

PROJECT PROFITABILITY  
CASE STUDIES

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PROJECT PROFITABILITY  
CASE STUDIES

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## Definitions of Economic Terms

### Accelerator

The accelerator is an agent which tends to accelerate booms or slumps in the economy. The Acceleration principle shares a functional relationship between consumption and investment, an increase in consumption bringing about a greater increase in capital goods to make consumer goods. Fluctuations are greater in capital goods producing industries than in consumer's goods industries.

Example : Envisage a plant producing 1 million units of a commodity per year. Assume 10% of productive capacity requires replacement each year. Now if the market demand increases from 1 million units to 1.1 million units, productive capacity will have to be increased by 10% to meet the additional demand. Thus the effect of a 10% increase in consumer demand is an increase of 100% in the capital equipment. Conversely, if demand for commodity fell by 10%, then the producer need not carry out his normal replacement of plant at all, and the effect of this relatively small fall in demand for the commodity is to reduce the demand for capital equipment to zero. In practice, the effect may not be as sharp as this. An increase in demand, if temporary, may be met by running down stocks, there may be reserve productive capacity which can be brought into use; existing plant may be used more intensively; and the cost of durable equipment may not be great in relation to materials and labour, reducing the importance in the economy of large variations in the demand for equipment.

Ad Valorem

"According to value".

Ad Valorem Assessment

According to the full cash value of the land and all improvement.

Amortization

The annual writing down of the value of an asset by depreciation.

Annuity

The payment of a certain sum of money to the recipient at uniform intervals of time, usually each year.

Appreciation

It is the increase in the value of an asset.

Arbitration

A method of setting disputes by referring the matter to an impartial person or body for adjudication.

Arithmetic Mean

Figure computed by aggregating a series of figures and dividing by the number of items included in the series.

$$M. = \frac{\sum x_i}{N}$$



### Assembly line

An organization of workers and machines, using division of labour, to achieve maximum efficiency in production.

### Assessment

A valuation for the purpose of Taxation.

### Assets

The property of a business, they may be classified as:

- (a) Current Assets, consisting of cash, stock and book debts;
- (b) Fixed Assets, consisting of buildings, plant and machinery.
- (c) Intangible Assets, being the value of good-will or patents.

### At Par

Means equal. Stocks and shares the market price of which is the same as the nominal or face value. If new stock is issued at Par, then Rs. 100 of such stock can be bought for Rs. 100.

### Autarky

"An ideal of self-sufficiency, a country attempting to be as independent as possible of imports from other countries.

Automation

A system of automatic control extending over an entire series of manufacturing operation.

Balance Sheet forecasts (Figure 2 in Appendix)

A balance sheet for the end of each year should also be prepared. This will show the formation of assets and liabilities of the project from year to year.

This estimate should be carried on until a point of stability is reached.

Balance of Payments

Payments are made between countries for trade and financial dealings. The balance of payments shows the relationship between one country's total payments to all other countries and its total receipts from them. It is a statement of income and expenditure on international account.

Balance Sheet

An ordered statement of:

- (a) the economic resources of assets of a company or other business organization,
- (b) the financial claims of persons or Organizations upon the value of these assets.

All assets are, by definition, owned by someone; Consequently, the total claims equal the value of the assets.

### Banking

The business of holding deposits and lending money.

The Pakistan Banking system comprises the State Bank of Pakistan; the Commercial banks; and other savings and banking institutions.

### Bank Credit

Loan made by a bank to a customer. A bank is prepared to grant loans from its cash reserve on the assumption that only a small proportion of depositors will demand cash at any time. To maintain confidence a bank must always be prepared to pay cash on demand. It is customary for banks to maintain a definite ratio between their reserve and their deposits - known as the cash ratio. It is 30 percent for Pakistani banks.

### Bank Loan

A loan of a fixed amount for a specific purpose, carrying a definite date for repayments. Such a loan is usually made on approved security, the interest charge tending to be lower for larger concerns.

### Bank Note

Paper currency issued by the State Bank of Pakistan.

### Bank Rate

It is the minimum rate at which State Bank of Pakistan will make advances. The interest rate of the commercial banks on deposits is somewhat below bank rate. At present it is 9%. (11% on 9-6-77).

### Barter

The exchange of goods for goods.

### Bill of Lading

A document used in foreign trade giving name of the ship, port of embarkation and dis-embarkation, particulars of the consignment and other important details.

### Bond

A document by signing which an obligation is made to pay a specified sum in future. It carries details of interest rate and conditions of repayment on it. If secured by a specific asset, it may be called a mortgage bond.

### Boom

A period of high business activity. There is increased production, prices & wages rise and unemployment declines.

### Break Even Point

The estimates described to-date enable the operating costs of the project to be established and a reasonable analysis made of economic viability of the project. These estimates are based on a realistic assessment of the likely volume of production to be expected.

However, the conditions in the country may change; prices for the product may fall without a corresponding drop in costs; or the anticipated market may have been too high. In this situation, it is wise to make some assessment of the effect on the project of such conditions of adversity. A measure used for this assessment is the break even point. The break even point is that percentage of full production capacity at which the plant may recover annual fixed charges, overheads and operating costs without making any profit. The break even point will vary widely with different industries, but obviously the lower the figure the more attractive the project.

Figure 3 (in Appendix) illustrates how a break even chart shows the cost of production and revenue relationship at different outputs. Build up of production capacity in the first few years is estimated while preparing the profit estimates. Given the same selling price, it is possible to determine where the revenue curve intersects the curve showing cost of production for different outputs. This point is the break even point. The feasibility study should indicate the year in which the break even point is likely to be reached. The break even point will vary from industry to industry but it is obvious that a project that makes a profit at a lower percentage of capacity is more attractive than one with a high break even point, other factors being equal.

**Bullion**

A country's gold reserves.

**Capital**

It is the wealth which is used in the production of further wealth. Generally it is regarded as money invested in enterprises.

**Capitalism:** It is based on theories of Adam Smith. Its characteristics are :

- (i) free enterprise
- (ii) price directed
- (iii) competition
- (iv) profit motive.

**Capital expenditure**

The amount paid to acquire an asset.

**Capital Goods**

Producer goods. They assist in the production of consumer goods. Examples: Machine tools, looms.

**Capital Intensive Product**

A commodity the production of which calls for relatively more capital and relatively less labour than the general average.

### Cash Flow Statements (Figure 1 in Appendix)

Any authority sanctioning a project wishes to know that the capital to be loaned for the project can cover the expenses of construction and initial operation. A forecast of cash flows showing the requirements and sources of cash should be prepared and carried upto the point of the project reaching a stable position in cash requirements. A cash flow forecast will also be needed in calculation by the discounted cash flow method (profitability).

### Cash ratio

The ratio of bank reserves of cash to the volume of deposits.

**Communism:** It is based on theories of Karl Marx.

Its characteristics are :

- (i) Government ownership
- (ii) Central planning
- (iii) Collectivisation of agriculture.

### Commuters

People living at one place who travel regularly to and from work at another distant locality.

## Compounding

The process of compounding is determination of the growth of an investment on the basis of a periodic interest.

Example : Rs. 1000 invested today (1976) at 5 percent will grow to Rs. 1050 a year from now (1977).

## Compound Interest

Interest that is calculated upon the original sum invested or lent plus accumulated interest.

Example :

$$S = P(1+i)^n$$

Where S = Compound Amount  
P = Principal  
i = rate of interest  
n = Interest periods

What is the compound amount of Rs. 1000 invested for 8½ years at 7% compounded quarterly.

$$\text{Here } P = 1000, i = 0.07 \times \frac{1}{4} = 0.0175 \left(1\frac{3}{4}\%\right)$$

$$n = 8\frac{1}{2} \times 4 = 34 \text{ periods.}$$

$$S = P(1+i)^n = 1000 (1 + 0.0175)^{34}$$
$$= 1000 (1.803725) = 1803.72 \text{ Rupees}$$

$$\text{Compound interest is } = S - P = 1803.72 - 1000$$
$$= 803.72 \text{ rupees}$$

## Cost of Capital

The cost of obtaining the total capital for a project expressed as a rate of interest.



### Crash Cost

The cost associated with the shortest possible completion time for a project. The crash cost is higher than the normal cost due to the expense of using more manpower or more plant and equipment.

### Currency

Anything which is acceptable as a medium of exchange can be called currency.

### Customs duty

A tax levied on imports and exports.

### Debentures

A debenture is a document which acknowledges a debt at field rate of interest. Debentures are loan capital.

### Debt Capital

That part of capital represented by Debentures.

### Deficit

A deficiency in monetary terms - amount by which liabilities exceed assets or expenditure exceeds revenue.

### Deficit financing

It is deliberate spending by state of more than is received in revenue. It is done to alleviate a depression by increasing the purchasing power of the people and generate economic activity. The deficit in the national budget can be met by borrowing or by printing more money.

### Deflation

A policy aiming at reducing money in circulation in order to check inflation. There is downward trend in general level of prices. A deflation is most favourable to creditors.

### Demography

The study of statistics of population.

### Demonetisation

Withdrawal from circulation of a certain currency.

### Demurrage

It is extra charge a consignee has to pay for delay beyond certain grace days after unloading of goods. It is charged by the port authority, railways, trucking and air freight companies.

### Denationalisation

Returning a nationalised industry back to free enterprise.

### Depreciation

Fall in value of something. It is used mainly in connection with capital and currency.

### Depression

A period of heavy unemployment and stagnation

---

of business activity. A brief period, when business activity declines a little low full employment level is known as recession.

### Devaluation

Reducing the value of currency to correct a disequilibrium in the balance of payments. It stimulates exports (cheaper) and discourages imports (dearer).

### Direct cost

Prime cost

## Discount

An inducement offered by a creditor to debtors to pay promptly (cash discount). Trade discount is a deduction from the catalogue price of an article allowed by a wholesaler to a retailer.

## Discounting

The process of discounting is bringing back the investment to a prior date.

Example 1 : Rs. 1000 available for investment in 1977 have a present (1976) value of Rs. 952 at 5 percent discount rate.

Example 2 : At 15% rate of return the present value of cash inflows received one year from the present would be  $(\frac{1}{1+0.15})$  or 0.86957 times the rupees received. Cash inflows received two years from the present would be valued at  $(\frac{1}{(1.15)^2})$  or 0.75614 times the absolute rupees received, and so on.

## Discounted Cash Flows

A method of assessing and so comparing alternative capital projects. Comparison is made of the present worth of the flows of cash that can be expected from each capital project during the course of its existence.

### Disinflation

A mild form of deflation.

### Disinvestment

Sale of investment  
for some other purpose.

### Dividend

The portion of a company's profits which the Directors each year decide to distribute to ordinary share holders. This is usually expressed as a percentage of the nominal value of the shares.

### Drawing Rights

The amount of foreign exchange a member country is entitled to purchase in exchange for its own currency from the International Monetary Fund.

### Econometrics

A branch of Economics in which economic data is systematically analysed with the aid of a computer.

### Economic Appraisal

The study of the economic implications of a project - a first step in assessing its acceptability.

### Economic Domination

When a country aims at securing political control or influence over another country for the purpose of economic advantages, e.g. to obtain raw materials and markets for finished products.

### Economic Efficiency

The efficiency with which scarce resources are used and organised to achieve stipulated economic ends.

### Economic Indicators

Statistics which are sensitive to changes in the state of industry, trade and commerce. Indicators are classified into three types:

1. 'Leaders' offering advance pointers.
2. 'Coincidents' moving in tandem with business conditions.
3. 'Laggers' showing delayed results.

## Economic Life of Project

Over a period of time, the equipment and machinery in a plant will physically wear out. Long before this point (the technical life of the equipment) is reached, the cost of maintenance may become so high that it is more economical to replace the item with new equipment. This period is known as the economic life of the item. In the process or chemical type of industries, the economic life of the project will depend on the economic life of the major or significant pieces of equipment. An assessment of the economic life of the project is required for:

1. determining the period over which the capital assets of the project should be depreciated;
2. determining the period over which the return on investment or other profitability measures can be calculated.

## Economic system

The nature of economic life under a particular social system. The main difference in one system compared to another depends upon the extent to which the government participates in the economy and the attitude towards private enterprise.

## Economy

Productive and financial structure of a country.

### Embargo

Prohibition by a government of the import or export of certain classes of goods. Example : U.S. embargo (1965-76) on sales of weapons to India and Pakistan.

### Eminent Domain

The right of condemnation of land or other property for the public good, e.g. land and property affected by the lake formed by a dam.

### Engineering Economics

The application of economic principles to engineering problems, for example in comparing the comparative costs of two alternatives capital projects.

### Enterprise

Factor of production which brings together all the other factors and co-ordinates their activities into a production management. The function is performed by the entrepreneur.



### Entrepreneur

The person who manages an enterprise. He makes all the decisions concerning the initiation and conduct of a firm and bears the risks involved in the building up of a new business.

### Equilibrium

A situation in which economic forces have no tendency to change.

### Equities

Ordinary Shares.

### Ergonomics

The study of output of labour.

### Escalation

A phenomena of increased prices of goods and services caused by rising cost of living.

### Exchange Rate

The rate at which one currency can be exchanged for another.

### Exchequer

Treasury of a country.

### Exise Duty

Taxes on home produced goods.

### Export- Import Bank

An American institution established by the U.S. Government to encourage (by means of loans) trade between U.S. and other countries.

### Face Value

The nominal value printed on a bank note or a document.

### Fascism

It has no clear cut philosophy. Its characteristics

are :

- (i) Private ownership
- (ii) Profit motive
- (iii) State planning
- (iv) War economy.

### Favourable trade balance

When the value of exports exceeds that of imports, the balance of trade is 'favourable'.

### Feasibility Study

The study of a proposed project in its technical and economic aspects to ascertain the possibility of commercial exploitation.

### Financial Ratios

Ratios indicating the financial position of a business. Examples are :

Profit / Sales ( Profit margin )

Sales / Capital ( Capital turn over )

Total capital Employed / Liquid Assests (A measure of the degree of employment of liquid assests)

### Fiscal policy

This is the policy pursued by a government for raising the revenue necessary to meet its expenditure. It embraces the scope and degrees of taxation, national debt, government borrowing, etc.

### Fiscal Year

An American term for the financial year (1st July to 30th June of the following year).

### Fixed costs

Manufacturing costs which tend to be unaffected by variations in the volume of output.

### Floating Capital

Capital which circulates, leaving a business by way of expenditure on materials and wages, and returning by way of receipts from sales.

### Flotation

The raising of new capital by public subscription.

### Forecasting

The use of collected and analysed data derived from the present and the past to forecast future economic, business or sales developments.

### Foreign Exchange

This is concerned with the exchange of one foreign currency for another.

### Free Capital (Money Capital)

Capital in the form of money, since its owner can turn it into any form of real capital that suits his purpose.

### Free list

A list of commodities on which no customs duty is levied.

### Free Enterprise

This is an economic system in which individuals are free to own capital and undertake economic activity within the framework of legislation designed to protect their interest. In its extreme form, it is directly opposite of the state planned economy. Most capital systems take the 'middle way', that is, some state planning occurs even though most economic activity may still be left to free enterprise.

### Free Trade

A condition of international trade where nations do not impose customs duties or other taxes on imports from other countries.

### Fringe Benefit

A reward received by an employee in addition to the monetary wages paid for actual work done. These may include paid vacation, insurance and health facilities.

### Full employment

It is impossible to have full employment in a dynamic economy but it does mean a maximum of 3 percent of the working population unemployed. A level of employment exceeding 97 percent is known as a situation of over-full employment.

Fund

Money put aside for a purpose.

Funding

The conversion of short term debts into long term debts.

Geometric Mean

It is nth root of n items. For example; Geometric Mean of 4,6,72 would be  $\sqrt[3]{4 \times 6 \times 72} = 12$

Gross Domestic Product (GDP)

It is gross national product excluding spending on imports from abroad. Referring to example of GNP, the GDP is 123,228 million rupees.

### Gross national product (GNP)

It is the market value of the output of goods and services produced by the nation's economy before deduction of depreciation charges and other allowances for business and institutional consumption of durable goods.

GNP is the rupee value of nation's output, without deducting the capital cost of producing new things. It is for this reason that this measure is called gross national product.

The production of the nation is measured by adding up the level of total spending necessary to buy that output. There are four types of spending which make up the level of total spending in the economy and hence the level of GNP:

1. Personal consumption expenditures (C). This is spending for food, housing and house-hold operation.
2. Gross private domestic investment (I): Investment expenditures for new plant, equipment and establishment.
3. Government purchases of goods and services (G): The purchase of nation's output by federal, provincial and local governments.
4. Net exports of goods and services (E): Other countries also buy part of our production and we also buy some of theirs. The difference between exports and imports is the net exports of goods and services.

$$\text{Then GNP} = C + I + G + E$$

Example:

	<u>Million Rs.</u>
(C) Personal consumption expenditure	91,828
(I) Gross private domestic investment	19,400
(G) Government purchases of goods & services	<u>12,000</u>
(E) Net export of goods and services (12,400-25,250)	<u>-12,850</u>
Gross national product	<u>110,378</u>

### Gross

A total without deductions, Not NET.

Hire Purchase

A hire purchase agreement is a hiring of goods coupled with an option to purchase.

Hoarding

Accumulation of consumer goods with intentions of bringing the same for sale when prices rise.

Hyperinflation

Inflation which goes out of control. It is also known as runaway inflation.

Incentive

An inducement in the form of bonus or opportunity of promotion to encourage workers for increased production.

Indemnity

This is a security against loss or damage; or compensation for such when incurred.

Indirect taxes

These are taxes on goods or services.



### Inflation

A condition in which the volume of purchasing power is constantly running ahead of the output of goods and services, with the result that as the incomes and prices rise, the value of money falls. The variable income groups and debtors are major beneficiaries of inflation.

### Intangible Assests

Goodwill or patent rights.

### Interest

A payment by a borrower for the use of a sum of money for a period of time.

### International monetary fund

The International Monetary Fund is an institution designed to provide a stock of international credit facilities that could be drawn on by members in balance-of-payments deficit.

### Investment

Investment is capital expenditure on physical production assets e.g. plant, machinery, factory buildings, roads, bridges, ports, etc.

### Labour

Human effort that contributes towards production.

### Labour intensive product

A commodity the production of which calls for relatively more labour and relatively less capital than the general average.

### Laissez-Faire

The doctrine that state interference in industry and commerce should be kept to a minimum.

### Lease

A contract giving possession of a property for a specified period of time.

### Limited Liability

An advantage of incorporation limiting an investor's loss to the amount of original investment.

### Liquid Assests

Assests either in the form of money or which can be quickly converted into money.

### Lock out

A weapon of employers to resist labour union demands by shutting down plant operations.

## Macro Economics

The branch of economics which deals with large aggregates such as volume of employment, the total amount of saving and investment, the national income etc.

## Manpower

The amount of labour, both male and female, available in the country.

## Market Price

The short run equilibrium price determined in a market at a particular time by the forces of supply and demand ruling in the market at that time.

## Market Research

The study of consumer demand.

## Marshall plan

A scheme named after the U.S. Secretary of State, to provide generous economic assistance to West European countries devastated by WW.II.

## Mass Production

The manufacture of a standardised commodity on a large scale with a consequent reduction in its cost of production and consequently selling price.

### Mechanisation

The employment in production of a large amount of machinery in relation to labour. Automation is a further development out of mechanisation.

### Micro Economics

The branch of economics concerned with individual firms, their output and costs, the production and pricings of single commodities, wages of individuals etc.

### Monetary Policy

Measures taken by the government to control the business cycle by regulating the flow of money and credit in the economy.

### Monopoly

The control of the entire output of a commodity or service.

### Moratorium

The granting by one government to a debtor government of an extended period of time in which to repay a loan or to pay the interest on it.

### Multiplier

The effect on total employment or on total consumption of a certain amount of real capital investment. An investment in building industry may give direct employment to 1000 men, but provision of materials and carriage may give employment to a further 1000 men while the additional demand generated by the increased earnings may create additional employment for another 1000 men. Thus as a result of investment employing 1000 men an eventual total of 3000 men have found new employment, that is three times the original numbers. The Multiplier is 3 in this case.

### National Income

National income is defined as sum of payments to the factors of production for engaging in current economic activities. It is NNP less indirect business taxes (sale taxes & exise duty) and business transfer payments (donations, bad debts) plus government subsidies.

### Nationlisation

Taking over ownership and management of an industry under the control of the state.

### Natural Resources

These are the goods supplied free by Nature but which may require human labour and capital to be converted in form, time or place utility for human consumption.

## Net National Product

This is Gross National Product (GNP) less capital used by depreciation.

Example : GNP	<u>Million Rs.</u>
	= 110,378
Less Capital used up by depreciation	= - 6,710
N.N.P.	<u>= 103,668</u>

### Obsolete

Out of date - but still in good running order - require to be replaced by more efficient and upto-date equipment.

### Operating Costs

The varying costs of production that increase or decrease with the volume of output.

### Opportunity Cost

This implies measuring the cost of anything in terms of the most desirable alternative or gain, foregone. The opportunity cost of an investment to build a plant will be the interest return the investor could have obtained by loaning the money to a transport company at, say, 15 percent. Thus the profit rate from the production of plant must exceed 15 percent before a real profit is realized.

### Outage cost

The cost of non availability of plant due to breakdown, overhaul, or simply failure to complete the construction of a project by a scheduled date, arising from the use of less efficient methods or the absence of any alternative service.

### Output

Quantity of goods manufactured by a factory, or the quantity of material extracted from a mine, quarry, etc., during a given time.

### Out turn

Actual attainment, as opposed to an estimate.

### Over-Full Employment

A condition in which the demand for labour is too high, the number of vacancies greatly exceeding the number of people seeking work. The effect is to produce a "wage push" inflation.

### Overheads

Supplementary costs - costs not directly chargeable to any unit produced. They included rent of premises, salaries of staff and all other general expenses as opposed to costs of raw materials, wages, etc.

### Paid Up Capital

The actual amount of capital that shareholders have subscribed.

