long-term planning and monitoring of capital expenditure, besides examining each proposal in a very logical and scientific manner so as to finalise the best proposal. Capital expenditure differs from the revenue expenditure in the sense that the benefits from such expenditure are necessarily generated after a long gestation period which is generally beyond one year. In the case of revenue expenditure, on the other hand, the benefits are generated and exhausted within the year.

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

According to Robert N. Anthony, "The capital budget is essentially a list of what management believes to be worthwhile projects for the acquisition of new capital assets together with the estimated cost of each product".

According to Milton H. Spencer, "Capital budgeting involves the planning of expenditures for assets, the returns from which will be realised in future time period".

3.1.3. Nature of Capital Budgeting

The process of capital budgeting exhibits following nature:

1) Only the long-term investment proposals are subject to capital budgeting technique.
2) Proposed investments are made in the present, but the returns of such investments accrued over a number of years in future.
3) While undertaking the exercise of 'Capital Budgeting' in respect of an investment proposal, expenditure and projected return are measured in terms of cash flow, i.e., cash outflow and cash inflow respectively.
4) The business may take investment decisions on single project proposal or for two or more project proposals which are mutually exclusive simultaneously.
5) Maximisation of value of the business organisation should be the sole criteria for selecting or dropping an investment proposal.

3.1.4. Need for Capital Budgeting

Following are the needs of capital budgeting:

1) **Maintaining Firm's Competitiveness:** Modernisation of plants and replacement of the obsolete plant and machinery are necessary for a company in order to survive and grow in the market. To achieve the above objective, it is necessary to go for capital expenditure, which in turn requires proper planning in the form of 'Capital Budgeting'.

2) **Planning for Future Needs of the Firm:** 'Capital Budgeting' exercise provides guidance with regard to the course of action, so as to enable the company's management to estimate the production factors in terms of quantity and timing, which ensure the expected outcomes.

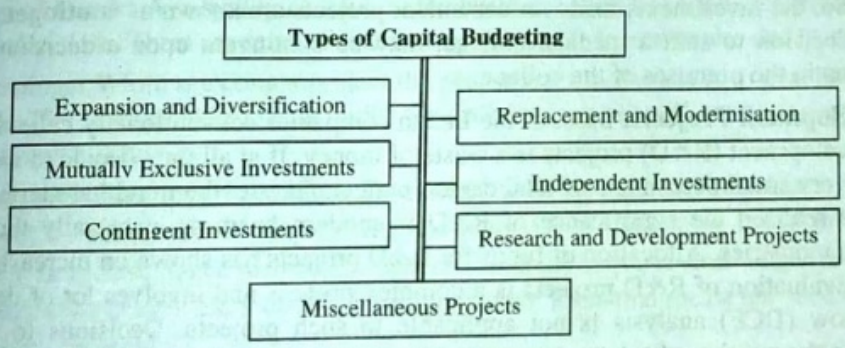
3) **Coordinating:** In order to achieve effective use of various resources and maximise output of a company, it is necessary that the requisitions of different departments are budgeted. This should be done in a coordinated manner.

4) **Cost Control:** 'Capital Budgeting' involves comparison of budgeted expenditure with the actual expenditure on an ongoing basis, which facilitates proper monitoring of expenditures and ultimately having a control over them. Timely corrective measures should be made, in case actual expenditures are not in conformity with the budgeted expenditures. Under the circumstances of decentralisation of authority, assigning responsibilities and fixing accountabilities is easy, which leads to saving of resources and ultimately cost control.

5) **Company's Effectiveness:** An appropriate 'Capital Budgeting' may lead to enhancement in the company's effectiveness. Appropriate allocation of the estimated expenditure to suitable 'Cost Centres' and 'Profit Centres' facilitates in construction of a framework, which enables the management to fulfill the company's goals.

3.1.5. Types of Capital Budgeting

The technique of capital budgeting is applied in respect of following types of investments:



1) **Expansion and Diversification:** These are explained below:

i) **Expansion:** At a certain phase, a company engaged in manufacturing activities may feel the need to enhance its capacity for manufacturing the same product, to meet the increased market demand. It may, therefore, decide to invest in plant and machinery with an objective of increasing the production of its product. To illustrate this, an **example** of a urea manufacturing unit (A) may be taken. If the capacity of that unit (A) is 'X' metric tonnes per annum and it (the unit) sees an increase in the demand for urea in the market, it may decide to invest in the acquisition of additional plant and machinery to increase the production of urea to the level of 'X+' in order to meet the market demand. Sometimes a company acquires another company to expand its business.

ii) **Diversification:** A company engaged in a particular line of business, may decide to diversify its activities in an altogether new line of business, because of better business opportunities in that field. Venturing into a new field necessitates investment in new technique, manpower, etc., besides new plants, machinery and related equipments. **For example,** Housing Development Finance Corporation (HDFC), engaged in the business of housing finance, decided to enter into the business of banking in 1993 (when the sector was opened by RBI) as it saw greater opportunity therein. HDFC Bank came into existence and today they are the leader amongst the private sector banks. A company decides to invest in order to diversify in a different field with the expectation of additional revenue.

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2) **Replacement and Modernisation:** A company may consider investing in modernisation and replacement of obsolete assets with a view to keep pace with the advent of new technology for improving operational efficiency and minimisation of costs, which results in a higher level of profits. Such investments require substantial capital investment (cash outflow) with no immediate return, but in the long run the company is a beneficiary. **For example,** huge investment is required in a paper producing company to change its manual handling machine to the fully automatic producing equipment. However, after some time the company starts reaping the benefits in the form of increased efficiency and an increase in its revenue. Investment for acquiring more efficient assets with features of advanced technology is also called **cost-reduction investment**.

3) **Mutually Exclusive Investments:** If there are many choices for making investments for the similar objective, there will be a sort of competition amongst them and only one of them will be selected at a time and others will be logically rejected. This concept would be clear from an example, if a company has two investment proposals to buy machinery for production:

   i) First proposal is to buy a semi-automatic machine, which is labour intensive, and

   ii) The other one is to buy a fully automatic machine, which is capital intensive.

   After applying the technique of 'Capital Budgeting' the company may decide in favour of one of the above proposals and the other one would be automatically rejected. There is an element of competition amongst such proposals.

4) **Independent Investments:** As the nomenclature suggests, they are two independent investment proposals having different objectives. In contrast to 'Mutually Exclusive Investments', there is no element of competition amongst such proposals. **For example,** two independent proposals may be under consideration of the automobile company, one proposal may relate to the expansion of its plant capacity to manufacture family and office purpose cars, and the other one may relate to the addition of new production facilities to manufacture mobile set (a new product). The company may decide in favour of both the proposals or both the proposals may be turned down depending upon the outcome of capital budgeting.

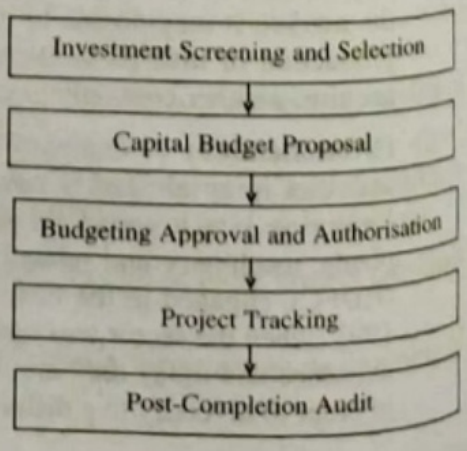
5) **Contingent Investments:** Investment in one project compels the business to spend additional funds related to that investment. So, the investments made on dependent projects are known as **contingent investments**. **For example,** the decision to start a medical college, may be contingent upon a decision to establish a hostel for the students in the premises of the college.

6) **Research and Development Projects:** Most of the Indian companies conventionally believe that investing in Research and Development (R&D) projects is a waste of money. If at all they decide to make investment in R&D, it forms a very small percentage of total capital budget. Of late, the trend has started to change, as the companies have realised the significance of R&D in modern business, especially those who are in knowledge intensive industries. Allocation of funds for R&D projects has shown an increasing trend during the last few years. Evaluation of R&D projects is a complex process and involves lot of decision making. Discounted Cash flow (DCF) analysis is not applicable to such projects. Decisions to invest in these projects depend upon the opinion of top management. Mostly to assess such projects, companies depend on quantitative tools like, decision tree analysis and option analysis.

7) **Miscellaneous Projects:** Decisions to invest in projects such as recreational facilities, interior decoration, executive aircrafts, landscaped gardens, etc., are taken generally on the basis of Top Management's personal choice. There are no specific techniques to evaluate these projects.

3.1.6. Process of Capital Budgeting

The process of capital budgeting involves five distinct stages as mentioned below:



Stage 1: Investment Screening and Selection: Various departments of the organisation, *viz.*, Production, Marketing, Research & Development, etc., identify projects, which need to be in conformity with the business policies. Evaluation and screening of such identified projects are undertaken based on the criteria with regard to their impact on the future cash flow of the company (value of the company).

Stage 2: Capital Budget Proposal: Identified projects, after passing through the process of evaluation and screening, are then subject to the

exercise of 'Capital Budgeting'. A list of suggested projects is submitted alongwith the estimated capital outlay (amount of investment) and revenue generation under each of the project. Data received from various departments, *viz.*, engineering, accounting, marketing, finance function, etc., are taken into consideration and a final selection of the project (s) is arrived at.

Stage 3: Budgeting Approval and Authorisation: After being put through the exercise of capital budgeting, a final review is taken with regard to various projects. Projects thus selected are authorised for further information gathering and analysis, and approval for the expenditures in respect of selected projects. Authorisation and approval is done in a sequence in some organisations (after authorisation, some additional research is carried out before the approval), whereas, the projects are authorised and approved simultaneously in some other organisations. The above authorisation and approval is undertaken in the case where huge expenditures are projected; smaller expenditures are left for the decision of management.

Stage 4: Project Tracking: Consequent to approval of a project, work on it is initiated. Monitoring of the work and expenditure incurred in connection thereof is monitored closely by periodical reporting to the management. This monitoring associated with a project is termed as 'Project Tracking'. This is a link between the 'Operating Management' and 'Decision Makers' of the organisation. 'Project Tracking' is of paramount importance, as it can immediately identify any problem associated with the project (like incidence of cost overrun) and decision makers can take corrective/remedial measures to resolve the same.

Stage 5: Post-Completion Audit: Some of the projects may be subjected to an audit (Post Completion Audit), after the approval of that project, i.e., after completion of few years, during which the project is reviewed so as to take a view whether or not they need to be continued. However, such audits are performed on a few selected projects only. Through Post Completion Audit, management of the company is able to ascertain how well the cash flow realised corresponds with the projected cash flow.