### Par exchange rate

The price of one country's currency in terms of another as decided by the International Monetary Fund

### Prime Costs

Prime costs in production include all variable costs and some of the fixed costs, e.g. costs of administration.

### Probability

The degree of certainty of the occurrence of a future event as given by the equation :

$$\text{Probability} = \frac{\text{Total no. of occurrences of event}}{\text{Total no. of trials}}$$

The answer will lie between 0 (absolute impossibility) and 1 (absolute certainty).

### Producers' Goods

Capital Goods, Machinery, capital equipment, factory buildings and workshops, raw materials, means of transport are all producers' goods.



### Productive Resources

These are labour, capital and natural resources.

These are also known as factors or means of production.

### Productivity

The amount of production in relation to the labour employed. Efforts are constantly being made to increase the productivity of labour by increasing its efficiency by education and training and by better organization.

### Profitability Analysis

A project may emerge as being of the most economic in size, suitably located and utilizing the most efficient modern production processes. However, it has to be compared with other investments that the government may make. It is common practice to quote a profitability index or a 'return' from the project.

There are many indices of profitability that may be used and most of them can be calculated in several different ways. Each method has advantages and disadvantages. The indices in most common use are :

#### I. Return on Investment Criteria

- a. Average return on original investment.
- b. Average return on average investment.
- c. Return at full production on original investment

#### II. Pay Back period.

#### III. Discounted cash flow indices.

- a. present worth
- b. interest rate of return.

I. Return on investment criteria suffers from certain defects and it is not recommended for project evaluation.

II. Payback period (See Case Study No.1)

This index measures the number of years required to recover the original investment out of gross profits and accruals to depreciation. The original investment, in this case, does not include the cost of the land and working capital as these amounts are assumed to be recoverable. Also the period of construction is not included in the payback period.

According to this index, the shorter the payback period, the more attractive is the project. The index is useful in identifying projects offering quick recovery of capital. It is simple to calculate and easy to understand.

However many economists discount the value of payback period as a meaningful criterion of profitability. They point out that two projects may have the same payback period but the earnings from one may cease shortly after the recovery of the capital, while the earnings from the other may continue for more many/years. In such a case, this index will give an erroneous picture of the project's total profitability, because it considers only those factors that affect the project under comparison upto the end of payback period. Factors that may affect the project after this period, particularly the economic life of the project, and final recovery of the capital are not considered.

The indices mentioned in I and II suffer from the disadvantage of not taking into full account, the value of money spent or earned at different periods in the life of a project. Discounted cash flow indices have come into a wider use in the recent years.

### III. Discounted Cash Flow indices:

These indices reduce the cash flow on the project, both incoming and outgoing, to one point in time. They can be calculated in two ways, depending on the rate used for discounting the cash flows.

See

#### (a) Present Value (or Present Worth). /Case Study No.2.

In this index, a comparison is made of the present value of investments against the present value of future returns. Present value (on present worths) may be expressed as a different or as a ratio:

P.V. = Present value of all future returns  
less the present value of all investments

$$P.V. = \frac{\text{Present value of all future returns}}{\text{Present value of all the investments}}$$

100 rupees invested to-day will grow to 115 rupees a year from now at 15% rate of interest. Alternatively, it can be said that Rs. 115 of one year from now, have a value of Rs. 100 to-day.

The calculation of present value requires a prior decision on the discount rate to be used in the calculations.

The ideal rate of discounting to be used in present value calculation is the minimum acceptable rate of return to be expected from a proposed project. If this rate is used and the present value ratio comes to unity, or greater, then the project is considered satisfactory and may be approved on a financial basis. If a present value difference is calculated then a value greater than zero is satisfactory.

Determination of a minimum acceptable rate of return for a project is, however, not a simple task. The planning commission has laid down 15% to 20% discount rate as opportunity cost of capital for public sector projects. The interest rate on basis to a project do not measure the true cost of capital in a country. The revenue raised by the Government as taxation, surpluses from operating projects etc., the cost of capital cannot be easily assessed.

(b) Internal rate of return (Case Study No.3)

The internal rate of return is based on the same concept as the present value index, in that the timing of cash flow is taken into account. Cash in hand is worth more than the cash to be realized in future and therefore cash to be received in future years must be discounted to what it is worth now. This trial and error method requires the determination of the rate of interest (or percent return on investment) which will make present

value  
/ of future returns equal to the present value of all  
investments.

This method provides the most accurate measure of return on investment as a percentage whereas the present value index is a numerical figure. It is also known as the Investor's method of measuring profitability. It is a more complex method than the present value method in that it requires trial and error calculation. Once the rate of return has been thus determined, the desirability of a project may be assessed by comparing its rate of return with the minimum acceptable rate of return (Presently 15 to 20%).

The usefulness of any index could only be realized if it is applied in a consistent and uniform manner. The agencies dealing with project appraisal must know how the profitability index has been calculated. The accuracy of the index depends on the authenticity and reliability of various estimates going into it. It is recommended that profitability index be considered as 'not absolute' but as only one of several factors on which an evaluation of the project can be made.

#### Public Enterprise

Economic activity undertaken by the state. Also includes industries nationalised and brought under state control.

### Public Expenditure

The amount spent by the state on defence, education, development, health and social services, interest on national debt and capital investment.

### Public issues

Block of securities sold by a company to Public at large.

### Public sector

That part of the economy in which the state acts as entrepreneur.

### Public utilities

Undertakings providing Services as local transport, water supply, gas and electricity.

### Quality Control

A procedure of inspection and testing carried out at periodic intervals to ensure the desired quality of the product.

### Quick Assets (Liquid Assets)

Assets which can easily be turned into cash.

Quota

A quota is a limit set as to the quantity or rupee value of specific goods permitted to enter the country in one year.

Raw material

A resource prior to production. Iron ore is raw material for making steel and steel is a raw material for many products.

Real capital

Machinery, factory buildings, etc.

Rebate

A reduction of the price of a commodity allowed for some reason - for example, the purchase of a large quantity.

Recession

A temporary falling off in business activity.  
A prolonged recession is called a depression.

Reclamation

The bringing of land into cultivation by Irrigation and drainage schemes.

### Redemption

The redemption of a debt is the repayment of the amount borrowed.

### Reflation

The easing of credit restrictions to encourage an expansion of production. It is a milder inflation.

### Reparations

An indemnity paid by a country defeated in war to the victors.

### Repatriation

The selling of foreign investments and investing the money at home.

### Repudiation

Refusal of a country to pay debts incurred of an ally during a war or the debts of the previous regime overthrown by revolution.

### Reserve Currency

Foreign currency held by a country as part of its reserves and as a fund from which it can make international payments. Both pound sterling and U.S. dollar serve as reserve currencies.



### Reserve Price

The price below which the seller is not prepared to sell.

### Residual value

Residual value of the plant is an estimate of the value of the plant at the end of its economic life. There are three possible values that can be taken for residual value.

1. If it is thought that the plant could be sold in its entirety, then an estimate of this value should be used.
2. If it is unlikely that the plant could be sold then the scrap value of the project should be estimated.
3. The third value is the undepreciated amount, usually in buildings, still remaining at the end of the economic life of the project. This value could be distorted and it is recommended that either; (1) or (2) above be used, depending on which is more suitable for the proposed project.

### Revaluation

The raising of the value of currency in terms of other currencies.

### Revival

The period when an economy is recovering from a depression.

## Risk

The amount of risk varies with different investments. An investigation must be made of the risk associated with any venture, so that authorities may decide whether vital resources should be placed in this project or in another, equally attractive but less risky project.

Factors contributing to risk are :

1. Possible changes in cost of raw materials.
2. The likelihood of the process proving obsolete.
3. A fall off in demand for the product.
4. Improvement in foreign exchange position might lessen the need for the project.
5. Whether a change in government's protectionist policy will cut too much into future projects.
6. Possible fluctuations in prices.
7. Skill and technical know-how being available for operation of the industry.
8. Inflationary techniques in the country.

It is recommended that all risk or uncertain items be isolated and described in the feasibility report. Where a change in basic assumptions such as price or cost of a raw material is a possibility, the study should also determine the profitability of the project under these changed conditions and present the alternative evaluations as part of the study.

## Sanctions, Economic

The economic boycott of a nation.

## Sector

A division of the economy of a country. Two main sectors, namely the public sector and the private sector. The public sector is further sub-divided into Government, Semi-government, local authorities and public corporations.

## Security

A security is a document entitling its holder to money, goods or property.

## Self Sufficiency

To produce most of the things a country wants itself. May be a good policy in war but not in peace.

## Simple interest

When only the principal earns interest for the entire life of the transaction, the interest due to the end of time is called simple interest.

$$I = Prt, \quad S = P+I$$

Where I = Simple Interest  
P = Principal  
r = rate  
t = years  
S = Amount

Example: Find simple interest on Rs.7500 at 4 percent for 1/2 year.

$$\begin{aligned} P &= 7500, r = 0.04, t = 1/2, I = Prt \\ 7500 (0.04) \frac{1}{2} &= 150 \\ S &= P+I = 7500 + 150 = 7650 \text{ rupees} \end{aligned}$$

### Sinking Fund

A fund established for the future redemption of a debt. It is built up by periodic instalments in order to accumulate a certain sum at a given date for some specific purpose. The interest arising out of the sinking fund investment is itself periodically re-invested and allowed to accumulate with the periodic contribution of principal.

### Slump

A period of high unemployment. Features of a slump are decreased production, increasing unemployment and falling prices and wages.

### Social Cost

The disadvantages suffered by the community from an enterprise. Examples: Pollution by industrial wastes and traffic congestion by expanding urban area.

Socialism: It is also based on theories of Karl Marx. Its characteristics are :

- (i) Basic industries owned by government
- (ii) Some private enterprise
- (iii) Some central planning
- (iv) Co-operatives.

### Social Security

A compulsory insurance that makes provision for old age, survivors of covered members, disability, unemployment, and the care of dependent children.

### Soft Currency

A currency with a relatively unstable or declining value in international exchange.

### Spot price

The price of a commodity for immediate delivery.

### Special drawing rights (SDRs)

Over the years, total world trade has increased tremendously but the world's supply of gold has increased much more slowly. Consequently, some form of world reserves other than gold has to be found to transact international payments. This new reserve facility called special drawing rights (SDRs) was approved by the IMF in September, 1967. Sometimes it is referred to as "paper Gold". SDRs will be issued according to stringent rules, and their amount increased every five years.

### Specific Taxes

Taxes levied on a commodity according to quantity purchased. Example : Tax on petrol is per gallon.

### State Bank of Pakistan

It is the Government's bank, carries out the monetary policy of the government, keeps the country's gold reserves, issues bank notes and is the bank of all the commercial banks in the country.

Sterling

The name given to British currency. Pound Sterling distinguishes the British pound from pound of some other currencies.

Sterling Area (or Block)

Those countries which link their currencies to Sterling.

Stock Exchange

A highly organized market for dealings in stocks and shares.

Streams of benefits and costs

Refer Table B - Case Study No.6 in Part II.

The streams of benefits appear in Col.6 and those of costs in Col.3.

Subsidy

A payment by the state to producers or distributors in order to reduce price.

Subsistence

The amount which is just sufficient to maintain a bare livelihood for a worker and his family.

Surcharge

An extra charge.

Surety

A security, in the sense of being a legal safeguard against loss.

Tariff

A tariff is a tax on goods coming into a country from a foreign country.

Tax

A compulsory contribution to be made to the government for the service of the public powers. Taxation can take many forms.

Tender

An offer made in response to an advertisement to undertake some work or supply certain goods at a stated price.

Toll

A charge for using a highway, bridge, tunnel or ferry.

Total cost

Sum of fixed and variable costs.

Transfer Payment

A payment for which no direct contribution to production has been made, e.g., social security or welfare payments.

### Under developed country

A non industrial country lacking technological skills and investment capital, with low output per capita, population suffering from illiteracy, poverty and disease.

### Underwriting

Insurance. A guarantee of payment in the event of accident or loss.

### Unemployment

The non use of a factor of production - labour. The labour is available for use in production but not actually being used due to a number of reasons.

### Usury

The charging of an excessive rate of interest on a loan.

### Variable costs

Costs which vary with output, e.g. the cost of labour and raw materials.

### Vertical Combination or Vertical integration

It is a combination of a number of firms engaged in various stages of the production of a product, e.g. a steel firm combining with an iron ore mine or a construction company combining with an aggregate (gravel) quarry.



Wages

Payment to labour for its assistance in production.

Welfare State

A society in which the government undertakes responsibility for minimum health and welfare of its citizens.

Working capital

The value of current assets less current liabilities.

World Bank

The name by which the International Bank for Reconstruction and Development is often known. It is an international financial institution to assist under-developed countries by providing low cost, long term loans for which private capital is not available.

World Industrial Production (1970)

	<u>Percent</u>
USA and Canada	: 34.3
USSR and Eastern Europe	: 31.7
Western Europe	: 24.2
Asia	: 6.1
Others	: 3.7
	<u>100</u>

North America (USA and Canada) lead in industrial production followed by Soviet Union and East European Communist countries. China produces much less.

1944-1945

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1946-1947

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**P A R T - II**

**C A S E   S T U D I E S**

1948-1949

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1950-1951

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1952

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CASE STUDY NO. 1  
(Pay back period)

The payback period is the most commonly used measure of project desirability. It is also known as 'pay off period', 'Payout', or simply 'pay back'. The underlying concept of this measure is the simple question: How many years will it take for the project to recover investment through the coverage cashinflows generated by its operation. Payback period method is reciprocal of internal rate of return method.

$$\text{Payback period} = \frac{\text{Net investment}}{\text{Average annual Cash inflow}}$$

$$\text{Where net investment} = \text{Total investment less salvage value.}$$

$$\text{(Say)} = \frac{\text{Rs } 42,000,000 - 2,000,000}{\text{Rs } 2,500,000} = 16 \text{ years}$$

The following factors determine investment desirability:

- (a) Size of cash flow
- (b) Length of time during which cash flow is generated (Economic life of project)
- (c) Pattern of cash flows - they occur evenly or unevenly.

The economic worth of a project is the balanced result of all these factors while the payback device averages the cash inflows regardless of the economic life, and compares this average annual cash flow to the net investment.

Let us study three projects having similar risks.

	(Million Rs)		
	Project A	Project B	Project C
Net investment	10	10	10
Average annual operating cash flow	2.5	2.5	3.3
Project Life	5 years	8 years	3 years
Total operating cash flow during life	12.5	20	10
Pay back	4 years	4 years	3 years

Project B is clearly superior to A and C, as it provides a total cash flow of 20 million rupees during its lifetime. The pay back period measure however qualifies project C in the first place. It does not differentiate between project A and B, even though project B is clearly better in terms of overall desirability. From this illustration it can be seen that the payback measure must be used with great caution. It will give a satisfactory ranking to a project only where the economic lives of the projects are equal or close, and where the pattern of operating cash flows is similar or uniform.

Example:

A cast iron pipe manufacturing plant is estimated to cost Rs 10 million. The economic life of the project is 10 years at the end of which the salvage value is expected at Rs 2 millions. The average annual cash inflow for the life of plant is as below:

	<u>Million Rs.</u>
Year 1 - 3	3
Year 4 - 6	2
Year 7 -10	1

Calculate pay back period for this investment at 20% rate of Interest.

( Million Rs. )

Period years	Fiscal year	Investment	Cash Inflow (Re-turn)	Present value factors (20%)	Investment	Present Value Re-turn	Capital Recovery at end of year
0	1976-77	10	-	1.000	10		
1	1977-78		3 )	2.293		6.879	6.879
2	1978-79		3 )	(Table 6-4)			
3	1979-80		3 )				
4	1980-81		2	0.525		1.050	7.929
5	1981-82		2	0.438		0.876	8.805
6	1982-83		2	0.365		0.730	9.535
7	1983-84		1	0.304		0.304	9.839
8	1984-85		1	0.253		0.253	10.092
9	1985-86		1	0.211		0.211	10.303
10	1986-87		1+2 (Salvage)	0.176 (Table 6-3)	0.162 (Table 6-1)	0.176 + 0.324 (Salvage)	10.479

Payback period = 8 years

CASE STUDY NO. 2

(Present value Index)

The method of calculation to determine the present value of an investment with an assumed pattern of cash flows is shown in the table below. Tables 6-3 and 6-4 (in appendix) with monthly discounting are employed under the assumption that the investment represents an outlay for plant to make a new product, whose sales are continuous during the period under consideration. All figures have been simplified to make the calculations easy to understand.

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( Million Rs. )

Period years	Fiscal year	Cash out-flow (investment)	Cash inflow (return)	Present value Factors (15%)	OF investment Inflows	
0 (Present)	1976-77	10	-	1.000	10	
1	1977-78		3.0 )			
2	1978-79		3.0 )	2.436 (Table 6-4)	7.308	
3	1979-80		3.0 )			
4	1980-81		2.5	0.610 (Table 6-3)	1.525	
5	1981-82		2.0	0.531 (Table 6-3)	1.062	
6	1982-83		1.0+2.0 (salvage value)	0.461 & 0.432 (Table 6-3)	0.461+0.864	
TOTAL					10	11.220

Net present value Index =  $\frac{10.356}{10-0.864} = 1.13$  ) Net present value = + 11.220 - 10.000 + 1.220 Million Rs.

Several points should be noted in these calculations.

1. Since the initial three years of cash inflow are equal (Rs 3.0 million each), Table 6-4 has been used to find the stream of inflow of Rs 3 million for three years at 15 percent, thus saving two multiplications.
2. Factors for cash inflows for 4th, 5th and 6th year were taken from Table 6-3 individually.
3. Salvage value has been assumed at Rs 2 million. Since this presumably will be more or less a lump sum at the end of 6th year, Table 6-1 was used to determine the present value of salvage.

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4. The present value index was derived by relating the present values of the operating cash flows and the investment.

Had there been an initial investment of only Rs 10 million and six equal annual operating cash flows of Rs 3 million per year, the calculations would have been much quicker, in as much as Table 6-4 would have shown a factor of 4.038 for a 6 year inflow at 15 percent to be multiplied by Rs 3 million cash inflow, yielding a present value of the inflows of 12.114 million rupees. The net present value would have been 2.978 million rupees.



CASE STUDY NO. 3 A

(Internal Rate of Return)

A zero net present value indicates that the investment is exactly yielding the rate of return used to discount both inflows and outflows to obtain the present value. Internal rate of return method focuses on the rate of return which yields a zero net present value. For investments with uneven cash flows the yield must be found by trial and error that is, starting with an assumed rate a net present value must be determined. If the result is positive, a higher rate must be tried; if result is negative, a lower rate is indicated. The example in case study No. 2 is used again to explain this method.

As is clear from this example, the net present value is approaching zero as the internal rate is increased from 15 to 20 percent, and the investment's individual rate of return is slightly higher than 20 percent.

( Million Rs. )

Period years	Fiscal year	Cash outflow (Investment)	Cash Inflow Return	Present value factors		Present Value			
				15%		20%			
				15%	20%	Inv- est ment flow	Inv- est- ment flow		
0	1976-77	10	-	1.000	1.000	10	10	-	
1	1977-78		3.0 )						
2	1978-79		3.0 )	2.436	2.293	7.038		6.879	
3	1979-80		3.0 )						
4	1980-81		2.5	0.610	0.525	1.525		1.313	
5	1981-82		2.0	0.531	0.438	1.062		0.876	
6	1982-83		10+2.0 (Salvage value)	0.461 0.432	0.365 0.335	0.461+ 0.864		0.365 0.670	
						10.356+		9.433+	
						0.864		0.670	
						Total 10	11.220	10	10.103
						Net present value +1.220		+0.103	

CASE STUDY NO. B-B

(Internal rate of return)

Investments that show uniform operating cash flows during their economic lives can be handled more simply by dividing the annual operating cash flow into the net investment to obtain the present value factor for a stream of payments on the line. This factor can then be located in Tables 6-2 and 6-4 (Appendix) with proper economic life for the investment and the yield can be read off or interpolated. The method is not hard to understand once it is remembered that the yield rate of an investment when applied as a discount rate results in equal present values of outflows and inflows - a net present value of Zero. We therefore know the present value of the inflows since it is equal to the net investment, we also know the economic life of the investment, the only unknown is the rate of interest which will discount the annual operating cash flows to equal the present value of the investment. Since the tables are built up on discount factors, we can read off the rate of interest once we know the factor and the life. Unfortunately this quick method works only if there are equal annual cash inflows, if there is only an initial net investment, and if there are no residual values and recoveries at the end of the economic life.

Illustration:

Investment = Rs 10,000,000  
Economic Life = 8 years  
Annual operating cash inflow Rs 2,00,000

Assume benefits to accrue continuously, which would dictate use of Table 6-4 with monthly figures. The factor would be  $\frac{\text{Net Investment}}{\text{Annual operating cash Inflow}} = \frac{10,00,000}{2,00,000} = 5$

In Table 6-4 we look on the eight yearline until we find the factor closest to 5.00 which is 4.929. This factor

(4.929) corresponds to a 14 percent rate of return and therefore the investment's true yield will be slightly less than 14 percent. Interpolation could be used to determine a more exact figure, but it is rarely advisable to make readings so exact since the nature of the estimates underlying the investments is usually so uncertain that precise figures are not necessary.

CASE STUDY NO. 4

(Annuity)

This method is to annualize the respective cash flow patterns of the alternative under consideration. For example, if old equipment with remaining productive life span of three years is to be replaced by better equipment with an economic life of seven years - the best way would be to determine the annual cash cost of these two alternatives. The choice then becomes one of selecting the alternative which has the greatest annual advantage. The process of annualizing the net present value of the cash inflow or outflow of an investment is very simple. It merely involves converting this present value into an annuity over the economic life of the equipment at the suitable opportunity rate. In other words, we convert a lump sum at the present into an equivalent stream of annual cash flows over a specified period which is reverse of finding the present value of an annual cash flow. The only conceptual difference is that we arrive at the present value to be annualized by first analysing the variety of cash inflows and outflows connected with the investment once time and bringing them back to the present into one net figure. This net figure is transformed into an equivalent value, which will be not be like the original annual values that made up the net figure, but will be a uniform equivalent annuity over the economic life of the proposal. By treating each alternative in this fashion, we arrive at directly comparable annual values for each of them, and we can make out choice directly. Both economic life and all cash flows have been incorporated into this number.

Illustration:

Let us take the example of case study 3 A

Net present value = 1.220 million rupees  
Economic life = 6 years  
Opportunity rate = 15 percent

We have to find the six year annuity at 15 percent which will yield a present value of rupees 1.220 million.

In Table 6-4 we locate the present value factor 4.038 which when substituted into our formula will give us the value of the annuity:

$$\begin{aligned} \text{Present value} &= \text{Factor} \times \text{annuity} \\ \text{Annuity} &= \frac{1.220}{4.038} = 0.302 \text{ million rupees} \end{aligned}$$

In other words, we can say that annualized net benefit of the project is Rs. 3,02,000. This figure could be compared directly with similar results for projects with entirely different lives and cash flow patterns. The device affords a comparison to be made between different proposals on a common denominator helps in the task of capital budgeting.

Annuity method is especially useful in the analysis of equipment replacement, where the question to be decided often is: "shall we wait another year before replacing the item?" The comparison can be made of the annual cost of owning new equipment and cost of keeping the old equipment for another year. The lower of two costs determine the choice.

CASE STUDY NO. 5

(Equipment Selection - Annuity analysis)

A machine tool corporation invested Rs. 8000.00. One year ago in a new machine to manufacture bolts. The management discovers that a much improved new model has arrived in the market with reduced operational and labour costs. The other data being:

	<u>Old machine</u>	<u>New machine</u>
Capital cost	Rs. 8000	Rs. 12,000
Economic life	8 years	7 years
Salvage value at full life	0	Rs. 1000
Present Salvage value	Rs. 5000	-
Annual production	100,000 bolts	100,000 bolts
Market price of bolt	Rs. 0.60	Rs. 0.60
Unit Production Cost:		
Labour	Rs. 0.14	Rs. 0.12
Materials	Rs. 0.10	Rs. 0.09
Overheads	Rs. 0.14	Rs. 0.13
Total	Rs. 0.38	Rs. 0.34
Annual value of production	60,000	60,000
Cost of production	38,000	34,000
Gain on production	22,000	26,000
Taxes @ 50%	11,000	13,000
Net profit per year	11,000	13,000
Opportunity cost of capital =	15%	

Calculate relative benefit of keeping the old machine or its replacement with the new model machine.

The annuity analysis (Table A) gives the benefit of old machine as Rs 12,170 and that of new model machine as Rs 11,528. It is not economical to replace the old model machine. Old model should continue the production.





CASE STUDY NO. 6

(Highway Project - Benefit cost Ratio and  
Internal Rate of Return)

A new highway is proposed between two major cities. The present traffic volumes justify construction of two 12-foot lanes and two additional lanes will be required in year 12. Other relevant data is as below:

Length of highway	=	78.03 miles
Economic life	=	20 years
Construction period	=	3 years
Capital cost of project		<u>Million Rupees</u>
First year of construction		92.35
Second " " "		68.57
Third " " "		66.25
Total		<u>227.17</u>
Capital cost of construction of two additional lanes during year-11		185.66
Annual Maintenance and Repairs (AMR)		
Year 1 to 11		year 12-20
Rs 1.53 million		Rs. 2.79 million
Resurfacing shoulders in year 6:		Rs. 3,53,440
Resurfacing & Repairing shoulders in year 12:		Rs.10,115,270

Calculate benefit cost ratio for this project and find out the Internal rate of return on investment.

Total cost of Highway (Length 78.03 miles)

<u>Item</u>	<u>Cost (Million Rs)</u>
Construction	165.79
Engineering	8.29
Supervision	9.95
Sub total :	<u>184.03</u>
Contingencies	16.58
Sub-Total	<u>200.61</u>

	Cost (M.Rs)
Land Acquisition	26.56
Sub total	227.17
Government Taxes	9.12

Sub total 236.29

Present Value of Additional two lanes to be constructed during year 11. 108.09

Sub total 344.38

Present worth of maintenance (20 years) 31.83

Total cost of Highway 376.21

* Cost of construction	(Initial 2 Lanes)
Roadway Items	Rs 116,497,620 (Table C-1)
Structural Items	Rs 44,444,330 (Table C-2)
Contingencies	Rs 2,898,050
Total	<u>Rs 165,790,000</u>

Cost of construction (2-Additional Lanes to be constructed during year 11)

	Cost (Million Rs)
Roadway Items	106.20
Structural Items	44.44
Contingencies	2.80

Const. cost without taxes 153.44

Government Taxes 8.44

Const. cost with Govt. Taxes. 161.88

Present worth of cost of construction of additional two lanes in year 11:

Cost of const. (without taxes)	153.44
Contingency	15.34
Engineering	16.88
Total	185.66
Present worth @ 5% (185.66 x 0.585)	108.09

MAINTENANCE COSTS

(Rupees)

Item	Length (Miles)	Cost (Per mile)	Cost (Per year)	Period (years)	Total cost
<u>Initial Construction</u>					
Annual Roadway main- tenance including Shoulders.	78.03	150.30	1,172,790.90	20	23,455,820
Surfacing Roadway	78.03	80,260.00	once in twenty years		6,262,290
Resurfacing shoulders	78.03	43,200.00	twice in 20 years		6,741,800
Annual Maintenance of cart Track	70.00	2,200.00	154,00	20	3,080,000
Small structures			9,390	20	187,800
Low level Structures (cart track)			30,000	20	600,000
Large structures			16,210	20	324,200
			<b>Total (A)</b>		<b>40,652,310</b>
<u>Addition of 2 Lanes - year 12</u>					
Annual Roadway main- tenance (including shoulders)	78.03	15,030,000	1,172,790.90	8	9,382,330
Small structures			9,390.00	8	75,120
Large structures			16,210.00	8	129,680
			<b>Total (B)</b>		<b>9,587,130</b>
			<b>Combined total (A) + (B)</b>		<b>50,239,440</b>
			<b>5% Administrative Overhead</b>		<b>2,511,970</b>
			<b>Total cost - 20 years</b>		<b>52,715,410</b>

Annual Maintenance Costs

(Rupees)

Annual Maintenance	Years 1 to 12 (per year)	Years 12 to 20 (per year)
Roadway	1,393,130	2,624,560
Structures	58,380	85,260
Contingencies	75,000	75,000
<b>Total per year</b>	<b>1,526,510</b>	<b>2,784,820</b>
Say	(1.53 Mill. Rs)	(2.79 Mill. Rs)
		Rs
Total cost of 20 years maintenance		52,781,410
Present worth at 5%		23,554,280
Present worth of Resurfacing shoulders in year 6 (Rs 3,539,440 @ 5% factor 0.746)		2,641,200
Present worth of Repaving and Resurfacing shoulders in year 12 (Rs 10,115,270 @ 5% - factor 0.557)		5,632,560
<b>Present worth of Total Maintenance cost</b>		<b>31,828,040</b>

ADJUSTED INDICES OF PROJECTED TRAFFIC

Y e a r	P.W	Normal	Traffic	Generated Traffic		Total Traffic	
	Factor (5%)	Index of Expansion	Expansion PWF	Index of Expansion	Expansion PWF	Index of Expansion	Expansion PWF
0	1.000	1.000	1.000	0.060	0.060	1.060	1.060
1	0.952	1.150	1.095	0.129	0.123	1.279	1.218
2	0.907	1.320	1.197	0.154	0.140	1.474	1.337
3	0.864	1.520	1.313	0.245	0.212	1.765	1.525
4	0.823	1.750	1.440	0.350	0.288	2.100	1.728
5	0.748	2.010	1.575	0.465	0.364	2.475	1.939
6	0.746	2.210	1.649	0.512	0.382	2.722	2.031
7	0.711	2.430	1.727	0.563	0.401	2.993	2.128
8	0.677	2.670	1.807	0.618	0.418	3.288	2.225
9	0.645	2.930	1.889	0.681	0.439	3.611	2.328
10	0.614	3.240	1.989	0.748	0.460	3.988	2.449
11	0.585	3.560	2.082	0.823	0.481	4.383	2.563
12	0.557	3.920	2.183	0.906	0.504	4.826	2.687
13	0.530	4.300	2.280	0.995	0.526	5.295	2.806
14	0.505	4.740	2.394	1.096	0.553	5.836	2.947
15	0.481	5.220	2.511	1.206	0.580	6.426	3.091
16	0.458	5.560	2.547	1.288	0.590	6.848	3.136
17	0.436	5.950	2.596	1.375	0.600	7.325	3.196
18	0.416	6.350	2.639	1.466	0.609	7.816	3.248
19	0.396	6.780	2.684	1.567	0.621	8.347	3.305
20	0.377	7.240	2.730	1.672	0.630	8.912	3.360
			<u>Totals : 41.326</u>		<u>8.981</u>		<u>50.307</u>

SALVAGE VALUE

Item	Original cost	Salvage Ratio	Salvage value
<u>20-year Old Portion</u>			
Right of way	26,560,000	67%	17,795,200
Structures	46,444,330	60%	27,866,600
Pavement	62,007,890	0%	-
Embankment	17,468,720	67%	11,704,000
Shoulders	17,752,790	0%	-
<u>8-year Old Portion</u>			
Structures	44,444,330	84%	37,333,240
Pavement	62,007,890	60%	37,204,730
Shoulders	17,752,790	60%	10,651,670
Embankment	16,924,450	87%	14,724,270
Pipes & Misc.	7,863,510	60%	4,718,100
Total :			<u>161,997,810</u>
say :			162 Million Rs.
Present worth at 5% =			162 (0.377)
			= 61.17 Million Rs.

## Value of Benefits

To justify an investment in a highway project, it is necessary to obtain monetary value of the benefits to be derived or obtained from road improvement. There are direct and indirect benefits. Normal benefits will accrue from the normal traffic. In addition there will be generated benefits contributed by the traffic generated as a result of construction of this highway.

### Direct Benefits

1. Reduced vehicle running time and operating expenses.

(i) Trucks: The operating cost of trucks average about 70% of gross operating income. It is estimated at mileage per gallon will improve to 16 to 17 miles from the existing 11 miles to a gallon. Increased running speed will result in reduction of operating wage costs by 40% and vehicle time spent in operation by 60%. Net costs will be reduced by 24%. The operating cost per truck mile is expected to decrease from the present Rs. 0.92 to Rs. 1.17 range to Rs. 0.62 to 0.81.

In addition to operating savings, an increase in vehicle utilization results. It will also be possible to use larger trucks. The new highway is 10% shorter than the existing. All these effects should give an additional saving of 10% and reduce operating costs to Rs. 0.56 to 0.73 per mile.

The savings to the truck users of the new highway will be Rs. 0.39 per truck mile. The savings to the generated or diverted traffic will be Rs. 0.195 per truck mile.

(ii) Similarly for buses, the following savings will result :

	<u>Savings</u>
(a) Operating Costs	Rs. 0.393
(b) Passenger time	Rs. 1.083
(c) Saving in distance and use of larger capacity buses	Rs. 0.073
<b>Total savings</b>	<b>Rs. 1.549 per vehicle mile</b>
Say	Rs. 1.55

Savings for diverted/  
generated traffic will be  
50% of those for normal  
traffic : Rs. 0.775

(iii) Passenger cars/pickups

The principal benefits of improved roads for

passenger car/pickup users are savings in time and operating costs and greater personal comfort afforded. The value of comfort is difficult to quantify and has been ignored.

Savings in time cost	=	Rs. 0.133
Savings due to higher running speeds and reduced distance	=	Rs. 0.221
Total	=	<u>Rs. 0.354</u>

(iv) Motor Rickshaws, motor cycles and scooters will save Rs. 0.127 per vehicle mile.

These savings for different type of traffic are listed in the table below :

Primary Road User Benefits per Vehicle Mile

( R u p e e s )

<u>Type of Traffic</u>	<u>to current users</u>	<u>to diverted or generated traffic</u>
Bus	1.550	0.775
Truck	0.390	0.195
Passenger car/ pickup	0.354	0.177
Motor cycle	0.127	0.063

If no new highway is constructed, by year 20 the congestion on the existing road will cause an increase of 30% to 50% in operating expenses for buses and trucks. Operating costs for passenger car will rise by estimated Rs. 0.167 per vehicle mile. Thus in year 20, the following increased savings for vehicle-mile would result from the construction of new highway :

	<u>Current Users</u>	<u>Generated Traffic (Rupees)</u>
Bus	0.525	0.262
Truck	0.416	0.208
Pass.Car/Pickup	0.166	0.083
Motor cycle	0.083	0.041



If road users costs increase at a uniform rate from year '1' to year '20', the average increased saving per vehicle mile in year '1' can be obtained as follows :

$$\text{Year 'one' saving} = \frac{1}{2} (\text{year '20' saving}) \times \text{Present value factor for 20 years}$$

Using 5% compound interest rate, the values per vehicle mile are :

$$\text{Bus} = \frac{0.525}{2} \times 0.377 = 0.099$$

$$\text{Truck} = \frac{0.416}{2} \times 0.377 = 0.078$$

$$\text{Passenger car} = \frac{0.166}{2} \times 0.377 = 0.031$$

$$\text{Motor cycle} = \frac{0.083}{2} \times 0.377 = 0.015$$

For generated traffic the values would be 50% of those above. Thus, the total savings for the various classes of users over the first 20 years on the proposed highway would be as follows :

Total Road users Benefits per vehicle- Mile  
(Rupees)

	<u>To current users</u>	<u>To generated traffic</u>
Bus	1.550+0.099 = 1.649	0.775+0.05 = 0.825
Truck	0.390+0.078 = 0.468	0.195+0.039 = 0.234
Pass. car/pickup	0.354+0.031 = 0.385	0.177+0.015 = 0.192
Motor cycle	0.127+0.015 = 0.142	0.063+0.007 = 0.070

To the above should be added the savings per mile resulting from a lower accident rate to obtain the overall savings for the road users. Savings due to accident reduction have been estimated at Rs. 1498 per mile of Road.

Evaluation of Benefits:

Using information from the traffic surveys the following estimates are obtained for first year benefits per mile for the four classes of traffic on the road:

Benefits for Normal Traffic in year " one "

Type of Traffic	Unit count per day	Benefit per vehicle mile	Total value per mile per day
Bus	420	1.649	692.580
Truck	356	0.468	166.608
Passenger car/pickup	180	0.385	69.300
Motor cycle	50	0.142	7.100
Total per day :			<u>935.588</u>

Total first year benefit :  
 $365 \times 935.588 = \text{Rs. } 341,489.60$

Benefits for Generated Traffic in year " one "

Type of Traffic	Unit count per day	Benefit per vehicle mile	Total value per mile per day
Bus	25	0.825	20.625
Truck	21	0.234	4.914
Passenger car/pickup	11	0.192	2.112
Motor cycle	3	0.070	0.210
Total per day :			<u>27.861</u>

Total first year benefit :  
 $365 \times 27.861 = \text{Rs. } 10,162.90$

The first year benefits are :

For normal traffic = Rs. 341,489.60

For Generated traffic= Rs. 10,162.90

The yearly benefits of the proposed road through the 20 year period following its completion can be obtained by multiplying the first year values by the projected growth of traffic.

The above values are used to compare the present worth of the total benefits over the 20 year period.

Each vehicle mile of normal traffic in the first year is equivalent to present traffic in the first year is equivalent to present worth of 41.326\* vehicle miles over 20 years.

In case of generated traffic the present value of one first year vehicle mile is  $(8.981^*/0.06)$  or 149.7 over 20 years.

The present worth of benefits per mile over twenty years to road users in two classes of traffic are then :

Rs. 341,489.60 x 41.326 = Rs. 14,112,399.00

Rs. 10,162.90 x 149.70 = Rs. 1,521,386.10

To this amount must be added the benefit from accident reduction over 20 years which is Rs. 1498 (first year benefit) times 50.307 or Rs. 75,359.88, per mile. The total present worth (per mile) of benefits over 20 years of the new highway is sum of these three amounts.

Rs. 14,112,399.00
+ 1,521,386.10
+ 75,359.88
<hr/>
Rs. 15,709,144.98

\* See Table of Adjusted Indices of Projected Traffic.

This value of present worth of benefits of the highway over 20 years is, however, based on traffic projection according to which a total traffic volume above 9 (8.981) times as great as first year traffic is predicted. This is well within the designed capacity (4 lanes) of the highway.

The following direct benefits have been quantified and used in the benefit cost ratio analysis :

1. Savings in vehicle running time and operating expenses.
2. Savings due to reduced accident rate. Accidents costed at Rs. 1498.00 per mile of highway.

The following direct benefits (or incentives) have not been quantified :

3. Increased revenue to transport.
4. Lower transportation charges.

Indirect Benefits (Not included in analysis)

1. Increase in Government tax revenues. Government tax revenue has not been included in the foregoing analysis of benefits. Assuming that traffic on the proposed roads increases exactly as projected, each trip during year '1' will represent 50.370 trips at present value during the 20 year period of analysis. Revenue accruing to Government can be calculated as below :

Present worth of revenue per vehicle mile = Revenue per vehicle mile x Vehicle miles in year '1' x Factor 50.370 (see Table of traffic projections)

Revenue per vehicle mile at present is :

		<u>Rupees</u>
(i) Motor fuel taxes	=	0.20
(ii) Motor vehicle taxes	=	0.05
(iii) Duties Sales Taxes	=	0.15
Total	=	<u>0.40</u>

P.W. of revenue per vehicle mile = 0.40 x 365,000 x 50.307  
 = 7.350 Million Rs.

2. Raise in land and property value.
3. Increased employment opportunities.
4. More exports due to better transportation facilities and consequent increase in country's foreign exchange earnings.

Result of Analysis:

1. The project Benefit cost ratio is high ( 4.08/1 )
2. The internal rate of return works out to be between 15 to 20 percent which is a good return on investment.
3. The project is economically sound and is recommended for implementation.

BENEFIT COST RATIO

	Million Rs.
Land acquisition :	26.56
Construction :	165.79
Contingencies :	16.58
Engineering :	8.29
Supervision :	9.95
	227.17
Present worth of year 12 2 additional lanes :	103.41
Present worth of maintenance :	31.83
	362.41
Less Present worth of salvage:	61.17
	301.24

Length of Road = 78.03 miles

cost per mile =  $301.24 \div 78.03 = 3.86$  Million Rs.

Benefits per mile = 15.709 Million Rs.

Benefit cost ratio  
( Excluding taxes) =  $15.709/3.86: 1=4.08:1$

TABLE B - 1  
Rate of Return (Taxes not included)  
Case Study No. 6 - Highway Project

No. of years	Year	Investment		Benefits		Present Value Factors 20% (7)	Present value when discounted at 20% Investment (8)	Total Benefits (9)
		(1)	(2)	(3)	(4)			
-3	1976-77			92.35		1.000	92.350	
-2	77-78			68.57		0.833	57.110	
-1	78-79			66.25		0.694	45.970	
1	79-80			1.53		0.579	0.880	15.667
2	80-81			1.53		0.482	0.740	15.019
3	81-82			1.53		0.402	0.615	14.299
4	82-83			1.53		0.335	0.512	13.822
5	83-84			1.53		0.279	0.430	13.269
6	84-85			1.53		0.233	0.356	12.740
7	85-86			1.53		0.194	0.296	11.665
8	86-87			1.53		0.162	0.247	10.711
9	87-88			1.53		0.135	0.183	9.806
10	88-89			1.53		0.112	0.171	8.936
11	89-90			195.84		0.093	18.213	
12	90-91			2.79		0.078	0.217	7.555
13	91-92			2.79		0.065	0.181	6.932
14	92-93			2.79		0.054	0.150	6.318
15	93-94			2.79		0.045	0.125	5.803
16	94-95			2.79		0.038	0.106	5.397
17	95-96			2.79		0.031	0.086	4.689
18	96-97			2.79		0.026	0.072	4.209
19	97-98			2.79		0.022	1.061	3.801
20	1998-99			2.79		0.018	0.050	3.320
Total:							209.121	182.055

Plus present value of Salvage (162.90.018) = 2.916

184.971

Net Present Value = 184.971 less 209.121

= -24.15 Million Rupees (-ve Present Value)

Result : The rate of return is less than 20%. Discount at 15% (Table B-2)

Benefit/Cost Ratio =  $184.971/209.121 = 0.88$



TABLE B - 2  
 Rate of Return (Taxes not included)  
 Case Study No. 6 - Highway Project

No. of years	Year	Investment		Benefits		Present Value Factors 15% (7)	Present value when discounted at 15%		Million Rs	
		(1)	(2)	Normal (4)	Generated Total (6)		Investment (8)	Total Benefits (9)		
-3	1976-77	92.35				1.000		92.350		
-2	77-78	68.57				0.879		60.273		
-1	78-79	66.25				0.756		50.085		
1	79-80	1.53		27.00	27.06	0.658		1.007	17.805	
2	80-81	1.53		31.04	31.16	0.572		0.760	17.823	
3	81-82	1.53		35.63	35.77	0.497		0.661	17.706	
4	82-83	1.53		41.03	41.26	0.432		0.575	17.824	
5	83-84	1.53		47.24	47.56	0.376		0.500	17.882	
6	84-85	1.53		54.26	54.68	0.327		0.434	17.880	
7	85-86	1.53		59.66	60.47	0.284		0.378	17.076	
8	86-87	1.53		65.60	66.12	0.247		0.329	16.332	
9	87-88	1.53		72.07	72.64	0.215		0.286	15.617	
10	88-89	1.53		79.09	79.79	0.187		31.922	14.920	
11	89-90	195.44		87.46	88.15	0.163		0.393	14.368	
12	90-91	2.79		96.10	98.86	0.141		0.343	13.657	
13	91-92	2.79		105.82	106.66	0.123		0.298	13.191	
14	92-93	2.79		116.08	117.00	0.107		0.259	12.519	
15	93-94	2.79		127.96	128.97	0.093		0.226	11.994	
16	94-95	2.79		140.92	142.04	0.081		0.195	11.505	
17	95-96	2.79		150.10	151.29	0.070		0.170	10.590	
18	96-97	2.79		160.62	161.99	0.061		0.148	9.875	
19	97-98	2.79		171.42	172.78	0.053		0.128	9.157	
20	1988-99	2.79		183.03	184.47	0.046			8.485	
Total :								242.595	276.206	