3.1.7. Factors Influencing Capital Budgeting

Important factors influencing capital budgeting is mentioned below:

1) **Availability of Funds:** Availability of funds is the basic and most important determinant impacting the capital expenditure decisions. There are cases of abandoning of projects by companies due to scarcity of funds.
2) **Future Earnings:** While selecting a project the purpose of any project is to generate additional revenue for the business. The level of cash inflow varies for each project, but still every project is expected to result in cash inflows in the future.
3) **Compliance with Statutory Provision:** To comply with the statutory provisions is another factor, which simply cannot be sidelined. A project with the potential of generating a higher level of cash inflow in future, if not is incompliance with even one of the legal requirements (e.g., provisions relating to the environment, public health, etc.), cannot be implemented. Remedial measures need to be taken before going ahead with such projects.
4) **Risks Involved:** In almost all the projects, some element of risk is involved, extent of which is difficult to assess at the beginning.
5) **Urgency:** All the projects cannot and need not to be treated equally. Some projects may be of urgent nature and are required to be taken up on priority basis to survive in the business. Others may not be so urgent and hence can wait. Therefore, projects may be prioritised and the policy of 'one size fits all' needs to be abandoned.
6) **Research and Development (R&D) Projects:** Investment in Research and Development is an integral part of modern industry, especially technology-based industry. R&D enables an industry to maintain competitiveness in the market.
7) **Obsolescence:** Investment in the projects involving replacement of obsolete plant and machinery of a manufacturing unit is of an urgent nature. Such investment decisions should preferably be taken even before the plant and machinery become actually obsolete.
8) **Competitor's Activities:** The activities undertaken by the rival companies have an impact on a company, as it may be driven to undertake similar activities with a view to remain in the race with other firms in the market.
9) **Integral Factors:** Capital expenditure of a business organisation has influence of what may be considered as 'Emotional Factors', like social welfare schemes for its employees, safety measures prevailing for its workers, its reputation in the market, etc.

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3.1.8. Importance/Significance of Capital Budgeting

Capital budgeting for taking an investment decision is the most effective and powerful tool. The importance of capital budgeting may be gauged from the following points:

1) **Long-Term Effects:** Decisions taken through capital budgeting are generally irreversible; they can be reversed, if at all possible, with a lot of difficulties. The outcome of a wrong decision may be heavy losses to the business enterprise. **For example,** if a company decides to set up a factory in a backward rural area with a provision of housing facilities for its employees. Construction of the factory and houses for the future employees starts. However, before the completion of the constructions, the company comes to know that there was a fault on its part regarding clearance from environment ministry and the factory cannot be set up in that area. The company will have to bear heavy losses in terms of money and time under the above circumstances.

2) **Risk and Uncertainty:** Capital Budgeting decisions are based on two important components, *viz.*, investment and return. While the former is certain and takes place in the present, the latter is totally uncertain, takes place in future, and only projections thereof may be made. A lot of risk is associated with the future. Uncertainty and risks are directly proportional to the period of project. A long-term project has a higher degree of risk and uncertainty. Estimates and projections are based on certain assumptions, which may prove to be wrong in future.

3) **Large Funds:** Large amount of funds are needed by any business organisation for taking up any capital investment. The exercise of capital budgeting gains a lot of importance due to the fact that huge amount of funds are at stake and any error may lead to a disastrous situation and heavy monetary loss to the company.

4) **Corporate Image:** Capital budgeting decisions have the capability to impact the profitability of a company. Such impact may be either way, i.e., profits can increase or decrease (depending upon the quality of capital budgeting exercise). Market value of the company's shares also gets impacted accordingly. Shareholders of a company are interested in dividends and appreciation in the value of the shares held by them. Both are dependent on the profits of the company. Successful projects result in increased profit of the company, which in turn leads to better dividends and appreciation in the value of shares. There would be an increase in the demand of the company's shares and goodwill in the market would improve.

3.1.9. Difficulties in Capital Budgeting

Certain problems and difficulties associated with the exercise of capital budgeting are furnished as under:

1) **Future Uncertainty:** Capital budgeting decisions mostly relate to the projects which are spread over a long-term horizon. Despite a very careful evaluation of a project by examining each aspect in detail and arriving at a projected cash inflow in future, it is possible that something may go wrong and the final result may be against the estimation. The uncertainty of a capital budgeting decision may relate to either cost of project (Cash Outflow) or expected returns (Cash Inflow). The personnel involved in the capital budgeting need to be very analytical and scientific (technical) in their approach.

2) **Time Element:** The implementation of projects approved through a capital budgeting decision is spread over a prolonged duration of time. The cost involve in a project (cash outflow) is certain and is incurred in the beginning of the implementation. However, the benefit or revenue generation (cash inflow) is uncertain and takes place at different point of time during the lifetime of a project. Therefore, cost and benefit analysis of a project is possible only after adjustment of the time value of money. Uncertainty of benefits is directly proportional to the length of the time period. Longer the time period involved, more the uncertainty and risk.

3) **Measurement Problem:** Measurement of cost and benefits of a project in quantitative terms may at times pose difficulties because of some other factors involved.

For example, implementation of the project to launch a new product by a company may result in increase or decrease of the sales of the company's other products (which are already in the market). However, the quantum of such increase/decrease (due to the new product's launching) is not easy to determine because phenomenon of such increase/decrease may not be necessarily due to launching of the new product, it may also be the result of some other issues.

3.1.10. Cash Flow

Cash flow is a dynamic process, in which the money moves into and/or out of a business. Its significance lies in its timing, especially in the case of small entrepreneurs, who have to concentrate more on the 'Cash Management' rather than profitability. A careful monitoring of the flow of cash is extremely important, as poor 'Cash Management' leads to negative 'Cash inflow' (inflows not matching with the outflows).

Cash flow is concerned with:

1) **Cash Outflows:** The investment to be made in a project at the beginning stage and at various stages from time to time needs to be estimated with utmost care. Besides the cost of the core assets required for the project, other miscellaneous expenses involved in the project implementation, like transportation charges, installation cost, working capital requirements, etc. are equally significant and are required to be estimated in a cautious manner.

2) **Cash Inflows:** This is the most important aspect of a project, as the viability of a project hinges upon the stream of cash inflows accruing as the return of the investment made in the project. As the cash inflows can only be projected on the basis of certain historical data, its estimation requires an extremely cautious approach. The benefit reaped by the investing entity depends upon the difference between the cash outflows (initial as well as the subsequent outflows at various stages of the project) and the estimated cash inflows likely to accrue during the lifetime of the project.

Accounting method based on 'accrual' principle facilitates transforming 'accrual profit' into the 'cash flow profit'.

3.1.10.1. Cash Flows as Profit

Cash flow of a company is altogether different from its profit. Broadly speaking, cash flow is the amount of money, which moves into (inflow) or out of (outflow) a business organisation, during various operational activities, like production, financing, investment, etc. Profit (net income), on the other hand, is the balance of sales income, which remains after deducting the total of the expenditures incurred by the business organisation. For the calculation of 'accounting profit' certain adjustments, relating to non-cash items like interest, tax, depreciation, etc., are required to be made in the 'net income' figure.

When a company maintains its books of account on the basis of accrual principle, in order to arrive at the figure of actual cash flow, certain adjustments are required to be made. Such adjustments are essential because of the fact that at the time of determining the accrual net profit, certain expenses were taken into consideration, though these expenses do not currently require a cash outlay. A company requires balance sheet's assessment for the conversion of the 'accrual net profit' to the 'cash flow profit'.

Following adjustments may be applied to convert the 'Accrual Net Profit' into 'Net Cash flow':

Accrual Net Profit
Add: Depreciation
Less: Increases (or + Decreases) in Accounts Receivable
Less: Increases (or + Decreases) in Inventories
Add: Increases (or – Decreases) in Accounts Payable
Less: Decreases (or + Increases) in Notes Payable (Bank Loans)
Net Cash Flow

3.1.10.2. Components of Cash Flows

Evaluation of a project is based on the assessment of relevant cash flows associated with the specific project. They are incremental after tax cash flows.

There are three key elements of a traditional project. A traditional project envisages initial cash outflows followed by cash inflows, which are as follows:

1) **Initial Investment:** At the time of setting up of a project, the cash outlay (net of taxes) on capital expenditure and net working capital is termed as 'Initial Investment' or 'Initial Cash Outflow'. Its calculation is illustrated in the table furnished below:

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Basic Format for Determining Initial Cash Outflow (for the period .....)

Cost of "new" asset(s)
Add: Capitalised expenditures (e.g., installation costs, shipping expenses, etc.)*
Add/Less: Increased (decreased) level of "net" working capital**
Less: Net proceeds from sale of "old" asset(s) if the investment is a replacement decision.
Taxes (tax savings) due to the sale of "old" asset(s) if the investment is a replacement decision.
= Initial cash outflow
*Asset cost plus capitalised expenditures form the basis on which tax depreciation is computed. **Any change in working capital should be considered "net" of any spontaneous changes in current liabilities that occur because the project is implemented.

It may be seen in the above format, that the cost of new asset is subject to a number of adjustments to arrive at the Initial Cash Outflows. Such adjustments relate to installation costs, transportation or shipping charges, changes in net working capital, replacement cost (if any), and taxation.

2) **Operating Cash Inflows:** During the economic lifetime of a project, the cash inflows (net taxes) accruing from the project operations are known as 'Operating Cash Inflows'. It is necessary to implement the project immediately after the 'Initial Cash Outflow' has taken place. A prompt implementation of the project would ensure early generation of future 'Incremental Cash Inflows', which is beneficial for the company as well as the future of the project. Such future 'Incremental Cash Inflows' for a specific period can be computed by applying the criteria mentioned in the following table:

Basic Format for Determining Interim Incremental Net Cash Flow (for the Period.....)

Net increase (decrease) in operating revenue less (plus) any net increase (decrease) in operating expenses, excluding depreciation.
Less/Add: Net increase (decrease) in tax depreciation charges.
Net change in income before taxes.
Less/Add: Net increase (decrease) in taxes.
Net change in income after taxes.
Add/Less: Net increase (decrease) in tax depreciation charges.
Incremental net cash flow for the period.

It may be seen from the above format that a number of adjustments (monetary as well as non-monetary) are required to be made to arrive at the figure of 'Incremental Net Cash Flow'. Such adjustments are related to 'Tax Depreciation Charges', 'Change in Taxes', 'Change in Income after Taxes', etc. Tax depreciation is a non-monetary charge against operating income which lowers the taxable income. That is why it is taken into consideration while calculating 'Incremental Net Cash Flow'.