Plus present value  
 of salvage (162x0.046) = 7.452  
 283.658

Net Present Value = 283.658 less 242.595 = +41.063 Million Rupees

Result : The rate of return on investment is more than 15%

Benefit/Cost Ratio =  $283.658/242.595 = 1.17$

TABLE C - 1

Construction Cost Estimates  
(2 Lane Highway Project)

Roadway Items		Rupees		
No.	Item	Unit	Quantity	Total
				Unit Price
1.	Clearing, Grubbing and demolition of Buildings	Lump Sum	-	L.S.
2.	Embankment in Place	CY	3,392,765	4.80
3.	Unclassified Excavation	CY	483,620	1.50
4.	Borrow ( Haul only)	CY	508,915	0.90
5.	Sub-base	CY	841,734	30.70
6.	Asphalt concrete pavement	Ton	127,321	110.50
7.	Bituminous concrete base course	CY	148,806	148.50
8.	Bituminous Stabilized shoulder	CY	79,363	194.60
9.	Surface treatment for shoulders	SY	721,484	3.20
10.	Height of way fencing	Mile	156,060	6,100.00
11.	Test Rolling of subgrade	S.Y	2,164,453	0.07
12.	Furnishing and Installing catch Basins	Each	43	800.00
13.	Concrete Pipe culverts 12 to 24 inches dia, in place	L.F.	15,000	69.90
14.	Concrete Pipe culverts 30 to 54 inches dia, in place	L.F.	11,800	237.80
15.	Concrete Pipe culverts 60 to 70 inches dia, in place	L.F.	5,000	445.20
16.	Rip Rap for pipe culverts	C.Y.	2,000	45.80
17.	Sand blanket	C.Y.	25,000	28.20
18.	Embankment protection	C.Y.	77,100	19.00
19.	Maintenance of Traffic and provision of detours	L.S.	-	L.S.
20.	Seeding, Mulching and Landscaping	Acres	1,810	4100.00
21.	Centre line stripping	L.F.	412,000	0.40
Total for Roadway items				116,497,620

Table C - 2

Structural Items

No.	Item	Unit	Quantity	Unit price	Total Rupees
22.	Structural Excavation	CY	45,298	33.10	1,499,360
23	Rip Rap	CY	2,609	45.60	118,970
24.	Concrete in culverts	CY	4,039	960.30	3,878,650
25.	Concrete in Super structure	CY	4,496	634.00	2,850,460
26.	Concrete in Piers	CY	11,902	623.50	7,420,900
27.	Concrete in abutments	CY	1,184	567.40	671,800
28.	Prestressed concrete voided slabs	LF	4,440	96.10	426,680
29.	Prestressed concrete Boxes	LF	20,460	106.90	2,191,170
30.	Prestressed concrete I - Beams	LF	14,991	164.10	2,460,020
31.	Prestressing wire strand	LF	814,418	1.12	912,150
32.	Concrete Railing	LF	11,930	44.00	524,920
33.	Reinforcing Bars	Lbs	3,136,935	1.40	4,391,430
34.	Structural steel	Lbs	75,917	2.40	182,200
35.	Test Piles	Each	26	11,300.00	293,800
36.	Piles, 12" x 12" Precast concrete	LF	18,800	106.90	2,009,720
37.	Piles, 14" x 14" Precast concrete	LF	4,720	108.60	512,590
38.	Bituminous wearing surface	C.Y	1,443	232.40	335,350
39.	Bituminous Tack coat	Gal	1,842	6.00	11,050
40.	Elastomeric Bearing Pad	S.F.	3,794	60.00	227,640
41.	Brick Masonry Piers	C.Y.	34,592	391.00	13,525,470
42.	Low level structures for cart track	L.S.		2,000.000	2,000,000
Total for Structural items				:	46,444,330

CASE STUDY NO. 7

(Construction of a Bridge -Economic analysis based on Adler's Manual)

A 3000 feet span two lane bridge is proposed over a major river. At present the river crossings are provided by an outdated ferry and considerable time is lost to cross the river. The bridge will cost Rs. 172 million, spread over a four year construction period as below :

	<u>Million Rupees</u>
1st year of construction	3.25
2nd year of construction	70.67
3rd year of construction	69.80
4th year of construction	28.28
Capital cost, Total	<u>172.00</u>

Annual maintenance and repair (AMR) 0.15 million rupees  
Carpetting of roadway, every 11th year: 0.33 Rs.  
Economic life of the bridge: 50 years  
Salvage value: Nil

The traffic forecast for the next 25 year is shown in Table 1.

The traffic grows at 8% annually. The traffic is assumed to remain at the 25th year level for the year 26 to year 50 period as the traffic would reach the bridge's capacity in the first 25 years life of the bridge. Appraise the project using the method of economic analysis outlined in Adler's manual.

Project Benefits:

The economic appraisal consists primarily of determining the least cost solution to the problem of moving freight and passenger traffic across the river. The two alternatives bridge and ferry, do not however merely differ in capital and operating costs but also in quality of service in that the ferry involves more time and is less convenient. As a result the traffic levels would, in fact, differ substantially under <sup>the</sup> two alternatives. To allow for this difference, the diverted and generated traffic has also been included in the ferry analysis, including the cost for delays.

The benefits of bridge consist primarily of;

- (i) the avoidance of the ferry capital and operating costs,
- (ii) the elimination of delays for vehicles, drivers, passengers and freight.

1. Ferry Costs:

The appraisal assumes specially designed Shotel Navigator flat bottom pontoon ferry vessel costing about Rs 2 million with AOMR and depreciation of about Rs 0.5 million per year. The ferry has a capacity for 22 vehicles and it can make four crossings per hour. The hourly capacity would be 88 vehicles. No stand by ferries are assumed since all ferries will be fully employed only during the peak hours. Taking into account the hourly distribution of traffic, the number of ferries needed will increase gradually as follows:

1980	2
1985	2
1990	3
1995	4
2000	6
2005	8

The economic life of ferry is estimated to be 20 years. The cost of two terminals (including access) is estimated at Rs 1.5 million and their annual maintenance at about Rs 0.15 million. The number of terminals will have to be increased from one on each river bank initially to 2 in 1995 and 3 in 2005. The economic life of terminals is also estimated at 20 years.

The annual economic costs of ferry service in the 50 years are listed in Table 2 below:

The costs for the 50 year life of the project are shown in column 4 of Table 3. The salvage value of the 8 ferries at the end of the project life is assumed to be half their cost at about Rs 8 million.

TABLE I : TRAFFIC FORECAST  
(AADT)

YEAR	T R U C K S			B U S E S			C A R S			TOTAL Trucks Buses cars				
	Normal	Generated	Diverted	Normal	Generated	Diverted	Normal	Generated	Diverted					
	1	2	3	1	2	3	1	2	3					
1980	112	22	206	97	19	100	119	216	490	98	122	220	710	1266
1985	164	32	286	143	29	146	175	318	720	144	167	311	1031	1831
1990	241	48	398	210	42	205	247	457	1057	211	213	424	1481	2625
1995	354	71	554	308	62	285	347	555	1554	311	262	573	2127	3761
2000	521	104	778	453	92	391	483	936	2283	457	315	772	3055	5394
2005	765	153	1104	666	133	541	674	1340	3355	671	374	1045	4400	7762

TABLE 2 : Annual Economic Costs of  
Ferry Service

In Million Rs.

Year	Capital Costs		Operating Costs		Total
	Ferry	Terminal	Ferry	Terminals	
1980	4.0	1.5	1.0	0.15	6.65
1980-89	-	-	1.0	0.15	1.15
1990	2.0	-	1.5	0.15	3.65
1991-94	-	-	1.5	0.15	1.65
1995	2.0	1.5	2.0	0.30	5.80
1996-99	-	-	2.0	0.30	2.30
2000	8.0	1.5	3.0	0.30	12.80
2001-2004	-	-	3.0	0.30	3.30
2005	4.0	1.5	4.0	0.45	9.95
2006-2009	-	-	4.0	0.45	4.45
2010	2.0	-	4.0	0.45	6.45
2011-2014	-	-	4.0	0.45	4.45
2015	2.0	1.5	4.0	0.45	7.95
2016-19	-	-	4.0	0.45	4.45
2020	8.0	1.5	4.0	0.45	13.95
2021-24	-	-	4.0	0.45	4.45
2025	8.0	1.5	4.0	0.45	13.95
2026-2029	-	-	4.0	0.45	4.45
2030					

Salvage: -8.00



The operating costs for motor vehicles are about the same for the bridges and ferry alternatives. While the bridge involves driving an additional 3000 feet, the ferry requires vehicles to slow down twice to stop and then accelerate to resume their previous speed, these two costs more or less off set each other.

Elimination of Delay:

Assuming reasonably efficient ferry service, the difference between it and driving across the proposed bridge is about 20 minutes. This involves capital costs for vehicles, wages for truck and bus drivers and time savings for passengers and freight.

(i) Vehicles:

At the 1980 traffic levels, the annual time savings for the normal traffic would be:

112 trucks x 360 days + 1/3 hour	13,440 hours
97 buses x " + "	11,640 hours
490 cars x " + "	58,800 hours

The effective utilization of a bus and truck under the conditions prevailing in the country is about 7000 hours during its economic life, this is the equivalent of a life time mileage of 210,000 miles, assuming an average speed in intercity traffic of 30 miles per hour. This means that the delay calculated above for 1980 involves the equivalent of about 1.92 trucks and 1.66 buses. At Rs 175,000 per truck and Rs 200,000 per bus - this involves a cost of Rs 3,36,000 for trucks and Rs 3,22,000 for buses, assuming an effective utilization of 4000 hours for passenger cars during their economic life, the cost of delay in 1980 would be equivalent of about 15 vehicles (58,800 ÷ 4000), with a value of perhaps Rs 30,000 (considering that some of these vehicles are auto - rickshaws and motor cycles). The total delay for normal traffic would therefore involve a capital cost for vehicles in 1980 of Rs 11,08,000.

As for generated and diverted traffic, it is assumed that it is generated and diverted in proportion to the reduction in transit time, so that the unit benefits for this traffic would be only one half of those for normal traffic. This would make the benefits as follows:

228 trucks x 360 days x 1/3 hour ÷ 2 ÷ 700 x 175,000 = Rs 342,000

119 Buses x 360 days x 1/3 hour ÷ 2 ÷ 700 x 200,000 = Rs 204,000

220 cars x 360 days x 1/3 hour ÷ 2 ÷ 700 x 300,000 = Rs 99,000

Sub Total, generated & diverted Traffic = Rs 645,000

Normal traffic = Rs 11,08,000

Total Rs.17,53,000

The cost of delay will increase after 1980 in proportion to the traffic growth.

The wages of the truck and bus drivers would be a reasonable indication of the costs of delay for them. The hourly wage costs per truck and bus are assumed to be Rs 4/- which includes both the driver and as well as an allowance for the conductor on buses and cleaner on trucks.

The benefits for normal traffic would thus be:

Trucks: 13,440 hours x Rs 4/- Rs 53,760

Buses : 11,640 " x " Rs 46,560

For generated and diverted traffic they would be:

Trucks 27,360 hours ÷ 2 x Rs 4/- Rs 54,720

Buses 14,280 hours ÷ 2 x Rs 4/- Rs 28,560

Total Rs.183,600

Say Rs 184,000

The cost of delay for drivers, conductors and cleaners would thus be about Rs 184,000 in 1980 and would increase in line with traffic growth.

(ii) Passengers and Freight:

For buses, an average of 30 passengers is estimated, of which one fourth earn an average of Rs 150 per month or 0.63 per hour. The value of time for each bus load would then be Rs 4.75 per hour. For the delay of 11,640 hours for normal traffic, this would involve a benefit of some what more than Rs 55,290 in 1980. For the delay of 14,280 hours for generated and diverted traffic and assuming one half the unit benefits, the annual benefit would be about Rs 34,000.

For cars it is estimated that every second vehicle carries one passenger with an income of Rs 1,000 per month or Rs 5 per hour, making the value per average car hour saved Rs 2.50. For the 58,800 hours delay for normal traffic, this would involve a cost of Rs 1,47,000 for the generated and diverted traffic, the delay of 26,400 hours would involve a cost of Rs 66,000.

The total time savings for passengers in houses and cars would thus amount to about Rs 302,000 in 1980/

Finally there are time benefits to freight. It is assumed that each truck carries 4 tons and that shippers would be willing to pay Rs 1.0 per ton /hour saved. For the 13,440 hours of delay for normal truck traffic, this would imply a cost of somewhat less than Rs 54,000. For the 27,360 hours of delay for normal truck traffic, this would imply a cost of somewhat less than Rs 54,000 for the 27,360 hours of delay for generated and diverted traffic, it would imply a cost of about Rs 110,000. The total benefit from the elimination of delay in 1980 could thus be summarized as follows:

Vehicles	17,53,000 Rs.
Drivers	1,84,000 Rs
Sub-total	19,37,000
Passengers	302,000
Freight	164,000
Total:	466,000

The inclusion of the highly speculative values for passenger and freight time would not significantly affect the justification for the project; they are, therefore not included in the appraisal.

Conclusion:

Discounting at 12 percent gave a net present value of - 104.01 million rupees

The rate of return on investment is much below 12%. Therefore, the project is economically not viable. It is not recommended for implementation.

TABLE 3 : RATE OF RETURN

CONSTRUCTION OF A BRIDGE

(In Rs. Million)

No. of years	Year	C o s t s			B e n e f i t s			Present worth	
		Capital costs	Maintenance costs	Total costs	Ferry costs	Cost of delays (Vehicles & Drivers)	Total benefits	Costs   Benefits	
								Discounted at 12 %	
		1	2	3	4	5	6=4+5	7	8
-4	1976	3.25		3.25				3.250	-
-3	77	70.67		70.67				63,108	-
-2	78	69.80		69.80				55,630	-
-1	79	28.28		28.28				20,135	-
1	80		0.15	0.15	6.65	1.93	8.58	0.095	5,456
2	1981		0.15	0.15	1.15	2.09	3.24	0.085	1,837
3	82		0.15	0.15	1.15	2.26	3.41	0.076	1,728
4	83		0.15	0.15	1.15	2.44	3.59	0.068	1,622
5	84		0.15	0.15	1.15	2.64	3.79	0.061	1,331
6	85		0.15	0.15	1.15	2.85	4.00	0.054	1,444
7	1986		0.15	0.15	1.15	3.07	4.22	0.048	1,358
8	87		0.15	0.15	1.15	3.37	4.52	0.043	1,297
9	88		0.15	0.15	1.15	3.59	4.74	0.038	1,218
10	89		0.48	0.48	1.15	3.87	5.02	0.110	1,149
11	90		0.15	0.15	3.65	4.18	7.83	0.031	1,065
12	1991		0.15	0.15	1.65	4.52	6.17	0.028	1,129
13	92		0.15	0.15	1.65	4.88	6.53	0.024	1,064
14	93		0.15	0.15	1.65	5.27	6.92	0.022	1,010
15	94		0.15	0.15	1.65	5.69	7.34	0.020	0,954
16	95		0.15	0.15	5.80	6.14	11.94	0.017	1,385
17	1996		0.15	0.15	2.30	6.64	8.94	0.016	0,929
18	97		0.15	0.15	2.30	7.17	9.47	0.014	0,880
19	98		0.15	0.15	2.30	7.74	10.04	0.012	0,833
20	99		0.48	0.48	2.30	8.36	10.66	0.036	0,788
21	2000		0.15	0.15	12.80	9.03	21.83	0.010	1,441
22	2001		0.15	0.15	3.30	9.75	13.05	0.009	0,770
23	2		0.15	0.15	3.30	10.53	13.83	0.008	0,733
24	3		0.15	0.15	3.30	11.37	14.67	0.007	0,670
25	4		0.15	0.15	3.30	12.28	15.58	0.006	0,654
26	5		0.15	0.15	9.95	13.27	23.22	0.006	0,859
27	2006		0.15	0.15	4.45	13.27	17.72	0.005	0,584
28	7		0.15	0.15	4.45	13.27	17.72	0.005	0,531
29	8		0.15	0.15	4.45	13.27	17.72	0.004	0,478
30	9		0.48	0.48	0.45	13.27	17.72	0.012	0,425
31	2010		0.15	0.15	6.45	13.27	19.72	0.003	0,414

Contd.....P/2.

( Million Rs. )

		1	2	3	4	5	6=4+5	7	8
32	2011		0.15	0.15	4.45	13.27	17.72	0.003	0.336
33	12		0.15	0.15	4.45	13.27	17.72	0.003	0.301
34	13		0.15	0.15	4.45	13.27	17.72	0.002	0.266
35	14		0.15	0.15	4.45	13.27	17.72	0.002	0.230
36	2015		0.15	0.15	7.95	13.27	21.22	0.002	0.254
37	2016		0.15	0.15	4.45	13.27	17.72	0.002	0.194
38	17		0.15	0.15	4.45	13.27	17.72	0.001	0.177
39	18		0.15	0.15	4.45	13.27	17.72	0.004	0.141
40	19		0.48	0.48	4.45	13.27	17.72	0.001	0.141
41	2020		0.15	0.15	13.95	13.27	27.22	0.001	0.150
42	2021		0.15	0.15	4.45	13.27	17.72	0.001	0.106
43	22		0.15	0.15	4.45	13.27	17.72	0.001	0.086
44	23		0.15	0.15	4.45	13.27	17.72	0.001	0.086
5	24		0.15	0.15	4.45	13.27	17.72	0.001	0.086
46	25		0.15	0.15	13.95	13.27	27.22	0.001	0.108
47	2026		0.15	0.15	4.45	13.27	17.72	0.001	0.053
48	27		0.15	0.15	4.45	13.27	17.72	-	0.053
49	28		0.15	0.15	4.45	13.27	17.72	-	0.053
50	29		0.15	0.15	4.45	13.27	17.72	-	0.035
<b>Total :</b>							143.12	39.11	
							- 143.12		
<b>Net present worth =</b>							+ 39.11		
							- 104.01 Million		

CASE STUDY NO. 8

(Amortization of a debt)

Amortization : An interest bearing debt will be said to be amortized when all liabilities (both principal and interest) are discharged by a sequence of (usually) equal payments made at equal intervals of time.

A debt of Rs. 5000 with interest at 5% compounded semiannually is to be amortized by equal semi annual payments over the next three years, the first due in 6 months. Find the payment and draw up the amortization schedule.

The 6 payments form an ordinary annuity whose present value is Rs. 5000.

$$A = \text{debt} = \text{Rs. } 5000$$

$$i = 0.05 \div 2 = 0.025 \text{ (semiannual)}$$

$$n = 3 \text{ years} \times 2 = 6 \text{ payments}$$

$$\text{Semi annual payment} = 5000 \times \frac{1}{a}$$

$$\frac{1}{6/25}$$

$$= 500 (0.18155) = \text{Rs } 907.75$$

$$\frac{1}{S} = \frac{i}{(1+i)^n - 1}$$

$$\frac{1}{n/i} = \frac{0.025}{(1+0.025)^6 - 1}$$

$$= 0.15655$$

$\frac{1}{S}$  is calculated with log Tables as shown above or  $\frac{1}{n/i}$  it can be read directly from Tables (if available)

$$\frac{1}{a} = \frac{1}{S} + \frac{i}{n}$$

$$\frac{1}{n/i} = \frac{1}{S} + \frac{i}{n}$$

$$= 0.15655 + 0.025$$

$$= 0.18155$$

The indebtedness at any time is called the outstanding liability or outstanding principal at that time. The outstanding principal at beginning of the term is the original debt. The out-standing principal at the end of the term is 0. The outstanding principal just after a ~~xxx~~ payment has been made is the present value of all payments yet to be made.

Amortization Schedule

Year	Per-iod	Outstanding principal at beginning of period (a)	Interest due at end of period (B)	Payment (C)	Rupees
					Principal re-paid at end of period (d)
0	1	5000.00	125.00	907.75	782.75
1	2	4217.25	105.43	907.75	802.32
	3	3414.93	85.37	907.75	822.38
2	4	2592.55	64.81	907.75	842.94
	5	1749.61	43.74	907.75	864.01
3	6	885.60	22.14	907.75	885.61
Total			446.50	5446.50	5000.01

The table is ; filled line by line as follows:

The outstanding principal (a) at the beginning of the first period is the original debt of Rs 5000. The interest due (b) at the end of that period is  $5000 (0.025) = \text{Rs } 125$ . The semi annual payment (c) is Rs 907.75 of which Rs 125 is used to pay the interest due and Rs 907.75 less Rs 125 = Rs 782.75 is used to repay the principal (d). At the beginning of the second period, the outstanding principal (a) is  $5000 - 782.75 = \text{Rs } 4217.25$ . At the end of this period, the interest due (b) is  $\text{Rs } 4217.25 (0.025) = \text{Rs } 105.43$ . Of the payment (c) of Rs 907.75 there remains  $907.75 \text{ less } 105.43 = \text{Rs } 802.32$  to repay the principal (d). At the beginning of third period, the outstanding principal (a) is  $4217.25 - 802.32 = \text{Rs } 3414.93$ , and so on.

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CASE STUDY NO. 9

(Sinking Fund)

Sinking Fund:

In the sinking fund method of discharging a debt, the creditor receives the interest when due and the face of the debt at the end of the term. In order to make the latter payment, the debtor creates a separate fund into which he makes equal periodic deposits over the term so that just after the last deposit the fund amounts to the original debt. This fund also earns interest but not necessarily at the same rate as that of the loan.