3) **Terminal Cash Inflow:** At the end of a project's economic life, during the process of its liquidation, the accrued cash inflow (net of taxes) is referred to as the 'Terminal Cash Inflow'. This is the incremental cash inflow in the final or terminal year of the project. For the calculation of the 'Terminal Year Incremental Net Cash Flow', the same underlying procedure is followed, which was applied in the calculation of 'Interim Incremental Net Cash Flow'. However, certain cash flows related to the termination or winding up of a project are given specific consideration. Such cash inflows during liquidation of project may be grouped under following categories:

i) Cash inflow in the form of salvage value due to sale/disposal of asset.
ii) Cash inflow in the form of taxes (tax savings) due to asset sale or disposal, and
iii) Any project termination related change in working capital (normally, any initial working capital investment is now reversed back to the business as an additional cash inflow).

All the necessary steps for project termination are furnished in the following format:

Basic Format for Determining Terminal Year Incremental Net Cash Flow

Net increase (decrease) in operating revenue less (plus) any net increase (decrease) in operating expenses, excluding depreciation.
Less/Add: Net increase (decrease) in tax depreciation charges.
Net change in income before taxes.
Less/Add: Net increase (decrease) in taxes.

Net change in income after taxes.
Add/Less: Net increase (decrease) in tax depreciation charges.
Incremental cash flow for the terminal year before project wind-up considerations.
Add/Less: Final salvage value (disposal/reclamation costs) of "new" asset(s).
Less/Add: Taxes (tax savings) due to sale or disposal of "new" asset(s).
Add/Less: Decreased (increased) level of "net" working capital*.
Terminal year incremental net cash flow.

3.1.10.3. Difficulties in Determining Cash Flows

As a result of a company's decision with regard to the finalisation and implementation of a project, an additional or incremental cash inflow is added to the company's existing cash inflows. However, the estimation of that additional or incremental cash inflow arising out of the new project is rather a difficult task. Following factors pose a problem in that matter:

1) **Sunk Costs:** The initial expenses incurred in connection with the analysis of a project, which cannot be recovered irrespective of the fact whether the project is accepted or rejected are known as 'Sunk Costs'. Such costs have no impact on future cash flows and logically need not be taken into consideration, while undertaking 'Capital Budgeting' decisions. The concept of 'Sunk Costs' and its implications may be explained through an example. Suppose a company 'XYZ' decides to go for an additional plant to supplement the production of the existing plant. To study the viability and analyse the proposal in detail, it hires a consultant firm to do the job on a lump-sum payment of ₹1,00,000 (Rupees one lac) only. Now, irrespective of the outcome of the study and also of the fact whether the project was finally approved by the management or not for implementation, the amount of ₹1,00,000 would be paid to the consultant firm. Such 'Sunk Cost' cannot influence the future cash flows, even in case the project is implemented.

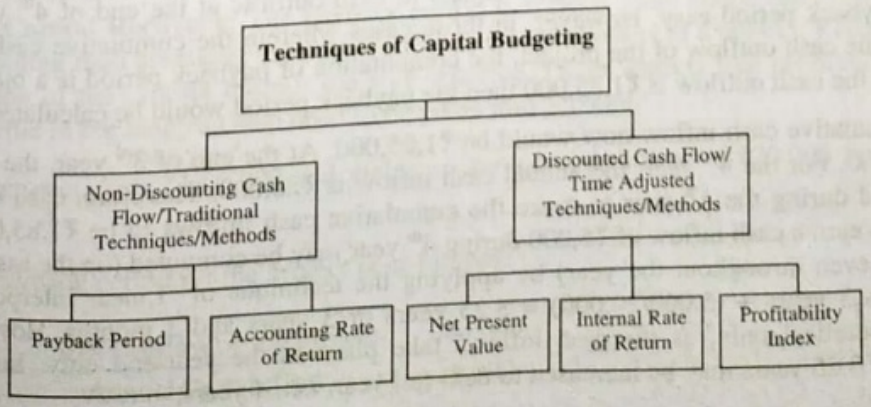
2) **Opportunity Cost:** 'Opportunity Cost' may be defined as the cost of an alternative that must be forgone in order to pursue a certain course of action. In other words, this is the cost of not implementing the project so as a result of that the cash flow could not generate expected revenue which could be with the acceptance of another available project. An example of Opportunity Cost is – if a farmer decides to grow grapes, his opportunity cost would be the alternative fruit that might have been grown instead (oranges, apples, guava, etc.).

3) **Side Effect:** A new project may impact the existing operations of the company either in a positive way or in a negative way. The former is referred to as 'Synergy' whereas the latter is referred to as 'Erosion'. In 'Synergy', a new product increases the sales of existing products of the company and results in increased cash inflows. In 'Erosion' the reverse action takes place, i.e., the new product decreases the sales of the existing products and results in decreased 'cash inflows'.

4) **Allocated Costs:** Sometimes, a common pool of finance is used by a company to fund multiple projects simultaneously. While determining the income from different projects, this cost is allocated across them (different projects). It is important from the 'Capital Budgeting' angle to view such costs as a 'Cash Outflow' of one project only, provided it is an incremental cost of the project.

3.2. TECHNIQUES OF CAPITAL BUDGETING

There are five techniques/methods applied in capital budgeting decisions, which have been kept under two broad categories as indicated below:



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3.2.1. Non-Discounted Cash Flow or Traditional Techniques/Methods

As the name itself suggests, these are traditional techniques, under which future cash inflows are not discounted to arrive at their present worth. There are two types of traditional techniques/method:

1) Payback Period Method, and
2) Accounting Rate of Return Method.

3.2.2. Payback Period Method

The number of years required for the proposal's cumulative cash inflows to be equal to its cash outflows is called 'Payback Period'. It is "the length of time (indicated as the number of years) to recover the initial cost of the project". Another way of looking it is as "the time required for a proposal to 'break-even' on the net investment of the project".

In simple words, payback period refers to the period of time in which the projects cash outflows can be recovered from the project cash inflows or investment.

3.2.2.1. Calculation of Payback Period

The calculation of payback period is carried out in different methods under two different situations as under:

1) **Equal Annual Cash Inflows:** When the revenue generated (cash inflows) during the implementation of a project remains same every year or in other words the cash inflows are in the form of an annuity, computation of the payback period is simple; it can be arrived at by dividing the 'cash outflow' by 'cash inflow per annum' (the amount of annuity).

   The formula used in this situation are as under:

$$\text{Payback Period} = \frac{\text{Initial Outflow of the Project}}{\text{Annual Cash Inflow}}$$

   For example, initial investment in a proposal involves a cash outflow of ₹10,00,000 and the revenue generation (cash inflow) is projected at ₹2,00,000 p.a. for 8 years. In this case, the payback period would be 5 years, i.e., 10,00,000/2,00,000. The initial cash outflow of ₹10,00,000 will be fully recovered within a period of 5 years and the cash inflows accruing thereafter (6th year and onwards) is ignored.

2) **Unequal Annual Cash Inflows:** When the revenue generated (cash inflows) during the implementation of the project is different every year (not in annuity form), then the cumulative figure of annual cash inflows are taken for calculating the payback period. The concept would be clear from the following example:

   For example, in a proposal, there is a cash outflow of ₹2,00,000 and the projected level of revenue generation (cash inflow) is not equal year after year. It is ₹80,000, ₹60,000, ₹40,000, ₹20,000 and ₹20,000 over next 5 years respectively. The payback period would be 4 years as illustrated below:

Year	Annual Cash Inflow (in ₹)	Cumulative Cash Inflow (in ₹)
1	80,000	80,000
2	60,000	1,40,000
3	40,000	1,80,000
4	20,000	2,00,000

In the above example, the cash inflow exactly equals to cash-outflow at the end of 4th year, making the calculation of payback period easy. However, in those cases wherein the cumulative cash inflows do not the above case, if the cash outflow is ₹1,85,000 then the payback period would be calculated as follows:

The required cumulative cash inflow now would be ₹1,85,000. At the end of 3rd year, the cumulative cash inflow is ₹1,80,000. For the 4th year, the annual cash inflow is ₹20,000. Therefore, cash inflow of ₹5,000 would be required during the 4th year to make the cumulative cash inflows to be ₹1,85,000. The precise period required to earn a cash inflow of ₹5,000 during 4th year may be computed (on the assumption that the cash inflows are even throughout the year) by applying the technique of "Linear Interpolation", i.e., the payback period is 3 years + (5,000/20,000) = 3.25 years or 3 years and 3 months. However, the above calculation is theoretical only, as the cash inflows take place at the year-end only. In such cases, the payback period of 3.25 years may be increased to next full year, i.e., 4 years.

Decision Rule

The payback period, on its own is not indicative of the decision rule. It is not helpful in taking decisions unless there is a standard target period for each industry/business, with whom the computed payback period of a particular project may be compared. If the computed payback period is less than the standard target period, then the project may be considered favourabl, otherwise (if the computed payback period is more than the standard target period) the proposal may be rejected. In the absence of any yardstick (standard payback period), the calculated payback period for a project remains an absolute figure with nothing to compare with, and the decision taken on its basis would be biased and illogical, lacking objectivity. However, if there is a series of proposals and ranking is required to be done in respect thereof, the proposal with lowest payback period will be ranked first.

3.2.2.2. Advantages of Payback Method

Despite certain shortcomings in the 'Payback Method', it has an many advantage over other methods in view of the following:

1) **No Expertise Operation:** Calculation of the payback period in respect of any project is simple and uncomplicated as compared to other advanced techniques. It is very convenient for small business houses having a limited workforce with little or no competence in respect of other advanced but complex techniques.

2) **Liquidity Indication:** As the payback method prioritises an early cash inflow, it is the most appropriate method for an organisation facing liquidity problems. During the implementation of a project, the liquidity position remains under close monitoring and a corrective measure may be taken by the organisation in case it is needed.

3) **Lower Level of Risk:** Under the payback method of capital budgeting, more emphasis is given on early cash inflows. In other words, the projects with short payback period are preferred and are considered less risky, when compared to the projects with a longer payback period. Thus, in an indirect manner, adoption of payback method results in lower level of risk (risk mitigation) for the company.

3.2.2.3. Disadvantages of Payback Method

There are certain drawbacks of using payback method for capital budgeting, some of which are as follows:

1) **Overlooks Cash Inflows:** Under the 'Payback Method', cash inflow accrued after the 'payback period' is not given any attention. The fact that in some projects, cash inflows are substantial after the payback period is completely overlooked. This could be false and may result in discrimination against those proposals which generate substantial cash inflows during post-payback period.

2) **Equal Importance to all Cash Flows:** Under this method, the 'time value of money', is not taken into consideration. It does not discriminate between the cash inflow of certain amount at present and the cash inflow of the same amount after two years. This approach is flawed, because a certain amount received today cannot be equal to the same amount received after a gap of some years. Also the cash inflows occurring after payback period are immaterial under this method.