A debt of Rs. 5,00,000 bearing interest at 5% compounded semi annually is to be discharged by the sinking fund method. 8 equal semi annual deposits, the first due in 6 months, are made into a fund which pays 3% compounded annually. Find size of each deposit (R), semi annual cost (C) of the debt and draw up a sinking fund schedule.

$$R = 5,00,000 \times \frac{1}{S} \times \frac{1}{n/i} = 5,00,000 \times \frac{1}{\frac{S}{8/0.015}}$$

$$= 5,00,000 (0.118584) = \underline{\text{Rs. 592.92}}$$

The semi annual interest charge is 50,00,000 (0.025) = Rs. 12500. The semi annual cost of the debt is the interest charge plus the periodic deposit into the sinking fund,

$$C = 12500 + 59292 = \text{Rs. 71792}$$

$$\frac{1}{S} = \frac{1}{\frac{S}{8/0.015}}$$

$$= 0.118584$$

Read from Tables of 1/S or compute with n/i log table as below:

$$\frac{1}{S} = \frac{i}{(1+i)^n - 1}$$

$$= \frac{0.015}{(1+0.015)^8 - 1}$$

$$= 0.118584$$

Sinking Fund Schedule

Year	Per - iod.	Rupees			
		(a) Interest added	(b) Deposit	(c) Increase in fund	(d) Amount in fund at the end of period
0	1	0	59292	59292	59292
1	2	889	59292	60181	119473
2	3	1792	59292	61084	180557
	4	2708	59292	62000	242557
3	5	3638	59292	62930	305487
	6	4582	59292	63292	369361
4	7	5540	59292	64832	434193
	8	6513	59292	65805	499998
Total		25662	474336	499998	



The table is ; filled line by line as follows:

At the end of the first period a deposit (b) of Rs 59,292 is made and this is then both the increase in the fund (c) and amount in the fund (d) at end of the first period. At end of the second period, the interest added (a) is  $59292 (0.015) = \text{Rs } 889$ , the deposit (b) is Rs 59292, the increase in the fund (c) is  $889 + 59292 = \text{Rs } 60181$ , and the amount in the fund (d) is  $59292 + 60181 = \text{Rs } 119473$ . At the end of the third period, the interest added (a) is  $119473 (0.015) = \text{Rs } 1792$ , the deposit (b) is Rs 59292, the increase in the fund is  $1792 + 59292 = \text{Rs } 61084$  and the amount in the fund (d) is now  $\text{Rs } 119473 + 61084 = \text{Rs } 1,80,557$  and so on!

Case Study No. 10 - A

(Depreciation by Sinking fund method)

Depreciation:

Depreciation is the loss in value of physical assets (buildings, machinery, oil drilling rig etc) through use. In order to provide for the eventual replacement of a given asset at the end of its useful life, a company sets aside a portion of its earnings each year in a fund, called a depreciation fund. The annual deposits into the depreciation fund are called depreciation charges. Book value is the difference between original cost of the asset and the sum in depreciation fund. At the end of its useful life, the book value of the asset must be its scrap or salvage value. Depreciation is calculated by various methods (straightline depreciation or method of averages, depreciation by no. of hours or by number of items produced, sinking fund method). The following example is based on the sinking fund method.

Let C = original cost

S = Scrap value

n = Economic life, years

i = rate of depreciation

R = Annual deposit in the fund

$$R = (C - S) \frac{1}{\frac{s}{n/i}}$$

Work  $\frac{s}{n/i}$  = Amount of annuity of 1 per period.

A tubewell drilling rig costing Rs 4,00,000 new is estimated to have, after 6 years of use, a scrap value of Rs 40,000. If the depreciation fund earns 3% effective, use the sinking fund method to (a) find the annual deposit into the fund, (b) find the amount in the fund at the end of 4 years, (c) prepare a depreciation schedule.

Let R = Annual deposit  
(a) Cost C = Rs 4,00,000. salvage value, S = Rs 40,000  
n=6, i = 0.03

$$R \cdot \frac{s}{67.03} = 4,00,000 - 40,000 = 3,60,000$$

$$R = 3,60,000 \frac{1}{\frac{s}{67.03}} = 3,60,000 (0.154598)$$

from Tables of  $\frac{1}{s/n/i}$

(b) Immediately after the 4th deposit the amount in the depreciation fund is

$$\frac{55,655 \times 4}{470.03} = 55,655 (4.18363) \text{ from Tables of } S_{\overline{n}|i}$$

$$= 2,32,840$$

Depreciation Schedule

(Rupees)

Age	Depreciation charge	Interest on fund	Increase in fund	Amount in fund	Book value
0	0	0	0	0	4,00,000
1	55655	0	55655	55,655	3,44,345
2	55655	1670	57325	1,12,980	2,87,020
3	55655	3387	59044	1,72,024	2,27,976
4	55655	5161	60816	2,32,840	1,67,160
5	55655	6985	62640	2,95,480	1,04,520
6	55655	8864	64519	3,59,999	40,000

Case Study No 10 - B

(Depreciation by straight line method)

The simplest method for depreciating an asset is the straight line method in which equal annual deposits over the useful life of the asset are made into the depreciation fund.

Using the data of case study No. 10-A, find out

- (a) the average yearly depreciation and
- (b) prepare a depreciation schedule showing the book value from year to year.
- (a) Total depreciation = Cost less scrap value  
= 4,00,000 - 40,000 = Rs 3,60,000

$$\text{Average yearly depreciation} = \frac{3,60,000}{6} = \text{Rs } 60,000$$

- (b) Since the annual depreciation charge is Rs 60,000, the depreciation fund increases by that sum each year and the book value of the rig decreases by that sum each year.

Depreciation Schedule			(Rupees)
Age	Depreciation charge	Amount in Dep. reciation fund	Book value at end of year
0	0	0	4,00,000
1	60,000	60,000	3,40,000
2	60,000	1,20,000	2,80,000
3	60,000	1,80,000	2,20,000
4	60,000	2,40,000	1,60,000
5	60,000	3,00,000	1,00,000
6	60,000	3,60,000	40,000

CASE STUDY NO. 11

(Depletion of an oil well)

Depletion

The loss in value of an oil well through gradual pumping of oil reservoir which makes up its value is called depletion. The oil company expects to receive interest at a certain rate and eventual return of investment. Thus the annual net income from the well must provide both for the required interest and for a sinking fund (replacement fund) which accumulates to the original investment less any salvage value of the well.

An oil company has spent 30 million rupees on the drilling and development of an oil well. The reservoir is estimated to yield for the next 20 years after which the well will go dry with no salvage value. If the replacement fund earns 5% effectively, find the annual net return (at 15%) on investment.

Let A = Net annual return, Million rupees

and C = capital invested = 30 million rupees

$$\text{then } A = 0.15 C + C \frac{1}{s} \frac{1}{20 \sqrt{.05}}$$

$$= 30 (0.15 + 0.03024)$$

$$= 30 (0.18024)$$

$$= 5.407 \text{ million rupees}$$

$$\text{Read } \frac{1}{s} \frac{1}{n \sqrt{i}} = \frac{1}{s} \frac{1}{20 \sqrt{0.05}} \text{ from}$$

Tables or compute with log tables as below

$$\frac{1}{s} \frac{1}{20 \sqrt{.05}} = \frac{0.05}{(1+.05)^{20} - 1}$$

$$= 0.03024$$

The oil well must yield a net annual return of Rs. 5.407 million rupees to stay operational.

Case Study No. 12

(Coal mine - rate of return on Investment)

A purchaser is interested to buy a coal mine which has coal reserves expected to last for the next 10 years. Annual cash in flow from sale of coal is expected to net Rs. 7.5 million. The salvage value of mine at the end of 10 years is Rs. 1 million. Calculate annual rate of return on investment on a purchase price of Rs. 37.5 million. The replacement fund earns at 4 percent.

Let A = Annual cash inflow = 7.5 Million Rupees

r = Annual rate of return on investment, percent

C = Capital invested = 37.5 million rupees

$$\text{Then } A = rc + C \cdot \frac{1}{\frac{S}{10 \uparrow .04}}$$

$$\text{or } r = \frac{A - \frac{C}{\frac{S}{10 \uparrow .04}}}{C}$$

$$\frac{1}{\frac{S}{10 \uparrow .04}} = 0.0833 \quad (\text{Direct from Tables})$$

$$\text{or } = \frac{0.04}{(1+.04)^{10} - 1} = 0.0833 \quad (\text{By calculations})$$

$$\text{so } r = \frac{7.5 - 37.5 (0.0833)}{37.5}$$

$$= \frac{7.5 - 3.12}{37.5} = \frac{4.38}{37.5} = 11.70\%$$

The return on investment is found to be 11.70 percent which is less than the cost of Capital (15 to 20%). It is not a profitable investment.

The  $37\frac{1}{2}$  million rupees capital can be invested elsewhere, in a more profitable enterprise.





Case Study No. 14 A

( Construction of Additional 2 lanes - Upgrading of a existing 2 lane highway to a 4 lane divided highway )

Description

The existing road (33.75 miles) between two major industrial cities is one of the busiest highway section in the country. There is industry located along the route, the traffic volumes are high but the road structural capacity and geometrics do not come up to the present requirements. The road width varies from 24 to 28 feet and pavement thickness is 8 to 12 inches. The traffic volumes and future projections are shown in Table I. The estimated cost of construction is Rs. 120 million spread over a 4 year construction period.

Compute the benefit/cost ratio and the internal rate of return on investment. Capital costs 15 percent.

Table I

Average annual daily traffic (AADT)

Year	(AADT in passenger car units-Ecafe Standards)
1976	5,512
1985	10,560
1997	25,168

There is considerable slow moving (animal drawn) traffic having access to this highway. The motorised traffic is estimated to grow at an annual compound

growth rate of 7½%. The general growth rate for highway traffic in the country is 7 percent.

Taking hourly volume as 30% of the AADT, the traffic per hour works out to be :

Year	Hourly volume (Both Directions)
1976	1653
1985	3170
1997	8004

Four lane divided highway capacity for the two lanes in direction of heavier flow is 1000 vehicles per hour. Since there is slow moving animal drawn traffic as well, this figure is estimated to reduce to 700-800 vehicles per hour in the direction of heavier flow. A traffic volume of 1653 units, justifies a dual carriage way in the year 1976.

#### Economic Appraisal

The capital costs of the project include the cost of construction of new 2 lane (24 feet wide) carriageway plus the spending on improvement of the existing 2-lane carriageway. The project benefits are reduced vehicle operating costs and lower maintenance costs of the highway.

Capital cost of construction :

Year	Cost in Million Rs. (Excluding taxes)
1976-77	20.0
1977-78	30.0
1978-79	30.0
1979-80	40.0
<b>Total :</b>	<b><u>120.0</u></b>

Construction Period = 4 years.

Adding interest (at 15%) during the four year construction period, total capital spending works out as :

Year	Capital cost with Interest @ 15% during construction period Million Rs.
1976-77	35.0
77-78	45.6
78-79	39.7
1979-80	45.6
<b>Total :</b>	<b><u>165.9</u></b>

Economic life of road = 20 years  
 Salvage value = Nil  
 Length of road = 33.75 miles  
 Economic cost per mile =  $165.9 \div 33.75 = 4.92$  Mill.Rs.

Construction period = 4 years

The benefits will start flowing from the year 1980-81. Discounting to year 1980-81, has yielded the following results:

	Discounting at 15%	Discounting at 20%
Present worth of benefits per mile, million Rs.	13.90	10.96
Benefit/cost ratio	2.83	2.23

Conclusion:

The economic analysis has yield a benefit cost ratio of 2.23 to 2.83. The internal rate of return on investment is more than 20 percent. The construction of the additional dual carriageway is, economically, highly viable. It is recommended for immediate construction.

ECONOMIC ANALYSIS OF ROAD WIDENING  
PRESENT WORTH OF BENEFITS PER MILE  
OF DUAL CARRIAGE WAY  
\*\*\*\*\*

Rupees

		<u>Total Benefits</u>	<u>PRESENT WORTH (DISCOUNTED @15%)</u>		<u>PRESENT WORTH (DISCOUNTED @20%)</u>	
			<u>Discount Factor</u>	<u>Present Worth</u>	<u>Discount Factor</u>	<u>Present Worth</u>
0	* 1980-81	1222644	1	1222644	1	1223000
1	81-82	1314583	0.879	1155518	0.833	1094000
2	82-83	1413544	0.756	1068639	0.694	911500
3	83-84	1519644	0.658	999925	0.579	980900
4	84-85	1633888	0.572	934583	0.482	879800
5	85-86	1756525	0.497	872992	0.402	787500
6	86-87	1888553	0.432	815854	0.335	706100
7	87-88	2030235	0.376	763368	0.279	632500
8	88-89	2182819	0.327	713781	0.233	566400
9	89-90	234668	0.284	666457	0.194	508600
10	90-91	1525806	0.247	376874	0.162	455200
11	91-92	2712219	0.215	583127	0.135	247200
12	92-93	2916032	0.187	545297	0.112	326600
13	93-94	3134991	0.163	511003	0.093	291500
14	94-95	3370485	0.141	475238	0.078	262800
15	95-96	3623278	0.124	445663	0.065	234500
16	96-97	3894517	0.107	416713	0.054	210300
17	97-98	4187495	0.093	389437	0.045	188400
18	98-99	4501916	0.081	364655	0.038	171100
19	99-2000	4839892	0.070	338792	0.031	150000
20	2000-2001	5203169	0.061	317393	0.026	135200
			<b>Total:</b>	<b>13977953</b>		<b>10964100</b>

At 15% Discount Rate

Present Worth of Benefits per mile = Rs. 13977953 (Rs. 13.9 Millions)  
Economic cost per mile = Rs. 4.92 million  
Benefit/Cost Ratio =  $13.9 \div 4.92 = 2.83$

At 20% Discount Rate

Present Worth of Benefits per mile = Rs. 10.96 million  
Economic Cost per mile = Rs. 4.92 million  
Benefit/Cost per mile =  $10.96 \div 4.92 = 2.23$

\*Four year is the construction period (1976/77 - 1979-80).  
Benefits start accruing from the year 1980-81.

CASE STUDY NO. 14B

(Selection of Type of road surface)

An old road is to be rehabilitated to serve a nearby dam construction project. The sub-base and base of the road are in good condition. Two types (A&B) of wearing surfaces are possible. Estimates (per mile) are given below. Compare the economic feasibility of the two types of surfaces for making a selection to use one of these for the proposed reconstruction of the road.

	Type A	Type B
	Rupees	
Capital cost	100,000	70,000
Economic life, years (n)	20	10
Interest, % (i)	8	8
Capital re-recovery factor	0.102	0.149
Salvage value	30,000	30,000
Annual Road users costs (Average for next 20 years)	120,000 (R <sub>A</sub> )	120,000 (R <sub>B</sub> )
Annual maintenance (Average for 20 years)	1,000	1,000

Assume that the annual road user costs for the existing bad road total Rs. 140,000 (R) and the annual highway costs are Rs. 2,000 (H) per mile.

Compute Benefit/Cost ratio and the annual transportation cost for each alternative.

Benefit / Cost Ratios

Type A

$$\begin{aligned} \text{Annual highway costs} &= (\text{construction} - \text{salvage value})K + \text{Interest on salvage} + \text{Maintenance} \\ &= (100,000 - 30,000)0.102 + 30,000(0.08) + 1000 \end{aligned}$$

$$\begin{aligned} &= 7140 + 2400 + 1000 \\ &= 10,540 \end{aligned}$$

$$\text{Benefits/Costs} = \frac{R - RA}{HA - H} = \frac{(140,000 - 120,000)}{10,540 - 2000}$$

$$= \frac{20,000}{8,540} = 2.34$$

$$\begin{aligned} \text{Annual transportation cost (per mile)} &= \begin{array}{r} 120,000 \\ 10,540 \end{array} \end{aligned}$$

$$\text{Rs. } \frac{120,000}{10,540} = \underline{\underline{11,385}}$$

Type B

$$\begin{aligned} \text{Annual Highway Costs, } (H_B), \text{ Rupees} &= (70,000 - 30,000)0.149 + 30,000(0.08) + 1500 \end{aligned}$$

$$\begin{aligned} &= 5,950 + 2400 + 1000 \\ &= 9,350 \end{aligned}$$

$$\text{Benefits/costs} = \frac{R - RB}{HB - H} = \frac{140,000 - 120,000}{9350 - 2000}$$

$$= \frac{20,000}{7,350} = 2.72$$

$$\begin{aligned} \text{Annual transportation cost (per mile)} &= \begin{array}{r} 120,000 \\ 9,350 \end{array} \end{aligned}$$

$$\text{Rs. } \frac{120,000}{9,350} = \underline{\underline{12,834}}$$

Conclusion:

Type B surface is selected as :

- (i) It has a higher Benefit/Cost ratio.
- (ii) Its annual transportation cost is less as compared to Type A.
- (iii) It has less initial cost, which is a very important consideration for a developing country where money is needed in other sectors (health, housing, etc.) of national development.

Case Study No. 15.

( 15-year Road Development Program - raising of additional funds).

(Escalation)

A country began a 15-year road development program, July 1, 1974. Due to increased prices of materials and wage rates, additional funds will be required as of July 1, 1976. Indicate a reasonable method of obtaining the additional 805.40 million rupees funds to make-up the deficit. An out-lay of funds available and additional revenue required is shown in Table I. State policy for revenues for highway construction includes tax on petrol and tax on motor vehicles for road use. Approximately 75% of the revenue is derived from petrol tax and 25% from road tax. The present rates of tax are :

Petrol tax = Rs. 2.00 per imperial gallon.

Road tax for= Rs.250.00 per year per vehicle.  
Cars and light  
vehicles.

Road tax for= Rs.500.00 per year per vehicle.  
Trucks, Buses,  
and other heavy  
vehicles.

Relevant traffic data is shown in figure 1 and 2.

Table I - Outlay of Funds

No. of Years	Fiscal Year	State money Available.	Rs. Millions	
			Funds needed (Net of Escalation)	Short fall in funds to be made up.
1.	1974-75	153	153.00	-
2.	1975-76	182	182.00	-
3.	1976-77	212	231.10	19.10
4.	1977-78	230	257.10	27.10
5.	1978-79	238	273.10	35.10
6.	1979-80	228	271.10	43.10
7.	1980-81	237	288.10	57.10
8.	1981-82	246	305.10	59.10
9.	1982-83	253	320.10	67.10
10.	1983-84	262	337.10	75.10
11.	1984-85	269	352.10	83.10
12.	1985-86	260	351.10	91.10
13.	1986-87	257	356.10	99.10
14.	1987-88	240	347.10	107.10
15.	1988-89	248	296.20	48.20
Total:		3515	4320.40	805.40