3) **Overlooks Salvage Value:** The salvage value and the total economic life of a project are totally overlooked under the payback period method. The total emphasis is on fast cash inflow so as to recover the initial investment. A project having substantial salvage value and economic life span may be kept aside in favour of a project with higher inflows in previous years. By ignoring such important aspects, this method cannot be considered as an effective tool for assessing the economic feasibility of a project. Decisions taken only on the basis of single criteria (faster and early cash inflow), avoiding other crucial aspects, may perhaps not be appropriate.

4) **Method of Capital Recovery:** The payback period method is more concerned with the recovery of initial investment rather than assessing the profitability and other benefits of a project. Recovery of the investment should be one of the criteria but not the sole criterion. Other aspects like profitability and other benefits likely to accrue in the long run also need to be taken into account.

Example 1: A project costs ₹1,00,000 and yields an annual cash inflow of ₹20,000 for 8 years. Calculate its payback period.

Solution: The Payback period for the project is as follows:

$$\text{Payback Period} = \frac{\text{Initial Outflow of the Project}}{\text{Annual Cash Inflow}} = \frac{1,00,000}{20,000} = 5 \text{years}$$

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Example 2: A project cost ₹2,50,000 and yields annually profit of ₹50,000 after depreciation @ 12% p.a. but before tax of 50%. Calculate the payback period.

Solution:

Particulars	₹
Profit before Tax	50,000
Less: Tax @ 50% on ₹50,000	25,000
Profit after Tax	25,000
Add: Depreciation @ 12% on ₹2,50,000	30,000
Profit before Depreciation but after Tax or Annual Cash Inflow	**55,000**

$$\text{Payback Period} = \frac{\text{Initial Outflow of the Project}}{\text{Annual Cash Inflow}} = \frac{2,50,000}{55,000} = 4.5 \text{years}$$

Example 3: The Company wants to reduce its labour cost by installing a new machine. Two types of machines are available in the market, Machine X and Machine Y. Machine X would cost ₹18,000 where as Machine Y would cost ₹15,000. Both the machines can reduce annual labour cost by ₹3,000.

You are required to calculate payback period method of both the machine and recommend the best machine.

Solution:

Machine X:

$$\text{Payback Period} = \frac{\text{Initial Outflow of the Project (Machine)}}{\text{Annual Cash Inflow}} = \frac{18,000}{3,000} = 6 \text{years}$$

Machine Y:

$$\text{Payback Period} = \frac{\text{Initial Outflow of the Project (Machine)}}{\text{Annual Cash Inflow}} = \frac{15,000}{3,000} = 5 \text{years}$$

Recommendation: According to payback period method, Machine Y is more desirable than Machine X because it has a shorter payback period than Machine X.

3.2.3. Discounted PBP (Payback Period)

The discounted payback period can be seen as a type of payback period and it represents the total number of years in which the original investment has to be returned on the basis of the predicted future cash flows and these are discounted on the basis of **hurdle rate or a suitable capital cost.** Therefore, apart from receiving the invested cash, it also facilitates the recovery of financing cost of investment for a time period when some of the investment is still unrecovered. Therefore, as opposed to the normal payback method, the minimum required returns are ensured in it, if nothing drastic happens after the payback period. It can be determined as below:

$$\text{Discounted Payback} = \frac{\text{Initial Cash Outlays}}{\text{Discounted Annual Cash Inflows}}$$

Decision Rule

1) For independent projects, accept the project if the discounted payback period is less than or equal to the maximum discounted payback period, otherwise reject the project.
2) For mutually exclusive projects, accept the project with the shortest discounted payback period, when the discounted payback is less than or equal to maximum discounted payback period.

3.2.3.1. Advantages of Discounted Payback Period

1) It fulfils the requirement of the Time Value of Money.
2) It can be understood and performed quite easily.
3) No acceptance of negative NPV projects/investments in this method.
4) It facilitates greater liquidity.

3.2.3.2. Disadvantages of Discounted Payback Period

1) The issue of time value is addressed in the discounted payback period the issue of cash flow after the payback period is not addressed.
2) If there is a requirement of huge cash flow in the coming years and afterwards making it a profitable option, these types of projects can be rejected. Thus, any payback measures can be short term profit-centric compromising the larger long term profits.

Example 4: The company is considering an investment of ₹1,00,000 in a project. The following are the income forecasts, after depreciation and tax – first year ₹10,000, second year ₹40,000, third year ₹60,000, fourth year ₹20,000 and firth year Nil.

From the above information you are required to calculate:
1) Payback period, and
2) Discounted payback period at 10% interest factor.

Solution:

1) **Calculation of Payback Period**

Year	Annual Cash Inflows (₹)	Cumulative Cash Inflows (₹)
1	10,000	10,000
2	40,000	50,000
3	60,000	1,10,000
4	20,000	1,30,000
5	–	1,30,000

The table shows that at the end of third year the cumulative cash inflows exceeds the investment of ₹1,00,000. Thus, the payback period is as follows:

$$\text{Payback Period} = 2 \text{ years} + \frac{1,00,000 - 50,000}{60,000}$$

$$= 2 \text{ years} + \frac{₹50,000}{₹60,000} = 2 \text{ years} + 0.833 = 2.833 \text{ years}$$

2) **Calculation of Discounted Payback Period at 10% Interest Rate**

Year	Cash Inflows (₹)	Discounting Present Value Factor at 10% (₹)	Present Value of Cash Inflows (₹)	Cumulative Value of Cash Inflows (₹)
1	10,000	0.909	9,090	9,090
2	40,000	0.826	33,040	42,130
3	60,000	0.751	45,060	87,190
4	20,000	0.683	13,660	1,00,850
5	–	0.621	–	1,00,850

From the table, it is observed that upto the fourth year ₹1,00,000 is recovered, because the discounting cumulative cash inflows of ₹1,00,850 exceeds the original cash outlays of ₹1,00,000. The discounted payback period is calculated as follows:

$$\text{Discounted Payback Period} = 3 \text{ years} + \frac{1,00,000 - 87,190}{13,660}$$

$$= 3 \text{ years} + \frac{₹12,810}{₹13,660} = 3 \text{ years} + 0.938 = 3.938 \text{ years}$$

3.2.4. Accounting Rate of Return (ARR) Method

The ARR may also be termed as Return on Investment (ROI). It is the ratio of 'Average Profit (after tax)' to 'Average Investment'.

Capital investment proposals under 'Accounting Rate of Return (ARR) Method' are evaluated according to their profitability level. 'Capital Employed' and 'Income Generated' during the entire economic life of a project are arrived at in conformity with the "Generally Accepted Accounting Principles (GAAP)". This will help in computing average yield of projects.

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3.2.4.1. Calculation of ARR

ARR is computed by following two formulae:

$$ARR = \frac{\text{Average Annual Earning after Tax}}{\text{Average or Initial Investment}} \times 100 \quad \text{Or} \quad = \frac{\text{Average EBIT}(1-t)}{\text{Average Investment}} \times 100$$

Where,

EBIT = Earning before Interest and Tax

*Initial Investment = Initial Investment + Additional NWC + Installation Charges + Transportation Charges

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

Or

$$\frac{\text{Initial investment} - \text{Scrap value}}{2} + \text{Additional net working capital} + \text{Scrap value}$$

3.2.4.2. Advantages of Average Rate of Return Method

The ARR method has following advantages:

1) **Easy to Calculate:** As this method uses readily available financial data, its computation is easy and smooth, whereas other sophisticated methods, e.g., 'Discounted Cash flow Technique' necessitate complex steps to arrive at a decision.
2) **Considers Entire Cash-Inflows:** As against the 'Payback Method', which considers only those inflows, which occur during payback period and ignores subsequent stream of income, ARR method takes into account all the cash inflows accrued during the entire life of a project. It has a comprehensive approach.

3.2.4.3. Disadvantages of Average Rate of Return Method

The ARR method suffers from the following drawbacks:

1) **Overlooks Time Value of Money:** Time value of money is not taken into consideration in ARR method. Suppose there are two proposals ('A' and 'B') having equal initial investments for a project. While proposal 'A' has a higher annual 'cash inflow' during the initial years of the project life, proposal 'B' has a higher 'cash inflow' during the latter years of the project life. If both the proposals are compared by using ARR method, project 'B' may stand a better chance of being opted for implementation, despite the present value of the cash inflow generated by proposal 'A' being higher.
2) **Uncertain Cost of Project:** It is difficult to ascertain accurately the estimated cost of the project and related sales figures, as the project is spread over a long period of time. Besides the inside factor (like 'cash inflow), there are various outside factors beyond the control of the business organisation, which may affect the sales and cost of the project.
3) **Way to Appraise a Project:** Appraisal of a project's proposal only on the basis of the 'cash inflow' without observing the concept of 'Net Present Value' may not be considered appropriate. Focusing only on 'cash inflows' may lead to a distorted conclusion, especially when projects with significantly different capital expenditure are compared.
4) **Use of Only Accounting Data:** ARR method heavily depends on accounting data which are likely to be affected by accounting policies, certain non-cash items (like depreciation) and also on expert opinions.
5) **Problem of Comparability:** The problem of comparison arises between two sub-methods of computing the 'Average Rate of Return' (ARR).

Example 5: Consider the following two alternatives:

Particulars	Continuation of Old Machine	Installation of New Machine
Cost price	20,000	50,000
Estimated life of machine	8 years	10 years
Estimated cash costs per annum	10,000	12,000
Estimated revenues per annum	18,000	24,000
Scrap value	4,000	10,000

Tax is charged @ 50%. From the given information calculate accounting rate of return.

Solution:

Computation of Earnings after Tax

Particulars	Old Machine (₹)	New Machine (₹)
Estimated Cash Costs	10,000	12,000
Add: Depreciation	2,000	4,000
Total Costs (TC)	12,000	16,000
Total Revenues (TR)	18,000	24,000
Earnings before Tax (TR–TC)	6,000	8,000
Less: Tax @ 50%	3,000	4,000
Earnings after Tax	**3,000**	**4,000**

Working Note:

Depreciation of Old Machine

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{20,000 - 4,000}{8} = ₹2,000$$

Depreciation of New Machine

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{50,000 - 10,000}{10} = ₹4,000$$

Calculation of Accounting Rate of Return

$$\text{Accounting Rate of Return (ARR)} = \frac{\text{Average Annual Earning after Tax}}{\text{Average Investment *}} \times 100$$

*Average Investment =

$$\frac{\text{Initial investment} - \text{Scrap value}}{2} + \text{Additional net working capital} + \text{Scrap value}$$

Average Investment of Old Machine: (20,000 – 4,000)/2 + 4,000 = ₹12,000
Average Investment of New Machine: (50,000 – 10,000)/2 + 10,000 = ₹30,000

Old Machine: $\text{ARR} = \frac{3,000}{12,000} \times 100 = 25\%$

New Machine: $\text{ARR} = \frac{4,000}{30,000} \times 100 = 13.33\%$

Comment: The old machine is the best proposal for the company because its expected ARR is higher than the new machine.

Example 6: Machines 'A' and 'B' are detailed below:

Items	Machine A	Machine B
Cost	50,000	50,000
Annual earning after depreciation and taxes:		
1st year	3,000	11,000
2nd year	5,000	9,000
3rd year	7,000	7,000
4th year	9,000	5,000
5th year	11,000	3,000
	35,000	**35,000**

Depreciation has been charged on straight line basis and estimated life of both machines is five years. You are required to find out:

1) Average rate of return on machines 'A' and 'B'.
2) Which machine is better from the point of view of payback period and why?
3) Calculate average rate of return when salvage value of machine 'A' turns out to be ₹3,000 and when 'B' machine has zero salvage value.

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Solution:

1) **Calculation of Average Rate of Return (ARR)**

$$ARR = \frac{\text{Average Annual Earning after Taxes}}{\text{Average Investment}} \times 100$$

Machine A:

$$\text{Average Annual Earning after Tax} = \frac{₹35,000}{5} = ₹7,000$$

$$\text{Average Investment} = \frac{\text{Initial Investment} + \text{Salvage Value}}{2} = \frac{₹50,000}{2} = ₹25,000$$

$$ARR = \frac{7,000}{25,000} \times 100 = 28\%$$

Machine B:

$$\text{Average Annual Earning after Tax} = \frac{₹35,000}{5} = ₹7,000$$

$$\text{Average Investment} = \frac{\text{Initial Investment} + \text{Salvage Value}}{2} = \frac{₹50,000}{2} = ₹25,000$$

$$ARR = \frac{7,000}{25,000} \times 100 = 28\%$$

2) **Calculation of Payback Period**

Years	Machine A			Machine B		
	Net Earning	Cash Inflows (Net Earning + Depreciation) (₹)	Cumulative Cash Flows (₹)	Net Earning	Cash Inflows (Net Earning + Depreciation) (₹)	Cumulative Cash Flows (₹)
1st	3,000	13,000	13,000	11,000	21,000	21,000
2nd	5,000	15,000	28,000	9,000	19,000	40,000
3rd	7,000	17,000	45,000	7,000	17,000	57,000
4th	9,000	19,000	64,000	5,000	15,000	72,000
5th	11,000	21,000	85,000	3,000	13,000	85,000

Machine A:

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{₹50,000}{5} = ₹10,000$$

Machine B:

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{₹50,000}{5} = ₹10,000$$

Machine A:

Payback Period: Out of ₹50,000; ₹45,000 are covered in 3 years. The balance of ₹5,000 out of initial investment will be recovered in $3 + \frac{5,000}{19,000} = 3.26$ years.

Hence, the payback period is 3.26 years.

Machine B:

Payback Period: Out of ₹50,000; ₹40,000 are covered in 2 years. The balance of ₹10,000 out of initial investment will be recovered in $2 + \frac{10,000}{17,000} = 2.59$ years.

Hence, the payback period is 2.59 years.

Recommendation: According to payback period method, Machine B is more desirable than Machine A because it has a shorter payback period than Machine A.

3) **Calculation of Average rate of return when salvage values are given:**

$$ARR = \frac{\text{Average Annual Earning after Taxes}}{\text{Average Investment}} \times 100$$

Machine A:

$$\text{Average Annual Earning after Tax} = \frac{₹35,000}{5} = ₹7,000$$

$$\text{Average Investment} = \frac{\text{Initial Investment} + \text{Salvage Value}}{2} = \frac{₹50,000 + 3,000}{2} = ₹26,500$$

$$ARR = \frac{7,000}{26,500} \times 100 = 26\%$$

ARR for Machine B will remain unchanged i.e., 28% because the machine has zero salvage value. Since, ARR of Machine B is higher. So, Machine B is better than Machine A.

3.2.5. Discounted Cash Flow Techniques/Methods

The Discounted Cash flows (DCF) or time-adjusted techniques are advanced techniques, wherein the drawbacks prevailing in 'Traditional Techniques' (Payback Period Method and Average Rate of Return Method) are taken care. They provide a basis for evaluating and finalising various investment proposals of a project. DCF methods have following three sub-categories:

1) Net Present Value (NPV) Method,
2) Internal Rate of Return (IRR) Method, and
3) Profitability Index (PI) Method.

3.2.6. Net Present Value (NPV) Method

This method anticipate discounting (by applying suitable discount factors for each year) of the cash inflows, likely to accrue in future years, and arriving at the present value of cash inflows of each year. The total of present value of cash inflows for each year thus calculated are compared with present value of total cash outflows (capital outlay or cost of project) and the net present value (the difference between total present value of cash inflow and present value of cash outflow) is determined. A proposal is accepted only if its NPV is positive or zero. Proposals with negative NPV are rejected. While comparing two or more exclusive proposals having positive NPVs, the one with highest NPV is accepted.

3.2.6.1. Calculation of NPV

The Net Present Value analysis of an investment proposal involves following four steps:

1) A table is prepared showing the cash inflows year-wise during the entire project life.
2) Present value of each cash inflow is calculated by using a discount rate that reflects the cost of acquiring the invested capital. This discount rate is often called the hurdle rate or minimum desired rate of return.
3) The sum of the present values of all the cash-inflows gives the total present value.
4) The difference between the total present value of cash inflow and total cash outflow (capital outlay) is arrived at, which is called Net Present Value (NPV).
5) The decision is based on NPV results.

If the Net Present Value is equal to or greater than zero, the investment proposal is accepted. If it is less than zero (i.e. negative), it is rejected.

The present value of ₹1 due in any number of years can be computed with the use of the following formula:

$$PV = \frac{1}{(1+r)^n}$$

Where, PV = Present value;
r = Rate of interest/discount rate;
n = Number of years

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Net Present Value method is known to be a sophisticated technique for capital budgeting exercise. Due consideration of the time value of money, is in-built in this method. Cash inflows are discounted at a specified rate in all Discounted Cash flow techniques. This rate (**also termed as the discount rate, required return, cost of capital, or opportunity cost**) is the minimum return that is expected on a investment to remain the firm's market value unchanged.

When **cash inflows are equal of the project** following formula will be used:

$$\textbf{NPV} = (CF_t \times PVIFA_{K,t}) - CF_0$$

PVIFA = Present value interest factor of annuity
CF_0 = Present value of project's cash outflows
CF_t = Present value of cash inflows
K = Cost of capital
t = Time period of the project

When **cash inflows of the project are not equal or uneven,** following formula will be used:

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows

Or

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+K)^t} - CF_0$$

Decision Rule

When NPV method is used for making decisions to accept or reject a proposal, the following criteria is applied:

1) **NPV > Zero:** The proposal may be accepted.
2) **NPV < Zero:** The proposal may be rejected.
3) **NPV = Zero:** Indifference.

3.2.6.2. Advantages of NPV Method

The advantages of NPV method for the evaluation of investment proposals are mentioned below:

1) **Recognition of Time Value of Money:** The most important edge this method has over other methods is that the time value of money is given due recognition in its application.
2) **Sound Method of Appraisal:** It is considered as a sound evaluation technique, as it considers the total benefits arising out of proposal during the entire lifetime of the project.
3) **Selection of Mutually Exclusive Projects:** NPV is the best option for selecting the proposals relating to mutually exclusive projects.
4) **Maximisation of the Shareholder's Wealth:** This technique of selecting one proposal (out of many) for a company's project is a scientific and sophisticated one, which takes into consideration all the relevant factors necessary for taking a decision. Thus, objective of financial management, i.e., the maximisation of the shareholder's wealth is achieved.

3.2.6.3. Disadvantages of NPV Method

Advantages of NPV method as mentioned in the foregoing paragraph notwithstanding, there are certain shortcomings in this method:

1) **Not Easy to Understand:** When compared with other simple methods of capital budgeting, e.g., 'Payback Period Method' or 'Average Rate of Return', it is a complex method in calculation as well as in understanding.
2) **May Not Give Accurate Decision:** In the cases where the amounts of investment of mutually exclusive projects are unequal, NPV method may fail to deliver appropriate decision
3) **Difficult Calculation:** The most important aspect in the application of Net Present Value method is 'Discount Rate', which is based on the cost of capital. Calculation of cost of capital is a complex process and its methodology is a matter of debate amongst the experts. Difficulty in calculation of 'Cost of Capital' makes computation of 'Discount Rate/Factor' difficult and in turn results in applying NPV method.

4) **Absolute Measure:** An 'Absolute Measure' of forecasting error is one of the drawbacks of this method. The focus is only on Net Present Value of the cash inflows involved in a proposal. A proposal with a higher NPV is acceptable, without taking into account the level of initial capital outflow. In case of projects having different levels of capital outflows, application of NPV method yield results, which may not be reliable.

Example 7: A company is contemplating purchasing a new mass storage unit for its computer facility. It is expected to cost ₹2,00,000. Further, the company estimates ₹20,000 as permanent working capital. The projected Net cash inflows from the proposed investment project are as follows for each year of operation:

Year	1	2	3	4	5
Net Cash Inflows (₹)	50,000	80,000	1,00,000	80,000	60,000

The company's cost of capital is 12% advise the company whether the project should be accepted or rejected. Compute net present value of the project.

Solution:

Years	Cash Inflows (₹)	Working Capital (₹)	PV at 12%	Present Value (₹)
1	50,000		0.893	44,650
2	80,000		0.797	63,760
3	1,00,000		0.712	71,200
4	80,000		0.636	50,880
5	60,000	20,000	0.543	43,440
Total Present Value				2,73,930

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows
NPV = 2,73,930 – 2,00,000 = ₹73,930

Recommendation: Since the net present value is positive, thus the company is advised to accept the project.

Example 8: Following are the expected cash inflows of the company. The cost of capital is 10%. The scrap value at the end of 4th year is ₹2,000:

Years	Cash Outflows (₹)	Cash Inflows (₹)
0	10,000	–
1	2,000	3,000
2	–	5,000
3	–	5,000
4	–	5,000

Calculate net present value.