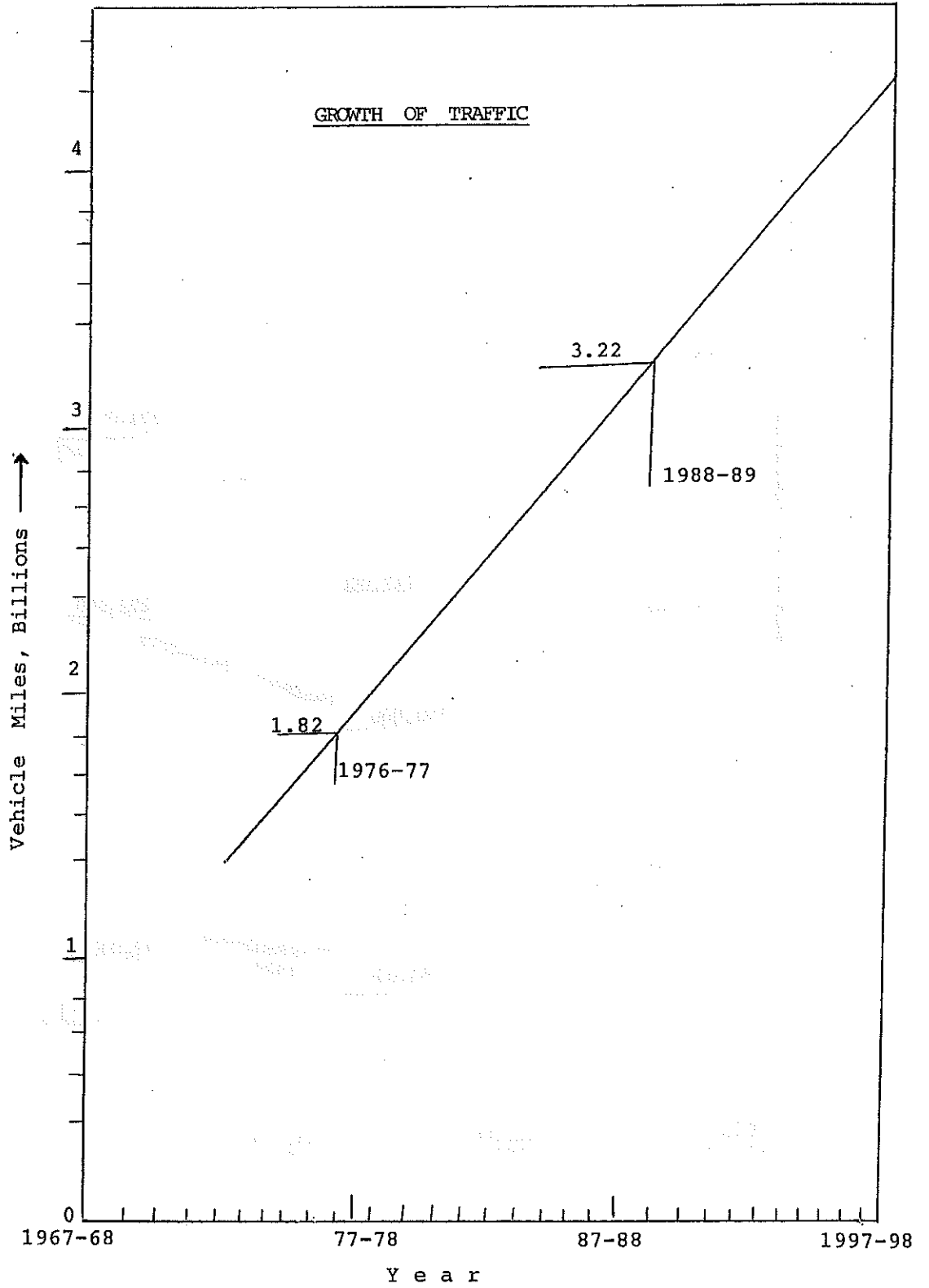


Figure 1

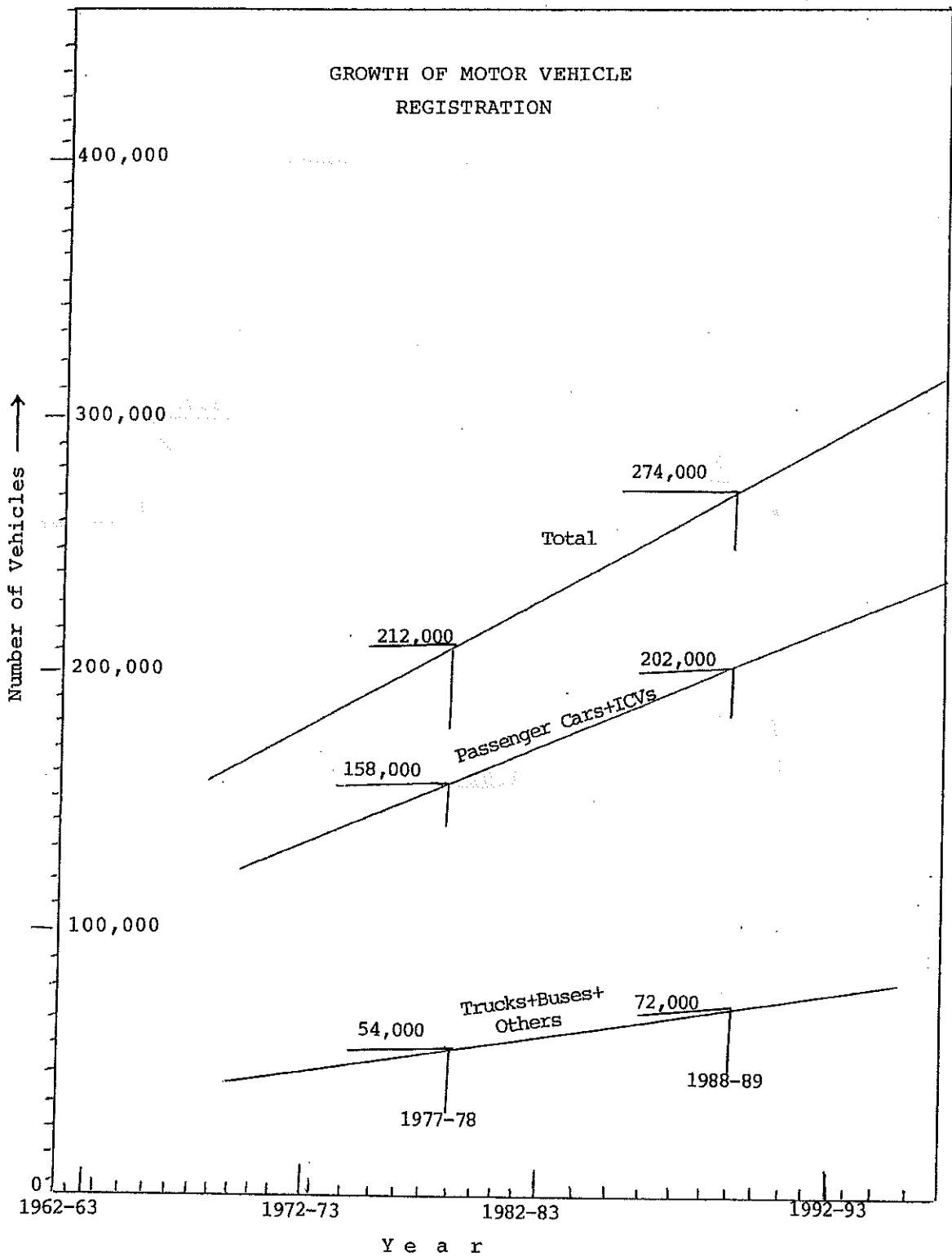


Figure 2

1. From Table I data it is clear that the State revenues are inadequate to meet the total needs for funds for the remaining 13 years (1976-77 to 1988-89) of the road development program.
2. A new fiscal policy is necessary to get the additional money required.
3. The present policy of the government is to raise road construction funds from petrol tax and road tax.
4. The present road taxes on light and heavy vehicles bear a ratio of 1:2. The increase in these taxes will be proportionately worked out.
5. Approximately 75% of the funds will be raised from increased petrol tax and the remaining 25% from increased road tax.

The additional funds required will be made up from an increase in :

- A. Petrol tax per gallon
- B. Road tax per vehicle per year.

From Figure I :

Average vehicle miles for the 13 year period  
(1976-77 to 1986-89) =  $\frac{1.82+3.22}{2} \times 13 = 32.8$  Billion Miles

Taking average fuel consumption = 12.73 miles per gallon,  
No. of gallons for the 13-years =  $\frac{32.8 \times 10^9}{12.73} = 2.58$  Billion Gallons  
period (1976-77/1988-89)

If all the money were to be raised by an increase in petrol tax, than tax increase would be =  $\frac{805.40 \times 10^6}{2.58 \times 10^9} \times 100 = 31.2$  Paisas per gallon.

But since the state policy is to raise only 75% of the funds from petrol tax, let the increase in petrol tax be 25 paisas per gallon. This is about 80% of the total increase. 25 paisas increase in petrol tax will yield a total revenue of :

$0.25 \times 2.58 \times 10^9 = 645$  million rupees over the  
13 - year period.

The remaining 160.40 (805.40-645) million  
rupees will be contributed by the increase in road  
taxes on vehicles.

Average passenger car registration:

$$= \frac{158,000 + 202,000}{2} = 180,000 \text{ car per year}$$

No. of cars for the 13 year period (1976-77/1988-89)  
 $= 180,000 \times 13 = 2,340,000.$

Average Trucks/Buses per year:

$$= \frac{54,000 + 72,000}{2} = 63,000$$

No. of Trucks and Buses for the 13 years period  
(1976-77/1988-89)

$$= 63,000 \times 13 = 819,000$$

Road tax on cars and Trucks is in the ratio of 1:2.

The increase will also be calculated to keep the 1:2  
ratio as nearly as possible.

Let  $x$  = Annual increase in road tax on car.

$$\text{Then } 2,340,000(x) + 819,000(2x) = 160.40 \times 10^6$$

$$\text{Or } x = \frac{160.40 \times 10^6}{3,978,000} = 40.3$$

Let us increase the road tax at following rates:

<u>Category</u>	<u>Increase per year, Rs.</u>	<u>Additional revenue collected Rs. Million</u>
Cars, light vehicles	40	93.60
Trucks, Buses and Other heavy vehicles.	85	69.61
		<u>163.21</u>

Additional funds of Rs. 805.40 millions are  
recommended to be raised as below :

126

Million Rupees

Type of Tax	Increase in Tax	Revenue raised	Funds Needed
Petrol Tax, per Gallon	25 Paisas	645.00	
Road Tax on Cars, light vehicles - per year per vehicle.	40 Rupees	93.60	805.40
Road Tax on Trucks, Buses and other heavy vehicles per year per vehicle	85 Rupees	69.61	
<b>Total :</b>		<b>808.21</b>	<b>805.40</b>

CASE STUDY NO. 16

(Urban low cost housing - Hire  
Purchase scheme)

The Government is keen to alleviate the housing problems of the low income groups in urban areas. It has been decided that the government will provide free land and that the cost of construction will be recovered from the occupants on "Hire - Purchase" basis. The occupants will become owners of the houses after the pay back period. A survey of the communities revealed the following two categories of monthly rent.

Category A people can pay a rental of Rs. 125 per month for 12 years.

Category B people can pay a rental of Rs. 250 per month for 10 years.

---

Capital at 8% (compounded monthly) is available from loan giving agencies. The first instalment is to be paid at the time of taking possession of the house. The construction period is one year. Find the present value of the houses in each of the two categories.

Category of houses	Monthly rent, Rs.	Pay back period years	No. of monthly payments
A	125	12	144
B	250	10	120

### Category A House

The cash equivalent (X) is the present value of an annuity due of 144 payments, that is one cash payment plus the present value of an ordinary annuity of 143 payments.

Thus,

$$\begin{aligned} X &= 125 + 125x \frac{a}{n/i} \\ &= 125 + 125 \frac{a}{143/2/300} \\ &= 125(1 + 91.998) \\ &= 125(92.998) \\ &= 11,600 \text{ Rupees} \end{aligned}$$

This is the cash value at the end of construction period. Taking out interest during construction, the present construction value of the house is, C

$$\begin{aligned} C &= 11,600 \div 0.9233 \\ &= 10,740 \text{ rupees} \end{aligned}$$

Taking low cost construction at Rs. 35/- per S Q. foot, 304 S.Q. feet covered area house is possible.

### Category B

The cash equivalent (X) is the present value of an annuity due of 120 payments, that is one cash payment plus the present value of an ordinary annuity of 119 payments, thus

$$\begin{aligned} X &= 250 + 250x \frac{a}{n/i} \\ &= 250 + 250 \frac{a}{119/2/300} \\ &= 250(1 + 81.97) \\ &= 250(82.97) \\ &= 20,700 \text{ Rupees} \end{aligned}$$

$$\begin{aligned} n &= (12 \times 12) - 1 = 144 - 1 = 143 \\ i &= 8/12\% = 2/300 \end{aligned}$$

$$\frac{a}{n/i} = 143 \overline{2/300} = 91.998$$

from annuity Tables

or Compute as below :

$$\frac{a}{n/i} = \frac{1 - (1+i)^{-n}}{i}$$

$$143 \overline{2/300} = \frac{1 - (1 + 2/300)^{-143}}{2/300}$$

$$= 91.998$$

$$\frac{a}{n/i} = 119 \overline{2/300} = 81.97$$

- From Tables

Or compute as below :

$$\frac{a}{n/i} = \frac{1 - (1+i)^{-n}}{i}$$

$$119 \overline{2/300} = \frac{1 - (1 + 2/300)^{-119}}{2/300}$$

$$= 81.97$$

This is the cash value at the time of taking possession of the finished house. This figure will further reduce to Rs. 20,700 x 0.9233 = Rs. 19,100 because of 8% interest during construction period (one year).

Taking low cost housing at Rs. 35/- per SQ ft., 546 SQ ft., covered area can be constructed in category B House.

*[Faint, illegible text and markings, possibly bleed-through from the reverse side of the page.]*



Case Study No. 17

( Construction of a New Deepwater Seaport )

A country has only one permanent deepwater seaport capable of handling international shipping. In addition, some volume of trade is handled at an anchorage located 200 nautical miles north west of the existing port. There is congestion at the only port, ships have to wait at the outer bar (sometimes a week to 10 days) before going in berth in the harbour. There are delays at shipside and turn around position has deteriorated beyond the tolerance of the international shipping lines. The shipping conference covering the country's trade has imposed a surcharge of 10 to 15 percent on freight charges. The

volume of cargo expected in the next 20 years; far exceeds the existing capacity of the port. It will be necessary to undertake major development programmes at the existing port and anchorage in order to handle the estimated increase in imports and exports. An engineering study has indicated the immediate need for first phase development of a permanent second port at an estimated cost of Rs. 14.62 crore rupees. Examine the economic feasibility of undertaking the second port project at the existing anchorage site. Capital is available at a low interest rate of 8 percent from a long term lending agency.

Types of cargo

The type of cargo to be handled at a port is a primary consideration in planning permanent port facilities. The country's imports are iron ore, coal, food grains, fertiliser and general cargo. Exports are rice, cement,

cotton, and general cargo. It is expected that country will export wheat surplus in future. Economic growth of the country will bring about a marked increase in the imports and exports of general cargo. Three distinct types of marine terminals (berths) can best serve the present and future trade. General cargo requires a conventional general cargo berth made up of a marginal wharf with transit and storage sheds served by rail and road. For proper handling of food grains, an efficient bulk cargo berth is needed. This type of berth has bulk loading equipment at the ship berths, with conveyors to carry the foodgrains from storage sites to ship holds. Another similar bulk cargo berth would be used for iron ore and coal unloading by conveyor from ship to storage piles in the adjacent steel mills. Petroleum products require a special tanker berth with pipe line connections to a tank farm located in vicinity of the port. Volume of oil import is probable as the country may find oil in the near future.

The three types of terminals for ocean going ships must be supplemented by various port buildings, utility services, roads and railway. These are essential to the operation of the port. Housing, schools, shopping areas, hospital and recreational facilities for the port staff will have to be built in the vicinity.

#### Quantity

Another controlling factor in port planning is the volume of cargo to be cleared through the port. The present anchorage handled 1.51 million tons during the last year (1975-76). This figure is made up of 0.71 million tons of exports and 0.80 million tons of imports.

The table below shows estimated future imports and exports of the country; and of the tonnage required to be handled at the two ports. The tonnage at each port will depend, of course, on the capacity available at the other.

Table I A

Estimated Volume of Exports and Imports \*

Year	( Low Estimates )					Million Tons				
	1976/77	1981/82	1986-/87	1991/92	1996/97	1976/77	1981/82	1986-/87	1991/92	1996/97
Exports	1.40	1.85	2.30	2.95	3.70					
Imports	3.10	4.35	5.90	6.75	7.90					
Total Estimated Tonnage	4.50	6.20	8.20	9.70	11.60					
Existing Port	2.60	4.20	5.20	6.10	6.30					
Existing anchorage (New port)	1.90	2.00	3.00	3.60	5.30					
Estimated Cargo at New Port by Type										
Foodgrains	0.40	0.50	0.50	0.50	0.50					
Cement	0.20	0.40	0.65	0.90	1.20					
Cotton	0.70	0.85	1.00	1.20	1.40					
General Cargo	0.60	0.25	0.85	1.00	2.20					
Total : -	1.90	2.00	3.00	3.60	5.30					

The above estimates are at the lower limit of the probable range. Higher estimates, based on alternative and what are believed to be on the whole more realistic assumption, are as follows :

Table I B

Estimated Volume of Exports and Imports \*

	( High Estimates )					Million Tons				
	1976/77	1981/82	1986/87	1991/92	1996/97	1976/77	1981/82	1986/87	1991/92	1996/97
Exports	1.40	1.90	2.40	3.00	3.80					
Imports	3.10	5.10	6.60	8.10	9.60					
Total Estimated Tonnage	4.50	7.00	9.00	11.0	13.40					
Existing Port	2.60	4.20	5.30	6.30	6.70					
New Port (Existing Anchorage)	1.90	2.80	3.70	4.80	6.70					
Estimated Cargo at New Port by Type										
Foodgrains	0.40	0.50	0.50	0.50	0.50					
Cement	0.20	0.40	0.75	1.10	1.40					
Cotton	0.70	0.85	1.00	1.20	1.40					
General cargo	0.60	1.05	1.45	2.00	3.40					
Total :	1.90	2.80	3.70	4.80	6.70					

\* Exclusive of Petroleum Products , see page 134 para 2.

The estimates of future cargo are based on tentative projections and indicate the approximate rate at which the sea borne trade is going to grow. The estimates should be considered with the following qualifications and limitations in mind:

1. The principal element in the difference between the low and the high estimates is in the volume of development imports for the economic development of the country.
2. The estimates do not include any oil imports for the new port as the existing port will continue to handle petroleum products.
3. Food grains imports are going to diminish and it is hoped that the country will be able to export some quantity of wheat in the near future.
4. The estimates of tonnage to be handled at the new port depend on the tonnage which will be handled at the existing port, and assumptions have accordingly been made as to the expansion of the port facilities there. Both the ports will need to be rapidly expanded and operated at the highest efficiency in order to handle the estimated future volume of trade.

#### Berth requirements

For planning purposes, the accepted practice in United States is to use a capacity figure of 150,000 short (U.S) tons (134,000 long or imperial tons) of general cargo per berth per year. Actual statistics of cargo handled at the existing port during 1971-72 confirm that this amount of cargo was handled there. The berths in the existing port are now handling much greater quantities and it has been estimated that each berth will have to handle 200,000 long tons each year for the next several years. This can only be done by resorting

overtime work and higher than normal berth occupancy rates. Because of the great volume of cargo forecast and the great expense involved in construction of a permanent port, the figure of 180,000 long tons per berth per year is used in this case study in determining the requirements for general cargo berths.

At the bulk cargo terminal special equipment for fast unloading and transporting to stock piles permits much higher tonnage figures for grains, cement (in clinkers), ore and coal to be realised. The bulk cargo terminal would be designed to handle over 1 million tons per year, the governing factors being the unloading equipment provided and the rate at which the cargo can be cleared from the port area. Foodgrains, cement, ore and coal will accordingly be handled at bulk cargo berths.

Given the number of general cargo berths projected for the existing port (shown in brackets), the estimates for the new port work out as below :

	1982	1987	1992	1997
Existing port (15)	(15)	(19)	(23)	(23)
New port (Low estimate) 2	2	5	6	13
(High estimate) 6	6	9	12	20

It is recommended that the first phase of the port development be undertaken by next year (1977-78) and that it consist of a foodgrain terminal, a bulk cargo terminal and 8 general cargo berths. If completed by

1982, the first phase will provide for the increased tonnage expected to develop in the ensuing 5 and possibly 10 years. The 8 general cargo berths recommended for the first phase will be used to capacity by about 1987 on the high estimate, or by about 1992 on the low estimate of future tonnage. Similarly, whether the need for 20 berths is reached by 1987 or year 2002 is less important than the fact that this need can now be foreseen and will eventually have to be met.

#### Port Revenue and Expenditure

A comparative analysis of the revenue and expenditure of the existing port and existing anchorage (New Port) is made difficult by their accounting. The existing port accounts are available in great detail, while the existing anchorage (new port) expenditures and revenues are not classified under the same heads. Summary statements of the finances of the two ports for the years 1971-72 to 1975-76 are given in Table II and Table III.

Table II  
Existing Anchorage (Proposed New Port)  
Summary of Revenue and Expenditure

	Million Rs.				
Revenue	1971-72	1972-73	1973-74	1974-75	1975-76
Landing+Mooring Fees	1.661	1.392	1.756	1.994	1.896
Port + River dues	2.589	2.282	2.816	3.199	3.016
Pilotage	0.558	0.501	0.554	0.664	0.564
Miscellaneous	0.350	0.398	0.301	0.386	0.400
- Less refund	- 0.049	- 0.018	- 0.033	- 0.002	0.050
Total :	5.109	4.555	5.394	6.221	5.826
Expenditure	2.030	1.600	1.612	1.796	2.222
Surplus	3.079	2.955	3.782	4.425	3.604

Table III  
Existing Port - Summary of Revenue and Expenditure

	Million Rupees				
Revenue	1971-72	1972-73	1973-74	1974-75	1975-76
Bunders + Jetties	N.A.	21.077	25.303	26.306	26.714
Charges at Moorings	N.A.	1.688	1.623	2.300	2.300
Sub Total :		22.765	26.926	28.606	29.014
River & Canal	9.302	8.109	9.206	9.654	10.122
Port Department	0.888	0.977	0.903	1.011	1.037
Pilotage	0.436	0.598	0.587	0.738	0.760
Railway Dept.	N.A.	1.777	1.556	2.012	2.035
Lands + Buildings	0.157	0.316	0.391	0.407	0.619
Miscellaneous	0.158	0.172	0.116	0.201	0.162
Interest	0.599	1.792	2.523	3.459	3.520
Total :	11.540	36.506	42.208	46.088	47.269
<u>Expenditure</u>					
Bunder + Jetties	0.003	4.972	5.720	9.118	8.995
River + Canal	0.358	0.295	0.370	0.826	0.839
Port Department	2.865	3.058	2.218	2.203	2.455
Pilotage	0.266	0.313	0.280	0.360	0.462
Railways Dept.	N.A.	0.214	0.741	1.024	1.004
Lands + Buildings	0.133	0.552	0.849	1.416	2.182
General charges + Contributory Funds	1.328	4.648	5.197	8.280	8.201
Interest on loans	0.266	0.255	4.782	4.718	4.755
Total	5.219	14.307	20.157	27.945	28.893
Surplus Revenue Over Expenditure	6.321	22.199	22.051	18.143	18.376
Surplus Less Income Interest Plus Interest on loans	5.988	20.662	24.310	19.402	19.611

Revenue and expenditure per ton of cargo handled at the existing port will give some indication of the revenue and expenditure which may be expected at the new port when it is completed by 1982.

Table IV

Comparison of Revenue and Expenditure per ton at the Existing Port and the existing anchorage (to be developed into a permanent port)

Average 1972-73 to 1974-75

	Rupees per ton	
	Port to be developed	Existing Port
<b>REVENUE PER TON</b>		
Bundlers + Jetties	-	8.33
Moorings	-	0.64
Sub total landings & Moorings	1.52	8.97
Port and River	2.46	3.42 (1)
Pilotage	0.50	0.22
Miscellaneous	0.31	0.79 (2)
<b>Total :</b>	<b>4.79</b>	<b>13.40 (3)</b>
<b>Expenditure per ton</b>	<b>1.48</b>	<b>6.03 (4)</b>
<b>Surplus :</b>	<b>3.31</b>	<b>7.37</b>

- (1) Income from River and canal and port department combined
- (2) Railways, land and Buildings and Misc. income combined.
- (3) Excluding interest
- (4) Excluding Debt charges.



Table IV shows that the main source of the higher revenue per ton at the existing port is from bunders and jetties. This is also the main source of the higher surplus, contributing Rs. 6.70 of the total surplus of Rs. 7.37 per ton. A secondary source of the difference is the railway department, which accounted for Rs. 0.61 per ton of the Rs. 0.79 shown under Miscellaneous. If these two items are deducted and if Rs. 1.52 is substituted for Rs. 0.64 as the revenue per ton from moorings, total revenue per ton at existing port would be Rs. 5.34, which is quite close to the total at existing anchorage (to be developed into a permanent second port).