Solution: **Calculation of Present Value of Cash Inflows**

Years	Cash Inflows (₹)	PV at 10%	Present Value (₹)
1	3,000	0.909	2,727
2	5,000	0.826	4,130
3	5,000	0.751	3,755
4	5,000	0.683	3,415
4 (Scrap Value)	2,000	0.683	1,366
	Total Present Value		15,393

Calculation of Present Value of Cash Outflows
Initial (Cash) Outflows = 0 Year Outflows + (1st Year Outflows × PV at 10%)
= 10,000 + (2,000 × 0.909) = 10,000 + 1,818 = ₹11,818

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows
= 15,393 – 11,818 = ₹3,575

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Example 9: From the following information of the two projects calculate the net present value and suggest which of the two projects should be accepted assuming a discount rate of 10%.

Particulars	Project X	Project Y
Initial Investment	₹20,000	₹30,000
Estimated Life	5 years	5 years
Scrap Value	₹1,000	₹2,000

The profits before depreciation and after taxes (cash flow) are as follows:

Years	1	2	3	4	5
Project X (₹)	5,000	10,000	10,000	3,000	2,000
Project Y (₹)	20,000	10,000	5,000	3,000	2,000

Solution:

Years	Project X			Project Y		
	Cash Inflows (₹)	PV at 10%	Present Value (₹)	Cash Inflows (₹)	PV at 10%	Present Value (₹)
1	5,000	0.909	4,545	20,000	0.909	18,180
2	10,000	0.826	8,260	10,000	0.826	8,260
3	10,000	0.751	7,510	5,000	0.751	3,755
4	3,000	0.683	2,049	3,000	0.683	2,049
5	2,000	0.621	1,242	2,000	0.621	1,242
5 (Scrap value)	1,000	0.621	621	2,000	0.621	1,242
	Total Present Value		**24,227**	**Total Present Value**		**34,728**

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows (Initial Investment)

Project X:

NPV = 24,227 – 20,000 = ₹4,227

Project Y:

NPV = 34,728 – 30,000 = ₹4,728

Recommendation: Net present value of project Y is higher than the net present value of project X, hence it is suggested that project Y should be selected.

3.2.7. Internal Rate of Return (IRR) Method

This is another method for appraisal of capital expenditure decisions, of discounted cash flow analysis. This method are also called as 'Yield on Investment', 'Marginal Efficiency of Capital', 'Marginal Productivity of Capital', 'Rate of Return', 'Time-Adjusted Rate of Return', etc. Under the IRR method, similar to the NPV method, time value of money is considered by discounting the stream of cash inflows. However, the two methods differ from each other with regard to the cost of capital/ discount rate:

1) In the NPV method, the discount rate is the required rate of return (a predetermined rate). Thus, the determinants of the discount rate are external to the proposal.
2) In contrast to the above, the determinants of IRR are internal to the proposal (that is why the term internal rate of return is used). The IRR depends entirely on the initial capital outlay and the cash inflows of the proposal under examination for acceptance or rejection. Generally, IRR is the rate of return that a project earns and gives NPV equal to zero. The internal rate of return (IRR) is defined "as the discount rate which equates the cumulative present value of the net cash inflows with the aggregate present value of cash outflows of a project".

3.2.7.1. Calculation of IRR

Calculation of IRR is done differently under two different situations using the following formula:

1) **When the Annual Cash Inflows are Equal:** In the projects with uniform cash inflows year after year during their lifetime, IRR is computed by finding Present Value (PV) factor in the following manner:

$$\text{Present Value Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflow}}$$

The present value (PV) factor will show the number of year's equivalent to the economic life of the project by placing the PV factor in the annuity table. If PV factor is not an absolute number, then IRR would be in between two factors and nearest factor is taken as internal rate of return. IRR can be calculated as under:

$$IRR = X + \frac{Px - I}{Px - Py}(Y - X)$$

Where,
IRR = Internal rate of return,
Y = Higher discount rate
X = Lower discount rate,
Px = Present value of cash inflows at X
Py = Present value of cash inflows at Y
I = Initial investment

2) **When the Annual Cash Inflows are Unequal:** In the projects with unequal cash inflows, the IRR is calculated by using "trial and error" method. Trial calculations are carried-out again and again in order to arrive at the exact IRR (which makes the present value of cash inflows and cash outflows equal).

In this process, the following steps are taken:

i) **Determination of First Trial Rate:** For the determination of first trial rate, present value factor is ascertained as follows:

$$\text{Present Value Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflow}}$$

$$\text{Average Annual Cash Inflow} = \frac{\text{Total Cash Inflows}}{\text{Economic Life of the Project}}$$

After this calculation, annuity table is used to obtain the IRR.

ii) **Application of Second Trial Rate:** If the NPV so obtained gives positive value, a higher rate of discount is applied, and if value continues to be positive, the discount rate is again increased. This process is continued till NPV becomes negative. If NPV figure becomes negative then IRR lies between that negative figure and the positive figure just preceding it.

Decision Rule

When IRR method is used to decide whether to accept or reject the proposal, following criteria is adopted:

1) **IRR > K:** Proposal is accepted.
2) **IRR < K:** Proposal is rejected.
3) **IRR = K:** Indifference.

3.2.7.2. Advantages of Internal Rate of Return Method

IRR method of capital budgeting has following advantages to its credit:

1) **Consideration of Time Value:** Internal Rate of Return is a superior technique for undertaking capital budgeting exercise to evaluate capital expenditure decisions. It ensures that time value of money is taken into consideration. Further, total cash inflows as well as total cash outflows are considered under this method.

2) **Easy to Understand:** Understanding the mechanism of IRR technique is simple and easy. Equations and formulae may appear to be complex, but the concept of IRR, by business people, especially non-technical persons, is accepted without any difficulty as compared to the concept of other techniques like NPV.

3) **Sign of Profitability:** In IRR method, the concept of the required rate of return/cost of capital is not used. This method on its own provides a rate of return, which gives a sign of profitability of the proposal. During the calculations, cost of capital appears at a later stage.

4) **Comprehensive Objective:** Under IRR technique, the acceptance or rejection of a proposal depends on the outcome of a comparison of IRR with the required rate of return. Required rate of return has been defined as the minimum rate expected by investors on their investment. Further, the 'Decision Rule' of IRR method states that only when IRR is more than the required rate of return, the proposal would be accepted. As a result market price of the company's shares is likely to increase. This would ultimately lead to the maximisation of shareholders' wealth, which as a rule is the overall objective of any company.

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3.2.7.3. Disadvantages of Internal Rate of Return Method

IRR method of capital budgeting suffers from certain shortcomings as following:

1) **Difficult to Calculate:** Calculations involved in IRR technique are complex and difficult to calculate.
2) **Confusion in Multiple Rates:** Multiple rates, which are part of the exercise, create a lot of confusion.
3) **Inconsistent in Firm Objectives:** Theoretically, during the evaluation of mutually exclusive proposals, the proposal having the highest IRR needs to be (and is) selected for implementation. However, in practice, that proposal (with highest IRR) may not prove to be the most profitable and therefore the objective of the company, i.e., maximisation of the shareholders' wealth, may not be achieved.
4) **Reinvestment of Cash Flows:** It is the presumption under this method that all intermediate cash flows are reinvested at the IRR. Reinvestment of the cash-inflows by the company at varying rates is rather odd.
5) **Overlook Rupees of NPV:** Rupees of NPV are not reflected in this method. Under basic methods, cash flows and project life are treated in an autocratic manner without due consideration of other possibilities. There is no specific recognition of preference for cash flow pattern.

Example 10: A company has to consider the following project with the initial outflow of ₹10,000:

Years	Cash Inflows (₹)
1	1,000
2	1,000
3	2,000
4	10,000

Compute the internal rate of return and comment on the project if the opportunity cost is 14%.

Solution:

Years	Cash Inflows (₹)	PV at 10%	Present Value (₹)	PV at 15%	Present Value (₹)
1	1,000	0.909	909	0.870	870
2	1,000	0.826	826	0.756	756
3	2,000	0.751	1,502	0.658	1,316
4	10,000	0.683	6,830	0.572	5,720
	Total Present Value		**10,067**		**8,662**

First, calculate the present value factor for the project.

$$\text{Present Value Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflow}} = \frac{10,000}{3,500} = 2.857$$

Average Annual Cash Inflow = (₹1,000 + 1,000 + 2,000 + 10,000) ÷ 4 = ₹3,500

In the Present Value Annuity table, value near to 2.857 for 4 year is found in 15%. However, IRR is between 10% and 15%.

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows

NPV at 10% = 10,067 – 10,000 = ₹67

NPV at 15% = 8,662 – 10,000 = ₹-1,338

Calculation of IRR

IRR may be found by interpolation between 10% and 15% as follows:

$$IRR = X + \frac{Px - I}{Px - Py}(Y - X)$$

Where,

X = Lower discount rate,
Y = Higher discount rate,
Px = Present value of cash inflows at X,
Py = Present value of cash inflows at Y, and
I = Initial investment.

$$IRR = 10\% + \frac{10,067 - 10,000}{10,067 - 8,662}(15 - 10) = 10\% + \frac{67}{1,405} \times 5 = 10\% + 0.24 = 10.24\%$$

Recommendation: As the opportunity cost of the firm is 14%, the project having IRR of 10.24% should be rejected.

Example 11: Project X and Project Y costs ₹50,000 and ₹25,000 respectively. Their cash flows are given below. You are required to find out the internal rate of return for each project and decide on that basis which project is more profitable.

Years	Cash Inflows	
	Project X (₹)	Project Y (₹)
1	5,000	10,000
2	15,000	10,000
3	30,000	10,000
4	20,000	10,000
5	10,000	–

Solution:

Years	Project X					Project Y				
	Cash Inflows (₹)	PV at 18%	Present Value (₹)	PV at 16%	Present Value (₹)	Cash Inflows (₹)	PV at 22%	Present Value (₹)	PV at 20%	Present Value (₹)
1	5,000	0.847	4,235	0.862	4,310	10,000	0.820	8,200	0.833	8,330
2	15,000	0.718	10,770	0.743	11,145	10,000	0.672	6,720	0.694	6,940
3	30,000	0.609	18,270	0.641	19,230	10,000	0.551	5,510	0.579	5,790
4	20,000	0.516	10,320	0.552	11,040	10,000	0.451	4,510	0.482	4,820
5	10,000	0.437	4,370	0.476	4,760	–		–		–
Total Present Value			**47,965**		**50,485**			**24,940**		**25,880**

First, calculate the present value factor for both the projects.

$$\text{Present Value (PV) Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflow}}$$

Project X:

Average Annual Cash Inflow = (5,000 + 15,000 + 30,000 + 20,000 + 10,000) ÷ 5 = ₹16,000

$$\text{PV factor} = \frac{50,000}{16,000} = 3.125$$

Project Y:

Average Annual Cash Inflow = (10,000 + 10,000 + 10,000 + 10,000) ÷ 4 = ₹10,000

$$\text{PV factor} = \frac{25,000}{10,000} = 2.5$$

In the Present Value Annuity table, for Project X, value near to 3.125 for 5 year is found in 18%. However, IRR is between 16% and 18%:

Similarly, for Project Y, it is 22% for 4 years.