Expenditures per ton at existing port can be adjusted in the same way to compare with those at the anchorage. Expenditures under "Bunders and Jetties" were Rs. 2.27 per ton and Rs. 0.23 per ton in the railway department, leaving an adjusted total expenditure of Rs. 3.53 at existing port compared to Rs. 1.48 at the anchorage. General expenses at the existing port are thus more than twice as high as they are at the anchorage. Correspondingly, the adjusted surplus at the existing port is only Rs. 1.87 per ton compared to Rs. 3.31 at the anchorage.

It follows from the above :

1. A large income from wharf charges is the principal change on the revenue side which may be expected at anchorage upon conversion to a port. This income will also be the principal source of the surplus of revenue over expenditure, from which the capital costs of the project can be recovered.

2. General operating expenses may also be expected to rise. The large scale growth of establishment at the existing port may not be necessary and consistent with maximum efficiency. The capital costs of the new permanent port will be high, and it is therefore important to keep the requirements for personnel, administration, buildings and housing as low as reasonably possible.

In calculating estimated benefits from the new port, two figures of surplus per ton have been used: (1) the actual surplus at existing port shown in Table IV; 2) the surplus which would result from the assumption that general expenses at the new port will increase from Rs. 1.48 to Rs. 2.50 instead of to Rs. 3.53 per ton, that is, by only half as much as the present difference between the existing anchorage and port. This would yield a surplus of Rs. 8.40 per ton instead of Rs. 7.37.

The annual revenue and surplus which would be obtained from the recommended first phase of development of the anchorage into a permanent port, based on the estimated tonnage of cargo, are shown in Table V.

Table V-A  
Revenue & Surplus, Existing Anchorage (New Port)  
First Phase - Low estimate

Years	Tonnage (Million Tons)	Revenue Rs.13.40 per ton	Million Rs.	
			Surplus Rs.7.37 per ton	Rs.8.40 per ton
1982/83 to 86/87	1.66	22.2	12.2	13.9
1987/88 to 91/92	2.31	31.0	17.0	19.4
1992/93 to 96/97	2.88	38.6	21.2	24.2
1997/98	3.14	42.1	23.4	26.4

Table V-B

Revenue & Surplus, Existing Anchorage (New Port)

First Phase - High Estimate

Years	Tonnage Million Tons	Revenue Rs.13.40 per ton	Surplus	
			Rs.7.37 per ton	Rs.8.40 per ton
1982/83-86/87	2.27	30.4	16.7	19.1
1987/88-91/92	2.86	38.3	21.1	24.0
1992/93-96/97	3.19	42.7	23.5	26.8
1997/98	3.34	44.8	24.8	28.1

The tonnage has been estimated for the next 15 years (1st Phase 1982-83 to 1996-97) only. The proposed port facilities have an economic life of 50 years. It is assumed for economic analysis that the tonnage remains at the 1997-98 level for the remaining 35 years (upto year 2032) of the useful life of the project. Accordingly, average annual tonnage has been computed as below :

Low Estimate

Average annual tonnage

$$\begin{aligned}
 1.66 \times 5 &= 8.30 \\
 2.31 \times 5 &= 11.55 \\
 2.88 \times 5 &= 14.40 \\
 3.14 \times 35 &= 109.90
 \end{aligned}$$

$$144.15 \div 50 = 2.88 \text{ million tons}$$

High Estimate

Average Annual tonnage

$$\begin{aligned}
 2.27 \times 5 &= 11.35 \\
 2.86 \times 5 &= 14.30 \\
 3.19 \times 5 &= 15.95 \\
 3.34 \times 35 &= 116.90
 \end{aligned}$$

$$158.50 \div 50 = 3.17 \text{ Million Tons}$$

The tonnage figures are obtained from the estimates in Table I-A and I-B, these include foodgrains, cement, general cargo and 10% of cotton exports, which could be expected to use the general cargo berths. The tonnage using the general cargo berths will gradually increase to maximum capacity available (1.44 million Tons) on completion of first phase construction. Maximum capacity= 0.18 million tons per berth multiplied by 8—the no. of berths. The maximum capacity will be reached in the year 1994 on the low estimate and 1986 on the high estimate. The port facilities are designed for an expected life of 50 years. Total estimated revenue and surplus over this period are shown below; discounting is at 8% per year to 1982.

Table VI

Total 50 years (1982-2032) Tonnage	Revenue and Surplus Benefit	Million Rupees	
		Total 1982- 2032	Discounted* at 8% to 1st July, 1982
Low Estimate	Revenue - Rs.13.40 per ton	1,933	492
144.15	Surplus - Rs. 7.37 per ton	1,069	270 -
Million Tons	- Rs. 8.40 per ton	1,210	308
High Estimate	Revenue - Rs.13.40 per ton	2,120	5538
158.50	Surplus - Rs. 7.37 per ton	1,168	296
Million Tons	- Rs. 8.40 per ton	1,330	338 -

The total discounted surplus would thus be between Rs.270 million and Rs.338 million or between 1.46 and 1.83 times the estimated capital cost of the project. This shows that the new port will be self-liquidating on the basis of current dues and charges levied at the existing ports.

Other Benefits

The volume of trade forecast and the need for a second port to handle this volume indicates that the development of the existing anchorage into a permanent second port will be a

\*See Table 6-4 (Appendix) for discount factor.

national project essential to the planned economic growth of the country. The new port is going to contribute in the growth of national production and will clearly pay for itself many times over during the expected 50 years of its useful life. The port will be a major project and enterprise, employing a large number of people. Even the initial first phase construction will employ thousands of men and require quantities of materials for 3 to 4 years, and later expansion will be necessary as the volume of trade continues to grow. The new port will help accelerate industrialisation of the country. Consumer goods imported from abroad will be cheaper, since the delays due to congestion at the existing port will be eliminated.

Recommended Initial Construction :

The first phase development provides for necessary facilities for handling the tonnage expected by the year 1996-97. The ultimate master plan will be implemented in phases so as to provide the essential installations at the time they are needed. The first phase construction cost is shown in Table VII.

Table VII  
Estimated Construction Cost - First Phase.

Item	Million Rs.	
	Cost	Total Cost
1. Land Acquisition		1.500
2. Clearing and Grubbing		0.475
3. Mobilization		1.000
4. Dredging and fill		9.500
5. General Cargo berths		
a. Whatves	23.600	
b. Transit Sheds Passenger Terminals.	10.000	
c. Ware houses	7.500	
d. Wharf Cranes	<u>9.000</u>	50.100

6. Bulk Cargo Terminal		
a. Wharf Structure	7.000	
b. Storage and material	<u>3.000</u>	10.000
7. Foodgrain Terminal		
a. Wharf Structure	7.000	
b. Storage and Material handling	<u>3.500</u>	10.500
8. Coastguard Terminal		
a. Wharf Structure	3.500	
b. Office Buildings	1.600	5.100
9. Vessel maintenance and repair facilities.		
a. Slipway and workshop	1.550	
b. Repair berth	<u>2.600</u>	4.150
10. Roads and Culverts		
a. Main roads	1.500	
b. Local roads	0.600	
c. Culverts	<u>0.300</u>	2.400
11. Railway and Crane Tracks		
a. Railway tracks	3.540	
b. Crane Tracks	<u>0.650</u>	4.190
12. Utility Systems		
a. Sanitary Sewer	1.350	
b. Water Supply	2.500	
c. Fire Protection	2.950	
d. Electrical distribution	0.980	
e. Telephones	0.785	
f. Fire alarm	0.180	8.745
13. Miscellaneous facilities		
a. Weigh bridge and truck scales	0.200	
b. Perimeter fence	0.650	
c. Signal tower	0.075	
d. Ferry terminal	0.500	
f. Heavy lift equipment-Railway	0.600	
g. Heavy lift equipment-wharves	<u>1.000</u>	4.655
14. Residential Area		
a. Housing	4.575	
b. Schools, Hospital, Market, etc.	1.250	
c. Streets and Park	<u>0.850</u>	6.675
15. Administrative Area		
a. Office building	0.875	
b. Workshops and Gatages	<u>1.000</u>	1.875
Sub Total :		<u>120.865</u>
Contingencies-10%		<u>12.086</u>
		<u>132.951</u>
Engineering and Administrative Costs-10%		<u>13.295</u>
TOTAL ESTIMATED COST		<u>146.246</u>

= 14.62 Crore Rupees

### Construction Period

It is estimated that a period of five years will be required to complete the design and construction of the first phase of development. Estimated annual expenditures compounded to 1st July, 1982 are as below :

Table VIII

Million Rs.				
No. of years	Year	Expenditure	Compound Factor @ 8%	Capital worth as of 1st July, 1982.
1.	1977-78	11.000	1.4693	16.18
2.	1978-79	40.000	1.3604	54.50
3.	1979-80	45.000	1.2597	56.60
4.	1980-81	35.000	1.1664	40.80
5.	1981-82	15.246	1.0800	16.47
T o t a l :		146.246		184.55

### Comparison of Benefits and Costs

The total capital cost of the recommended first phase of development is estimated at Rs. 146.246 million with Interest (at 8%) during the five year construction period, the total cost would amount to Rs. 184.55 million.

The total surplus of port revenue over expenditure, arising out of the tonnage to be handled, and discounted to 1982, was estimated at Rs. 270 million to Rs. 338 million. This would give a benefit/cost ratio of between 1.46 to 1.83.

Another way of stating the ratio of benefits/costs is to compare the annual benefit with the cost of amortizing the capital by a series of equal year end payments at a given rate of interest. The average annual surplus, not discounted, would be between Rs. 2.12 (see table VI - Rs. 1043 million ÷ 50 years) crores and Rs. 2.66 (Rs. 1330 million ÷ 50 years) crores.

The annual cost of amortizing the capital, including interest (at 8%) over the 50 years of the port's expected useful life would be Rs. 184.55 million  $\div$  12.2334\* = Rs. 15.06 million. This gives a Benefit/Cost ratio of 1.41 to 1.76. The slight difference in these ratios and those above is due to the benefits being unevenly spread over the life of the port - the higher benefits being further in the future and this subject to heavier discounting.

Since interest at 8 percent over 50 years amounts to a large sum, it would be better to amortize the cost over a short period. The capital recovery factor  $(184.55 \div 9.8181)^*$  over 20 years would be Rs. 18.80 million/which would yield a Benefits/Costs ratio of 1.13 to 1.41. After the first 20 years, the entire surplus would be uncommitted and available for other purposes.

Finally, the return on capital—average annual benefits divided by capital cost, works out to 11.5% (2.12 crores  $\div$  18.455x100) on the low estimate of tonnage at Rs. 7.37 per ton and to 14.4% (2.66  $\div$  18.455x100) on the high estimate at Rs. 8.40 per ton.

#### Recommendations

A permanent port is found to be economically feasible and it is recommended that the first phase of the port construction be under taken immediately. The estimated cost of this initial construction phase is Rs. 14.62 crores, spread over a five year period.

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\*Factors 12.2334 and 9.8181 are obtained from "Present value of annuity" Tables.



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P A R T - III

...	APPENDICES	...
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ABBREVIATIONS

A

- AA DT : Average annual daily traffic  
AFL-CIO : American Federation of Labour & Congress  
of Industrial Organizations.  
AMR : Annual Maintenance & Repair Costs.  
AOMR : Annual Operation, Maintenance & Repair Costs.

C

- CIF : Cost, Insurance and Freight.  
CEC : Cotton Export Corporation

D

- DCF : Discounted Cash Flow  
DCFR : Discounted Cash Flow Rate of Return  
DM : Deutsche Mark

E

- EBIT : Earnings before Interest and Taxes  
EEC : European Economic Community  
EPS : Earnings per Share (of common stock)

F

FAS : Free Alongside  
FOB : Free on Board  
FOR : Free on Rails  
FOQ : Free on Quay  
FAO : Food and Agricultural Organization of UN  
FOT : Free of Tax

G

GATT : General Agreement on Tariffs and Trade

I

IBRD : International Bank for Reconstruction & Development  
( World Bank )  
IDA : International Development Association  
IFC : International Finance Corporation  
IMF : International Monetary Fund  
IAEA : International Atomic Energy Agency  
IDBP : Industrial Development Bank of Pakistan  
ITU : International Tele Communications Union  
ILO : International Labour Organization

K

Kilo : Thousand,  $10^3$

M

Mega : Million, 10<sup>6</sup>

N

NEC : National Economic Council

O

OECD : Organization for Economic Cooperation and Development

OEEC : Organization for European Economic Cooperation

OPEC : Organization of Petroleum Exporting Countries

P

PICIC : Pakistan Industrial Credit & Investment Corporation

PFC : People's Finance Corporation

S

SDRs : Special Drawing Rights (IMF)

SR : Saudi Riyal

T

TCP : Trading Corporation of Pakistan

U

- UN : United Nations
- UNCTAD : UN Conference on Trade and Development
- UNIDO : UN Industrial Development Organization
- UNICEF : UN International Children's Emergency Fund
- UNESCO : UN Educational, Scientific & Cultural Organization.
- UNDP : UN Development Programme
- UNESOC : UN Economic and Social Council
- UNRWA : UN Relief and Works Agency

W

- WHO : World Health Organization.

F I G U R E S

CASH FLOW STATEMENT

	Million Rs.				
	First year	Second year	Third year	Fourth year	Fifth year
<u>Sources of funds</u>					
Share capital					
Long term loans					
Short term loans					
Net profit after taxes					
Depreciation					
Total					
<u>Uses of funds</u>					
Fixed Assests					
Net working capital					
Interest					
Repayment of loans					
Dividends					
Total					

Figure 1

BALANCE SHEET FORECASTS

	Million Rs.				
	First year	Second year	Third year	Fourth year	Fifth year
<u>ASSETS</u>					
Fixed Assests (less depreciation)					
Capital work in progress					
current assests					
Deferred revenue					
expenditure					
Total					
<u>LIABILITIES</u>					
Share capital					
Reserves					
Long-term debt					
Surplus					
current Liabilities and provisions					
Total					

Figure 2

BREAK EVEN POINT CHART

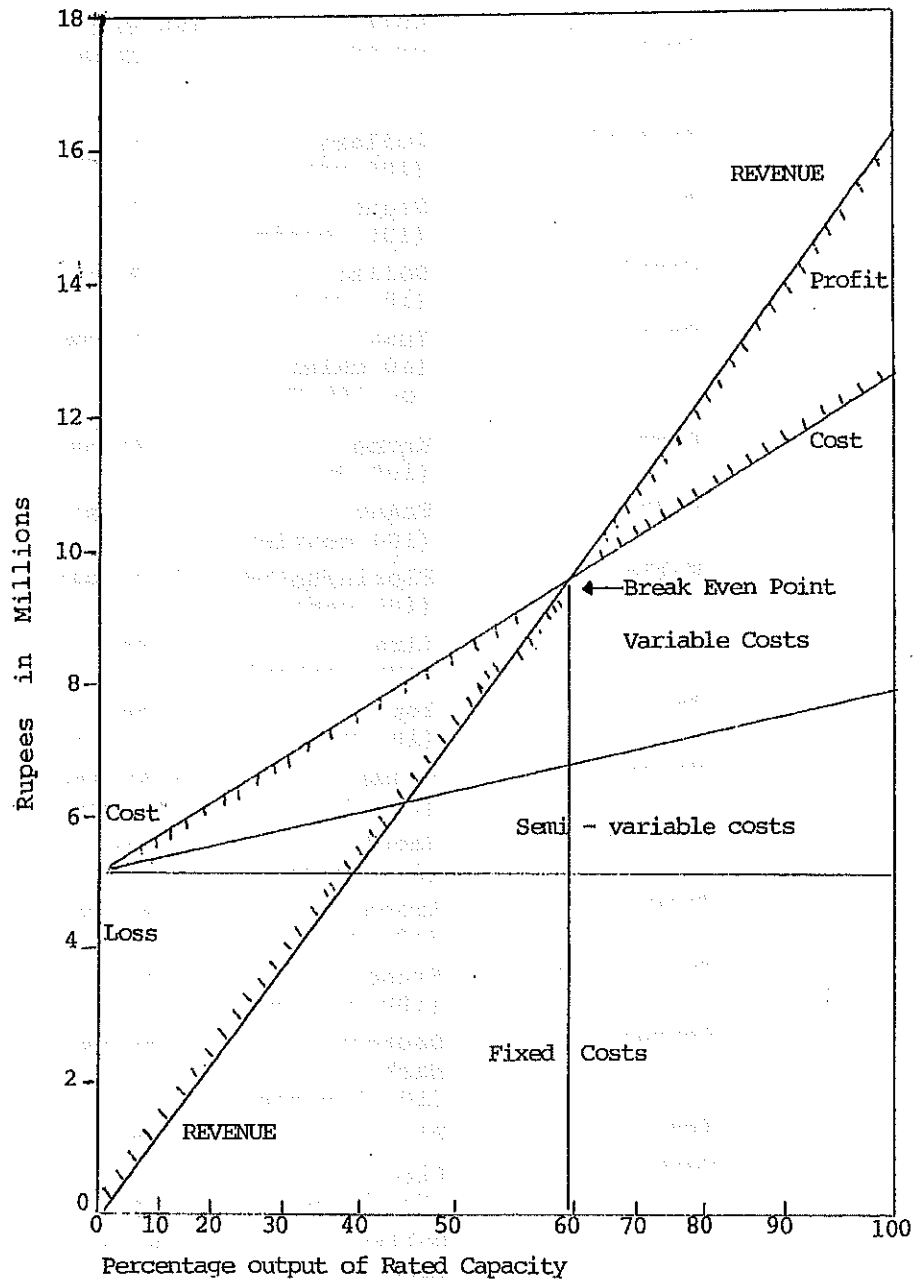


Figure 3

TABLE OF EXCHANGE RATES

(Correct as of June 12, 1976)

<u>Country</u>	<u>Unit of Currency</u>	<u>100 Pak rupees Equal</u>
Australia	Dollars (100 cents)	8.170
Belgium	Franc (100 centimes)	397
Canada	Dollar (100 cents)	9.822
China	Yuan (10 chiao) or 100 fen	19.754
Denmark	Krone (100 Ore)	61.357
France	Franc (100 centimes)	47.527
Holland	Florin/Builder (100 cents)	27.943
Italy	Lira (100 centesimi)	8573
Japan	Yen (100 Sen)	3013
Norway	Krone (100 Ore)	55.494
Portugal	Escudo (100 centaros)	310
Sweden	Krona (100 ore)	44.565
Switzerland	Franc (100 centimes)	25.037
Germany	Deutsche Mark (100 Pfennig)	25.858
Iran	Riyal	721
Turkey	Lira (100 kurus)	169
USA	Dollar (100 cents)	9.736
England	Pound (20 Shillings)	5.705



PARITY EXCHANGE RATES ( 1974 )

Country	Currency	Equivalent Pakistan Rs	Country	Currency	Equivalent Pakistan Rs
Abu Dhabi	Dirham	2.5080	Netherlands	Guilder	3.5596
Ajman	Dirham	2.5080	Nepal	Rupee	0.9375
Australia	Dollar	14.7262	New Zealand	Dollar	14.6322
Austria	Schilling	0.5059	Nigeria	Pound	15.0480
Bahrain	Dinar	25.0800	Norway	Crown	1.6553
Belgium	Franc	0.2454	Oman	Rial Omani	28.6627
Burma	Kyat	2.0566	Portugal	Escudo	Floating
Canada	Dollar	Floating	Ras-Al-Khaimah	Dirham	2.5080
China	Renminbi Yuan	5.2828	Saudi Arabia	Rial	2.7887
Cyprus	Pound	28.6628	Sharjah	Dirham	2.5080
Denmark	Crown	1.5759	Sierra Leone	Leone	Floating
Dubai	Dirham	2.5080	Singapore	Dollar	Floating
Ethiopia	Dollar	4.7771	Somali Republic	Shilling	1.5884
Finland	Markka	2.5383	Spain	Peseta	0.1706
France	Franc	2.1502	Sri Lanka	Rupee	Floating
Germany (West)	D. Mark	3.7092	Switzerland	Franc	Floating
Greece	Drachma	0.3300	Sweden	Crown	22.1710
India	Rupee	Floating	Tanzania	Shilling	1.4348
Iraq	Dinar	33.4400	Thailand	Baht	0.4759
Iran	Rial	0.1452	Tunisia	Dinar	22.7482
Italy	Lira	Floating	Turkey	Pound	0.7071
Japan	Yen	Floating	Uganda	Shilling	1.3860
Jordan	Dinar	30.8001	Umm-Al-Qaiwain	Dirham	2.5080
Kenya	Shilling	1.4348	United Arab Emirates	Dirham	2.5080
Kuwait	Dinar	33.4400	U.K.	Pound Sterling	Floating
Lebanon	Pound	No fixed parity	U.S.A.	Dollar	9.9000
Liberia	Dollar	11.0000	U.S.S.R.	Rouble	13.2626
Libya	Dinar	33.4400	Yemen Arab Republic	Rial	2.3500
Malaysia	Dollar	Floating	Yugoslavia	Dinar	0.5823
Mauritius	Rupee	Floating	Zambia	Kwacha	15.4000
Morocco	Dirham	2.3600			
Mexico	Peso	0.8800			

METRIC SYSTEM  
HANDY CONVERSION RULES  
=====

To convert	..... Multiply by	To convert	Multiply by
Inches to Centimeters	2.540	Cub. Centimeters to Cub. Inches	0.06102
Centimeters to inches	0.3937	Cub. Feet to Cub. Metres	0.02832
Feet to Meters	0.3048	Cub. Metres to Cub. Feet	35.31
Meters to Feet	3.281	Cub. Yards to Cub. Metres	0.7646
Yards to Metres	0.9144	Cub. Metres to Cub. Yards	1.308
Metres to Yards	1.094	Cub. inches to Litres	0.01639
Miles to Kilometers	1.609	Litres to Cub. inches	61.03
Kilometers Miles	0.6214	Gallons to Litres	4.546
Sq. Inches to Sq. Centimetres	6.452	Litres to Gallons	0.22
Sq. Centimetres to Sq. inches	0.1550	Grains to Grams	0.0648
Sq. Feet to Sq. Metres	0.0929	Grams to Grains	15.43
Sq. Metres to Sq. Feet	10.76	Ounces to Grams	28.35
Sq. Yards to Sq. Metres	0.8361	Grams to Ounces	0.03527
Sq. Metres to Sq. Yards	1.196	Pounds to Grams	453.6
Sq. Miles to Sq. Kilometers	2.590	Grams to Pounds	0.002205
Sq. Kilometres to Sq. Miles	0.3861	Pounds to Kilograms	0.4536
Acres to Hectares	0.4047	Kilograms to Pounds	2.205
Hectares to Acres	2.471	Tons to Kilograms	1016.
Cub. inches to Cub. Centimeteres	16.39	Kilograms to Tons	0.0009842

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3. Economic and financial Appraisal of Public Enterprises, Planning Division, Govt. of Pakistan, United Consultants Ltd., Lahore. May, 1975.