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows

Project X:

NPV at 18% = 47,965 – 50,000 = ₹– 2,035

NPV at 16% = 50,485 – 50,000 = ₹485

Project Y:

NPV at 22% = 24,940 – 25,000 = ₹– 60

NPV at 20% = 25,880 – 25,000 = ₹880

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Calculation of IRR

$$IRR = X + \frac{Px - I}{Px - Py}(Y - X)$$

Project X:

IRR may be found by interpolation between 16% and 18% as follows:

$$IRR = 16\% + \frac{50,485 - 50,000}{50,485 - 47,965}(18 - 16) = 16\% + \frac{485}{2,520} \times 2 = 16\% + 0.38 = 16.38\%$$

Project Y:

IRR may be found by interpolation between 20% and 22% as follows:

$$IRR = 20\% + \frac{25,880 - 25,000}{25,880 - 24,940}(22 - 20) = 20\% + \frac{880}{940} \times 2 = 20\% + 1.87 = 21.87\%$$

Recommendation: Project Y is more profitable than project X because it shows a higher IRR.

3.2.8. Profitability Index (PI) Method

It is also termed as **Benefit-Cost Ratio** or **Cost-Benefit Ratio**. Capital budgeting exercise through Profitability Index (PI) method basically involves assessment of profitability arising out of an investment proposal, which is comparable with profitability of similar other investment proposals. PI is expressed in terms of the ratio of discounted benefits over the discounted costs.

3.2.8.1. Calculation of PI

The efficiency and effectiveness of a proposed investment may be assessed through various methods; Profitability Index is one of them. Measurement of PI is carried out with the help of following formula:

$$\text{Profitability Index (PI)} = \frac{\text{Present Value of Cash Inflows}}{\text{Present Value of Cash Outflows}}$$

Or

$$= \frac{\text{Present Value of Cash Inflows}}{\text{Initial Cash Outflows or Outlay or Initial Investment}}$$

The profitability index may be found for net present values of inflows:

$$PI\ (Net) = \frac{NPV\ (Net\ Present\ Value)}{Initial\ Cash\ Outflows} \quad \text{or} \quad \frac{PV\ of\ Cash\ Inflows}{Initial\ Cash\ Outflows}$$

The **net profitability index** can also be found as Profitability Index (gross) minus one.

Decision Rule

When PI is used to make a decision regarding acceptance or rejection of a proposal, the decision criteria are as follows:

1) **PI > 1:** The proposal is accepted.
2) **PI < 1:** The proposal is rejected.
3) **PI = 0:** Indifference.

3.2.8.2. Advantages of Profitability Index Method

Profitability index method of evaluating a proposal has following advantages:

1) It is in conformity with the objective of 'Maximisation of the Shareholders Wealth'.
2) Time value of money is taken into consideration.
3) Cash flows generated during the entire life of the project are taken for analysis purpose.
4) It is most appropriate for proposals with varying amount of cash outflow relating to varying projects.
5) It give consider the exact rate of return on relating to a project.
6) Through this method, the allocation of capital is ensured, while ranking and choosing the projects.

3.2.8.3. Disadvantages of Profitability Index Method

The disadvantages of profitability index method are as follows:

1) For using this method, in depth long-term projections of incremental costs and benefits are needed.
2) To determine interest rate/discount rate is rather not easy in this method.
3) To compute profitability index is difficult in respect of two projects, which have different economic life.

Example 12: A company invests ₹5,000 in a project, which generates the following cash flow in the next 5 years. The firm has a cost of capital of 10%. Calculate profitability index and advice whether the company should accept or reject the project.

Years	Cash Inflows (₹)
1	2,000
2	2,000
3	2,000
4	1,000
5	1,000

Solution:

Years	Cash Inflows (₹)	PV at 10%	Present Value (₹)
1	2,000	0.909	1,818
2	2,000	0.826	1,652
3	2,000	0.751	1,502
4	1,000	0.683	683
5	1,000	0.621	621
Total Present Value			6,276

$$\text{Profitability Index (PI)} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}} = \frac{6,276}{5,000} = 1.255$$

Recommendation: Since PI > 1, the project can be accepted.

Example 13: A company is appraising two projects A and B. Assuming the present value of future cash flows for project A is ₹5,000 and that for project B is ₹4,850. Also assume that both projects have an initial capital investment of ₹4,750 each. Calculate the PI for both projects and determine whether or not to invest in the projects.

Solution:

Project A:

$$\text{Profitability Index (PI)} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}}$$

$$= \frac{5,000}{4,750} = 1.053$$

Project B:

$$\text{Profitability Index (PI)} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}}$$

$$= \frac{4,850}{4,750} = 1.021$$

Recommendation: Both projects have a PI > 1 so, we can accept both project if they are independent. However, if we can only accept one project, we will most likely accept the project with the largest PI (i.e., project A).

Example 14: The directors of Alpha Limited are contemplating the purchase of a new machine to replace a machine, which has been in operation in the factory for the last five years. Ignoring the interest; but considering tax at 50% of the net earnings. Suggest which of the two alternatives should be preferred? The following are the details:

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Particulars	Old Machine	New Machine
Purchase price	₹40,000	₹60,000
Estimate life in years	10	10
Machine running hours per annum	2,000	2,000
Units produced per hour	24	36
Wages per running hour	₹3	₹5.25
Consumable stores p.a.	₹6,000	₹7,500
All other charges p.a.	₹8,000	₹9,000
Material cost per unit	₹0.50	₹0.50
Selling price per unit	₹1.25	₹1.25
Power p.a.	₹2,000	₹4,500

You may assume that the above information regarding sales and cost of sales will hold good throughout the economic life of both the machines. Calculate accounting rate of return and suggest whether replacement of old machine by new machine is profitable or not. [Assume straight line depreciation.]

Solution:

Profitability Statement

Particulars	Old Machine (₹)	New Machine (₹)
Production (p.a.)	(2,000 × 24) 48,000	(2,000 × 36) 72,000
Sales	(48,000 × 1.25) 60,000	(72,000 × 1.25) 90,000
Cost of Sales (p.a.):		
Wages	(2,000 × 3) 6,000	(2,000 × 5.25) 10,500
Power	2,000	4,500
Consumable Stores	6,000	7,500
All Other Charges	8,000	9,000
Materials Cost	(48,000 × 0.5) 24,000	(72,000 × 0.5) 36,000
Total Cost of Sales	**46,000**	**67,500**
Earning Before Depreciation and Tax (EBDT) (Sales – Total Cost of Sales)	14,000	22,500
Less: Depreciation	4,000	6,000
Earning Before Tax (EBT)	**10,000**	**16,500**
Less: Tax 50%	5,000	8,250
Earning After Tax (EAT)	**5,000**	**8,250**

Incremental Profit = Earning After Tax (EAT) of New Machine – Earning After Tax (EAT) of Old Machine
= 8,250 – 5,000
= ₹3,250

Incremental Investment = ₹20,000

$$\text{ARR} = \frac{\text{Average Annual Earning after Tax}}{\text{Average or Initial Investment}} \times 100$$

Calculation of ARR before Tax on Initial Investment:

1) ARR Old Machine $= \frac{5,000}{40,000} \times 100 = 12.5\%$

2) ARR New Machine $= \frac{8,250}{60,000} \times 100 = 13.75\%$

Calculation of ARR after Tax on Initial Investment:

1) ARR Old Machine $= \frac{5,000}{20,000} \times 100 = 25\%$

2) ARR New Machine $= \frac{8,250}{30,000} \times 100 = 27.5\%$

$$\text{Incremental ARR} = \frac{\text{Incremental Earning after Tax (EAT)}}{\text{Incremental Initial Investment}} \times 100 = \frac{3,200}{40,000} \times 100 = 8\%$$

Thus, replacement of the old machine (ignoring interest) is profitable.

Working Note:

	Particulars	₹
1)	**Incremental investment in new machine:**	
	Investment in new machine	60,000
	Less: Sale value of old machine	20,000
	[Cost – Depreciation for 5 years i.e., (40,000 – 4,000 × 5)]	
		40,000
2)	**Depreciation:**	
	Old machine (40,000 ÷ 10)	**4,000**
	New machine (60,000 ÷ 10)	**6,000**

Example 15: Private Limited is planning an investment in new project. The company has following two investment alternatives:

Particulars	Project A	Project B
Investment	30,00,000	30,00,000
Useful Life	5 Years	6 Years
Cost of Capital	12%	12%
Cash Inflows at the End of the Years:		
1	7,00,000	8,00,000
2	10,00,000	8,00,000
3	9,00,000	8,00,000
4	8,00,000	8,00,000
5	4,00,000	6,00,000
6	–	2,00,000

Find which project the company should select and also advice on the basis of:

1) Payback Period Method
2) Net Present Value Method

Solution:

Years	Project A				Project B			
	Cash Inflows	Cumulative Cash Inflows	PV at 12%	Present Value (₹)	Cash Inflows	Cumulative Cash Inflows	PV at 12%	Present Value (₹)
1	7,00,000	7,00,000	0.893	6,25,100	8,00,000	8,00,000	0.893	7,14,400
2	10,00,000	17,00,000	0.797	7,97,000	8,00,000	16,00,000	0.797	6,37,600
3	9,00,000	26,00,000	0.712	6,40,800	8,00,000	24,00,000	0.712	5,69,600
4	8,00,000	34,00,000	0.636	5,08,800	8,00,000	32,00,000	0.636	5,08,800
5	4,00,000	38,00,000	0.567	2,26,800	6,00,000	38,00,000	0.567	3,40,200
6	-	-	-	-	2,00,000	40,00,000	0.507	1,01,400
	Total Present Value			**27,98,500**	**Total Present Value**			**28,72,000**

1) **Calculation of Payback Period**

Project A:

Payback Period: Out of ₹30,00,000; ₹26,00,000 are covered in 3 years. The balance of ₹4,00,000 out of initial investment will be recovered in $3 + \frac{4,00,000}{8,00,000} = 3.5$ years. Hence, the payback period is 3.5 years.

Project B:

Payback Period: Out of ₹30,00,000; ₹24,00,000 are covered in 3 years. The balance of ₹6,00,000 out of initial investment will be recovered in $3 + \frac{6,00,000}{8,00,000} = 3.75$ years. Hence, the payback period is 3.75 years.

Recommendation: According to payback period method, Machine A is more desirable than Machine B because it has a shorter payback period than Machine B.

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2) **Calculation of Net Present Value**

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows (Investment)

Project A:

NPV = 27,98,500 – 30,00,000 = ₹–2,01,500

Project B:

NPV = 28,72,000 – 30,00,000 = ₹–1,28,000

Recommendation: Since the project A and B has negative NPV. It is advisable to company to reject both the project.

Example 16: A company is considering an investment proposal to install a new machine. This project will cost ₹1,00,000 and will have 5 years life with no salvage value. Tax rate is 50 per cent; the company follows straight line method of depreciation. The earnings before depreciation and tax (EBDT) as follows:

Years	1	2	3	4	5
EBDT(₹)	20,000	22,000	28,000	30,000	50,000

Evaluate the project using:

1) Payback Period
2) Profitability Index at 10%.

Solution:

Years	Earnings Before Depreciation and Tax (EBDT) (₹)	Depreciation (₹)	Earnings After Depreciation (₹)	Tax at 50% (₹)	Earnings Before Depreciation but After Tax (EBDAT) (₹)	Cumulative EBDAT	PV at 10%	Present Value of EBDAT (₹)
1	20,000	20,000	Nil	Nil	20,000	20,000	0.909	18,180
2	22,000	20,000	2,000	1,000	21,000	41,000	0.826	17,346
3	28,000	20,000	8,000	4,000	24,000	65,000	0.751	18,024
4	30,000	20,000	10,000	5,000	25,000	90,000	0.683	17,075
5	50,000	20,000	30,000	15,000	35,000	1,25,000	0.621	21,735
	Total Present Value							92,360

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{1,00,000}{5} = ₹20,000$$

1) **Calculation of Payback Period**

₹90,000 are covered in 4 years. The balance of ₹10,000 out of initial investment will be recovered in $\frac{10,000}{35,000}$ or 0.28 year. Hence, the payback period is 4.28 years.

2) **Calculation of Profitability Index at 10%**

$$\text{Profitability Index (PI)} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}} = \frac{92,360}{1,00,000} = 0.92$$

Recommendation: Since PI < 1, the project is rejected.

Example 17: Nutide Industries Ltd. has an investment budget of ₹100 lac for year 2014-15. It has started listed two projects A and B after carrying out market study and technical appraisal. The management wants to compare the financial appraisals before making the investment. Further particular regarding the two projects are given below:

(₹ in Lac)

Particulars	Project A	Project B
Investment required	100	90
Average annual cash inflow before depreciation and tax (estimate)	28	24

Salvage Value – Nil for both projects.
Estimated life – 10 years for both projects.
The Company follows straight line method of depreciation.
Its tax rate is 50%

You are required to calculate:
1) Pay-back period.
2) IRR of the these projects.

Solution:

Particulars	Project A (₹ in Lac)	Project B (₹ in Lac)
Average Annual Cash Inflow Before Depreciation and Tax	28	24
Less: Depreciation	10	9
Profit before Tax	18	15
Less: Tax @ 50%	9	7.5
Profit after Tax	9	7.5
Add: Depreciation	10	9
Annual Cash Inflow after Tax	**19**	**16.5**

1) **Computation of Payback Period**

$$\text{Payback Period} = \frac{\text{Initial Outflow of Project}}{\text{Annual Cash Inflow}}$$

Project A

$$\text{Payback Period} = \frac{100}{19} = 5.26 \text{ years}$$

Project B

$$\text{Payback Period} = \frac{90}{16.5} = 5.45 \text{ years}$$

2) **Computation of IRR**

Project A

In the Present Value Annuity table, value near to 5.26 is found in 14%. However, IRR is between 13% and 14%.

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows
NPV at 14% = (5.2162 × 19) – 100 = ₹–0.89
NPV at 13% = (5.4262 × 19) – 100 = ₹3.10

IRR may be found by interpolation between 10% and 15% as follows:

$$\text{IRR} = X + \frac{P_x - I}{P_x - P_y}(Y - X) = 13\% + \frac{3.10}{3.10 - (-0.89)}(14 - 13) = 13\% + \frac{3.10}{3.99} \times 1 = 13\% + 0.78 = 13.78\%$$

Project B

In the Present Value Annuity table, value near to 5.45 is found in 13%. However, IRR is between 10% and 15%.

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows
NPV at 13% = (5.4262 × 16.5) – 90 = ₹–0.47
NPV at 12% = (5.6502 × 16.5) – 90 = ₹3.23

IRR may be found by interpolation between 10% and 15% as follows:

$$\text{IRR} = X + \frac{P_x - I}{P_x - P_y}(Y - X) = 12\% + \frac{3.23}{3.23 - (-0.47)}(13 - 12) = 12\% + \frac{3.23}{3.70} \times 1 = 12\% + 0.87 = 12.87\%$$

Example 18: A company is considering an investment proposal to install a new milling control at a cost of ₹50,000. The facility has a life expectancy of 5 years without any salvage value. The firm uses SLM of depreciation and the same is used for tax purposes. The tax rate is assumed to be 35%. The estimated cash flows before depreciation and tax (CFBDT) from the investment proposal are as follows:

Years	1	2	3	4	5
CFBDT (₹)	10,000	10,692	12,769	13,462	20,385

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Compute:

1) Payback period
2) Average rate of return
3) NPV at 10% discount rate
4) Profitability index at 10% discount rate.

Solution:

Years	Cash Flows Before Depreciation and Tax (CFBDT) (₹)	Depreciation (₹)	Cash Flows After Depreciation (CFAD) (₹)	Tax at 35% (₹)	Cash Flows After Depreciation and Tax (CFADT) (₹)	Cash Flows Before Depreciation but After Tax (CFBDAT) (₹)	Cumulative CFBDAT (₹)	PV at 10%	Present Value of CFBDAT (₹)
1	10,000	10,000	Nil	Nil	Nil	10,000	10,000	0.909	9,090
2	10,692	10,000	692	242	450	10,450	20,450	0.826	8,632
3	12,769	10,000	2,769	969	1,800	11,800	32,250	0.751	8,862
4	13,462	10,000	3,462	1,212	2,250	12,250	44,500	0.683	8,367
5	20,385	10,000	10,385	3,635	6,750	16,750	61,250	0.621	10,401
	Total Present Value								45,352

$$\text{Depreciation} = \frac{\text{Cost Price} - \text{Scrap Value}}{\text{Number of Years}} = \frac{50,000}{5} = ₹10,000$$

1) **Calculation of Payback Period**

Out of ₹50,000; ₹44,500 are covered in 4 years. The balance of ₹5,500 out of initial investment will be recovered in $4 + \frac{5,500}{16,750} = 4.33$ years. Hence, the payback period is 4.33 years.

2) **Calculation of Average Rate of Return (ARR)**

$$\text{ARR} = \frac{\text{Average Annual Earning after Taxes}}{\text{Average Investment}} \times 100$$

$$\text{Average Annual Earning after Tax (CFADT)} = \frac{0+450+1,800+2,250+6,750}{5} = \frac{11,250}{5} = ₹2,250$$

$$\text{Average Investment} = \frac{\text{Initial Investment} + \text{Salvage Value}}{2} = \frac{₹50,000}{2} = ₹25,000$$

$$\text{ARR} = \frac{2,250}{25,000} \times 100 = 9\%$$

3) **Calculation of Net Present Value at 10% Discount Rate**

NPV = Present Value of Cash Inflows – Present Value of Cash Outflows

= 45,352 – 50,000 = ₹–4,648

4) **Calculation of Profitability Index at 10% Discount Rate**

$$\text{Profitability Index (PI)} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}} = \frac{45,352}{50,000} = 0.907$$

Example 19: The companies initial investment in a project was ₹1,00,000 and the expected cash inflows during the project are as follows:

Years	1	2	3	4	5
Cash Inflow	20,000	30,000	40,000	50,000	30,000

The cost of capital is 12%. Calculate the following:

1) Net present value
2) Benefit cost ratio
3) Internal rate of return
4) Payback period

Solution:

Years	Cash Inflows (₹)	Cumulative Cash Inflows (₹)	PV at 12%	Present Value (₹)	PV at 18%	Present Value (₹)	PV at 21%	Present Value (₹)
1	20,000	20,000	0.893	17,860	0.847	16,940	0.826	16,520
2	30,000	50,000	0.797	23,910	0.718	21,540	0.683	20,490
3	40,000	90,000	0.712	28,480	0.609	24,360	0.564	22,560
4	50,000	1,40,000	0.636	31,800	0.516	25,800	0.467	23,350
5	30,000	1,70,000	0.567	17,010	0.437	13,110	0.386	11,580
	Total Present Value			**1,19,060**		**1,01,750**		**94,500**

1) **Calculation of Net Present Value**
NPV = Present Value of Cash Inflows – Present Value of Cash Outflows
NPV = 1,19,060 – 1,00,000 = ₹19,060

2) **Calculation of Benefit Cost Ratio (Profitability Index)**

$$\text{Benefit Cost Ratio} = \frac{\text{PV of Cash Inflows}}{\text{Initial Cash Outflows}} = \frac{1,19,060}{1,00,000} = 1.19$$

3) **Calculation of Internal Rate of Return**
First, calculate the present value factor for the project.

$$\text{Present Value Factor} = \frac{\text{Initial Investment}}{\text{Average Annual Cash Inflow}} = \frac{1,00,000}{34,000} = 2.94$$

Average Annual Cash Inflow = (₹20,000 + 30,000 + 40,000 + 50,000 + 30,000) ÷ 5 = ₹34,000

In the Present Value Annuity table, value near to 2.94 for 5 year is found in 21%. However, IRR is between 18% and 21%.

IRR may be found by interpolation between 18% and 21% as follows:

$$IRR = X + \frac{Px - I}{Px - Py}(Y - X)$$

$$IRR = 18\% + \frac{1,01,750 - 1,00,000}{1,01,750 - 94,500}(21 - 18) = 18\% + \frac{1,750}{7,250} \times 3 = 18\% + 0.72 = 18.72\%$$

4) **Calculation of Payback Period**
₹90,000 are covered in 3 years. The balance of ₹10,000 out of initial investment will be recovered in $\frac{10,000}{50,000}$ or 0.2 year. Hence, the payback period is 3.2 years.

Example 20: Wealth Bridge Company is contemplating to purchase a machine. Two Machines A and B are available, each costing ₹5,00,000. In comparing the profitability of the machines, a discounting rate of 10% is to be used and machine is to be written off in five years by straight line method of depreciation with nil residual value. Cash inflows after tax are expected as follows:

Year	Machine A	Machine B
1	1,50,000	50,000
2	2,00,000	1,50,000
3	2,50,000	2,00,000
4	1,50,000	3,00,000
5	1,00,000	2,00,000

Indicate which machine would be profitable using the following methods of ranking investment proposals:
1) Payback period.
2) Net Present Value considering discounting rate @ 10%.
3) Profitability Index @ discounting rate of 10%.

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