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4. Lahore-Lyallpur Highway Economic and Engineering feasibility report. M/s Louis Berger, Inc., Consulting Engineers.
5. A Manual for the Economic Appraisal of transport projects by Hans A. Adler. Planning Commission, Govt. of Pakistan. June, 1969.
6. Economic and Engineering feasibility study - Chalna Port (Pussur River), Bangla Desh. Frederic R. Harris, Inc. New York.

Table 6-1  
PRESENT VALUE OF \$1

Periods until Payment	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1.....	0.990	0.980	0.962	0.943	0.926	0.909	0.893	0.877	0.870	0.862	0.847	0.833	0.820	0.806	0.800	0.794	0.781	0.769	0.741	0.714	0.690	0.667
2.....	0.980	0.961	0.925	0.890	0.857	0.826	0.797	0.769	0.756	0.743	0.718	0.694	0.672	0.650	0.640	0.630	0.610	0.592	0.549	0.510	0.476	0.444
3.....	0.971	0.942	0.889	0.840	0.794	0.751	0.712	0.675	0.658	0.641	0.609	0.579	0.551	0.524	0.512	0.500	0.477	0.455	0.406	0.364	0.328	0.296
4.....	0.961	0.924	0.855	0.792	0.735	0.683	0.636	0.592	0.572	0.552	0.516	0.482	0.451	0.423	0.410	0.397	0.373	0.350	0.301	0.260	0.226	0.198
5.....	0.951	0.906	0.822	0.747	0.681	0.621	0.567	0.519	0.497	0.476	0.437	0.402	0.370	0.341	0.328	0.315	0.291	0.269	0.223	0.186	0.156	0.132
6.....	0.942	0.888	0.790	0.705	0.630	0.564	0.507	0.456	0.432	0.410	0.370	0.335	0.303	0.275	0.262	0.250	0.227	0.207	0.165	0.133	0.108	0.088
7.....	0.933	0.871	0.760	0.665	0.583	0.513	0.452	0.400	0.376	0.354	0.314	0.279	0.249	0.222	0.210	0.198	0.178	0.159	0.122	0.095	0.074	0.059
8.....	0.923	0.853	0.731	0.627	0.540	0.467	0.404	0.351	0.327	0.305	0.266	0.233	0.204	0.179	0.168	0.157	0.139	0.123	0.091	0.068	0.051	0.039
9.....	0.914	0.837	0.703	0.592	0.500	0.424	0.361	0.308	0.284	0.263	0.225	0.194	0.167	0.144	0.134	0.125	0.108	0.094	0.067	0.048	0.035	0.026
10.....	0.905	0.820	0.676	0.558	0.463	0.386	0.322	0.270	0.247	0.227	0.191	0.162	0.137	0.116	0.107	0.099	0.085	0.073	0.050	0.035	0.024	0.017
11.....	0.896	0.804	0.650	0.527	0.429	0.350	0.287	0.237	0.215	0.195	0.162	0.135	0.112	0.094	0.086	0.079	0.066	0.056	0.037	0.025	0.017	0.012
12.....	0.887	0.788	0.625	0.497	0.397	0.319	0.257	0.208	0.187	0.168	0.137	0.112	0.092	0.076	0.068	0.062	0.052	0.043	0.027	0.018	0.012	0.008
13.....	0.879	0.773	0.601	0.469	0.368	0.290	0.229	0.182	0.161	0.145	0.116	0.093	0.075	0.061	0.055	0.050	0.040	0.033	0.020	0.013	0.008	0.005
14.....	0.870	0.758	0.577	0.442	0.340	0.263	0.205	0.160	0.141	0.125	0.093	0.078	0.062	0.049	0.044	0.039	0.032	0.025	0.015	0.009	0.006	0.003
15.....	0.861	0.743	0.555	0.417	0.315	0.239	0.183	0.140	0.123	0.108	0.084	0.065	0.051	0.040	0.035	0.031	0.025	0.020	0.011	0.006	0.004	0.002
16.....	0.853	0.728	0.534	0.394	0.292	0.218	0.163	0.123	0.107	0.093	0.071	0.054	0.042	0.032	0.028	0.025	0.019	0.015	0.008	0.005	0.003	0.002
17.....	0.844	0.714	0.513	0.371	0.270	0.198	0.146	0.108	0.093	0.080	0.060	0.045	0.034	0.026	0.023	0.020	0.015	0.012	0.006	0.003	0.002	0.001
18.....	0.836	0.700	0.494	0.350	0.250	0.180	0.130	0.095	0.081	0.069	0.051	0.038	0.028	0.021	0.018	0.016	0.012	0.009	0.005	0.002	0.001	0.001
19.....	0.828	0.686	0.475	0.331	0.232	0.164	0.116	0.083	0.070	0.060	0.043	0.031	0.021	0.017	0.014	0.012	0.009	0.007	0.003	0.002	0.001	0.001
20.....	0.820	0.673	0.456	0.312	0.215	0.149	0.104	0.073	0.061	0.051	0.037	0.026	0.019	0.014	0.012	0.010	0.007	0.005	0.002	0.001	0.001	0.001
21.....	0.811	0.660	0.439	0.294	0.199	0.135	0.093	0.064	0.053	0.044	0.031	0.022	0.015	0.011	0.009	0.008	0.006	0.004	0.002	0.001	0.001	0.001
22.....	0.803	0.647	0.422	0.278	0.184	0.123	0.083	0.056	0.046	0.038	0.026	0.018	0.013	0.009	0.007	0.006	0.004	0.003	0.001	0.001	0.001	0.001
23.....	0.795	0.634	0.406	0.262	0.170	0.112	0.074	0.049	0.040	0.033	0.022	0.015	0.010	0.007	0.006	0.005	0.003	0.002	0.001	0.001	0.001	0.001
24.....	0.788	0.622	0.390	0.247	0.158	0.102	0.066	0.043	0.035	0.028	0.019	0.013	0.008	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.001
25.....	0.780	0.610	0.375	0.233	0.146	0.092	0.059	0.038	0.030	0.024	0.016	0.010	0.007	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001
26.....	0.772	0.598	0.361	0.220	0.135	0.084	0.053	0.033	0.026	0.021	0.014	0.009	0.006	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001
27.....	0.764	0.586	0.347	0.207	0.125	0.076	0.047	0.029	0.023	0.018	0.011	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
28.....	0.757	0.574	0.333	0.196	0.116	0.069	0.042	0.026	0.020	0.016	0.010	0.006	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
29.....	0.749	0.563	0.321	0.185	0.107	0.063	0.037	0.022	0.017	0.014	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
30.....	0.742	0.552	0.308	0.174	0.099	0.057	0.033	0.020	0.015	0.012	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
40.....	0.672	0.453	0.208	0.097	0.046	0.022	0.011	0.005	0.004	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50.....	0.608	0.372	0.141	0.054	0.021	0.009	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Source: By permission, from Robert N. Anthony, *Management Accounting: Text and Cases* (rev. ed.; Homewood, Ill.: Richard D. Irwin, Inc., 1960), p. 650.

Table 6-2  
PRESENT VALUE OF \$1 RECEIVED ANNUALLY FOR N YEARS

Years (N)	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1.....	0.990	0.980	0.962	0.943	0.926	0.909	0.893	0.877	0.870	0.862	0.847	0.833	0.820	0.806	0.800	0.794	0.781	0.769	0.741	0.714	0.690	0.667
2.....	1.970	1.942	1.886	1.833	1.781	1.736	1.690	1.647	1.626	1.605	1.566	1.528	1.492	1.457	1.440	1.424	1.392	1.361	1.289	1.224	1.165	1.111
3.....	2.941	2.884	2.775	2.673	2.577	2.487	2.402	2.322	2.283	2.246	2.174	2.106	2.042	1.981	1.952	1.923	1.868	1.816	1.696	1.589	1.493	1.407
4.....	3.902	3.808	3.630	3.465	3.312	3.170	3.037	2.914	2.855	2.798	2.699	2.589	2.494	2.404	2.362	2.320	2.241	2.166	1.997	1.849	1.720	1.605
5.....	4.853	4.713	4.452	4.212	3.993	3.791	3.605	3.433	3.352	3.274	3.127	2.991	2.864	2.745	2.689	2.635	2.532	2.436	2.220	2.035	1.876	1.737
6.....	5.795	5.601	5.242	4.917	4.623	4.355	4.111	3.889	3.784	3.685	3.498	3.326	3.167	3.020	2.951	2.885	2.759	2.643	2.385	2.168	1.983	1.824
7.....	6.728	6.472	6.002	5.582	5.206	4.868	4.564	4.288	4.160	4.039	3.812	3.605	3.416	3.242	3.161	3.083	2.937	2.802	2.508	2.261	2.057	1.883
8.....	7.652	7.325	6.733	6.210	5.747	5.335	4.968	4.639	4.487	4.344	4.078	3.837	3.619	3.421	3.329	3.241	3.076	2.925	2.598	2.311	2.108	1.922
9.....	8.566	8.162	7.435	6.802	6.247	5.759	5.328	4.946	4.772	4.607	4.303	3.786	3.566	3.463	3.366	3.184	3.019	2.665	2.379	2.144	1.948	1.768
10.....	9.471	8.983	8.111	7.360	6.710	6.145	5.650	5.216	5.019	4.833	4.494	4.192	3.923	3.682	3.571	3.465	3.269	3.092	2.715	2.414	2.168	1.965
11.....	10.368	9.787	8.760	7.887	7.139	6.495	5.937	5.453	5.234	5.029	4.656	4.327	4.035	3.776	3.656	3.544	3.335	3.147	2.757	2.438	2.185	1.977
12.....	11.255	10.575	9.385	8.384	7.536	6.814	6.194	5.660	5.421	5.197	4.791	4.439	4.127	3.851	3.725	3.606	3.387	3.190	2.779	2.456	2.196	1.985
13.....	12.134	11.343	9.986	8.853	7.904	7.103	6.424	5.842	5.583	5.342	4.910	4.533	4.201	3.912	3.780	3.656	3.427	3.223	2.799	2.468	2.204	1.990
14.....	13.004	12.106	10.563	9.295	8.244	7.367	6.628	6.002	5.724	5.468	5.008	4.611	4.265	3.962	3.824	3.695	3.459	3.249	2.814	2.477	2.210	1.993
15.....	13.865	12.849	11.118	9.712	8.559	7.606	6.811	6.142	5.847	5.575	5.092	4.675	4.315	4.001	3.859	3.726	3.483	3.268	2.825	2.484	2.214	1.995
16.....	14.718	13.578	11.652	10.106	8.851	7.824	6.974	6.265	5.954	5.669	5.162	4.730	4.357	4.033	3.887	3.751	3.501	3.283	2.834	2.489	2.216	1.997
17.....	15.562	14.292	12.166	10.477	9.122	8.022	7.120	6.373	6.047	5.749	5.222	4.775	4.391	4.059	3.910	3.771	3.518	3.295	2.840	2.492	2.218	1.998
18.....	16.398	14.992	12.659	10.828	9.372	8.201	7.250	6.467	6.128	5.818	5.273	4.812	4.419	4.080	3.928	3.786	3.529	3.304	2.844	2.494	2.219	1.999
19.....	17.226																					

Table 6-3  
PRESENT VALUE OF \$1/12 RECEIVED MONTHLY IN YEAR N

Year (N)	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	0.995	0.989	0.979	0.969	0.959	0.950	0.941	0.932	0.928	0.924	0.915	0.907	0.899	0.892	0.888	0.884	0.877	0.870	0.853	0.837	0.822	0.808
2	0.985	0.970	0.941	0.914	0.888	0.864	0.840	0.818	0.807	0.796	0.776	0.756	0.737	0.719	0.710	0.702	0.685	0.669	0.632	0.598	0.567	0.539
3	0.975	0.951	0.905	0.862	0.823	0.785	0.750	0.717	0.702	0.686	0.657	0.630	0.604	0.580	0.568	0.557	0.535	0.515	0.468	0.427	0.391	0.359
4	0.965	0.932	0.870	0.814	0.762	0.714	0.670	0.629	0.610	0.592	0.557	0.525	0.495	0.468	0.455	0.442	0.418	0.396	0.347	0.305	0.270	0.239
5	0.956	0.914	0.837	0.768	0.705	0.649	0.598	0.552	0.531	0.510	0.472	0.438	0.406	0.377	0.364	0.351	0.327	0.305	0.257	0.218	0.186	0.160
6	0.946	0.896	0.805	0.724	0.653	0.590	0.534	0.484	0.461	0.440	0.400	0.365	0.333	0.304	0.291	0.278	0.255	0.234	0.190	0.156	0.128	0.106
7	0.937	0.879	0.774	0.683	0.605	0.536	0.477	0.425	0.401	0.379	0.339	0.304	0.273	0.245	0.233	0.221	0.199	0.180	0.141	0.111	0.088	0.071
8	0.928	0.861	0.744	0.644	0.560	0.488	0.426	0.373	0.349	0.327	0.287	0.253	0.224	0.198	0.186	0.175	0.156	0.139	0.104	0.079	0.061	0.047
9	0.919	0.844	0.715	0.608	0.518	0.443	0.380	0.327	0.303	0.282	0.244	0.211	0.183	0.160	0.149	0.139	0.122	0.107	0.077	0.057	0.042	0.032
10	0.909	0.828	0.688	0.574	0.480	0.403	0.339	0.287	0.264	0.243	0.206	0.176	0.150	0.129	0.119	0.110	0.095	0.082	0.057	0.041	0.029	0.021
11	0.900	0.812	0.661	0.541	0.444	0.366	0.303	0.251	0.229	0.209	0.175	0.147	0.123	0.104	0.095	0.088	0.074	0.063	0.042	0.029	0.020	0.014
12	0.892	0.796	0.636	0.510	0.411	0.323	0.271	0.221	0.199	0.180	0.148	0.122	0.101	0.084	0.076	0.070	0.058	0.049	0.031	0.021	0.014	0.009
13	0.883	0.780	0.612	0.482	0.381	0.303	0.242	0.193	0.173	0.156	0.126	0.102	0.083	0.067	0.061	0.055	0.045	0.037	0.023	0.015	0.010	0.006
14	0.874	0.765	0.588	0.454	0.353	0.275	0.216	0.170	0.151	0.134	0.106	0.085	0.068	0.054	0.049	0.044	0.035	0.029	0.017	0.011	0.007	0.004
15	0.865	0.750	0.565	0.429	0.327	0.250	0.193	0.149	0.131	0.116	0.090	0.071	0.056	0.044	0.039	0.035	0.028	0.022	0.013	0.008	0.005	0.003
16	0.857	0.735	0.544	0.404	0.302	0.227	0.172	0.131	0.114	0.100	0.076	0.059	0.046	0.035	0.031	0.028	0.022	0.017	0.009	0.005	0.003	0.002
17	0.848	0.721	0.523	0.381	0.280	0.207	0.153	0.115	0.099	0.086	0.065	0.050	0.037	0.029	0.025	0.022	0.017	0.013	0.007	0.004	0.002	0.001
18	0.840	0.707	0.503	0.360	0.259	0.188	0.137	0.100	0.086	0.074	0.055	0.041	0.031	0.023	0.020	0.017	0.013	0.010	0.005	0.003	0.002	0.001
19	0.832	0.693	0.483	0.340	0.240	0.171	0.122	0.088	0.075	0.064	0.047	0.034	0.025	0.019	0.016	0.014	0.010	0.008	0.004	0.002	0.001	0.001
20	0.823	0.679	0.465	0.320	0.222	0.155	0.109	0.077	0.065	0.055	0.039	0.028	0.021	0.015	0.013	0.011	0.008	0.006	0.003	0.001	0.001	0.001
21	0.815	0.666	0.447	0.302	0.206	0.141	0.098	0.068	0.057	0.047	0.033	0.024	0.017	0.012	0.010	0.009	0.006	0.005	0.002	0.001	0.001	0.001
22	0.807	0.653	0.430	0.285	0.191	0.128	0.087	0.060	0.049	0.041	0.028	0.020	0.014	0.010	0.008	0.007	0.005	0.004	0.002	0.001	0.001	0.001
23	0.799	0.640	0.413	0.269	0.176	0.117	0.078	0.052	0.043	0.035	0.024	0.016	0.011	0.008	0.007	0.005	0.004	0.003	0.001	0.001	0.001	0.001
24	0.791	0.627	0.397	0.254	0.163	0.106	0.069	0.046	0.037	0.030	0.020	0.014	0.009	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.001
25	0.783	0.615	0.382	0.239	0.151	0.096	0.062	0.040	0.032	0.026	0.017	0.011	0.008	0.005	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001
26	0.776	0.603	0.367	0.226	0.140	0.088	0.055	0.035	0.028	0.023	0.015	0.010	0.006	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.001	0.001
27	0.768	0.591	0.353	0.213	0.130	0.080	0.049	0.031	0.025	0.019	0.012	0.008	0.005	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001
28	0.760	0.580	0.340	0.201	0.120	0.072	0.044	0.027	0.021	0.017	0.010	0.007	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
29	0.753	0.568	0.326	0.191	0.110	0.066	0.039	0.024	0.019	0.014	0.009	0.006	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
30	0.745	0.557	0.314	0.179	0.103	0.060	0.035	0.021	0.016	0.012	0.008	0.005	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
40	0.675	0.457	0.212	0.100	0.048	0.023	0.011	0.006	0.004	0.003	0.001	0.001										
50	0.611	0.375	0.143	0.056	0.022	0.009	0.004	0.002	0.001	0.001												

Source: By permission, from Robert N. Anthony, *Management Accounting: Text and Cases* (rev. ed.; Homewood, Ill.: Richard D. Irwin, Inc., 1960), p. 658.

Table 6-4  
PRESENT VALUE OF \$1/12 RECEIVED MONTHLY FOR N YEARS

Years (N)	1%	2%	4%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	0.995	0.989	0.979	0.969	0.959	0.950	0.941	0.932	0.928	0.924	0.915	0.907	0.899	0.892	0.888	0.884	0.877	0.870	0.853	0.837	0.822	0.808
2	1.979	1.959	1.920	1.883	1.848	1.814	1.781	1.750	1.735	1.720	1.691	1.663	1.637	1.611	1.598	1.586	1.562	1.539	1.485	1.435	1.390	1.347
3	2.954	2.910	2.826	2.746	2.670	2.599	2.531	2.467	2.436	2.406	2.348	2.291	2.241	2.191	2.167	2.143	2.098	2.054	1.953	1.863	1.781	1.706
4	3.920	3.843	3.696	3.559	3.432	3.313	3.201	3.096	3.046	2.998	2.905	2.818	2.736	2.658	2.621	2.585	2.516	2.450	2.309	2.168	2.050	1.946
5	4.876	4.757	4.533	4.327	4.137	3.962	3.799	3.648	3.577	3.508	3.377	3.256	3.142	3.066	2.985	2.936	2.842	2.755	2.557	2.386	2.236	2.106
6	5.822	5.653	5.338	5.051	4.790	4.551	4.333	4.132	4.038	3.948	3.778	3.620	3.475	3.340	3.276	3.214	3.098	2.989	2.747	2.541	2.365	2.212
7	6.759	6.531	6.111	5.734	5.395	5.088	4.810	4.557	4.439	4.327	4.117	3.924	3.748	3.585	3.509	3.435	3.297	3.169	2.888	2.653	2.453	2.281
8	7.687	7.392	6.855	6.379	5.954	5.575	5.235	4.929	4.788	4.654	4.404	4.177	3.971	3.783	3.695	3.611	3.453	3.308	2.992	2.732	2.514	2.330
9	8.605	8.237	7.571	6.987	6.473	6.018	5.615	5.256	5.091	4.935	4.647	4.388	4.154	3.942	3.844	3.750	3.575	3.414	3.070	2.789	2.556	2.362
10	9.515	9.065	8.259	7.560	6.953	6.421	5.955	5.543	5.355	5.178	4.854	4.564	4.305	4.071	3.963	3.860	3.670	3.497	3.127	2.829	2.585	2.383
11	10.415	9.876	8.920	8.101	7.397	6.788	6.258	5.794	5.584	5.388	5.029	4.711	4.428	4.175	4.058	3.948	3.744	3.560	3.169	2.858	2.605	2.397
12	11.307	10.672	9.556	8.612	7.809	7.121	6.528	6.015	5.784	5.568	5.177	4.833	4.529	4.257	4.135	4.018	3.802	3.608	3.201	2.879	2.619	2.406
13	12.189	11.452	10.167	9.094	8.190	7.423	6.770	6.208	5.957	5.724	5.302	4.935	4.611	4.326	4.196	4.073	3.847	3.646	3.224	2.894	2.629	2.412
14	13.063	12.217	10.755	9.548	8.542	7.699	6.985	6.378	6.108	5.858	5.409	5.019	4.679	4.380	4.245	4.117	3.883	3.674	3.241	2.904	2.635	2.417
15	13.928	12.967	11.321	9.977	8.869	7.949	7.178	6.527	6.239	5.973	5.499	5.090	4.735	4.424	4.284	4.152	3.911	3.696	3.254	2.912	2.640	2.419
16	14.785	13.702	11.864	10.381	9.171	8.176	7.350	6.658	6.351	6.073	5.576	5.149	4.780	4.460	4.315	4.179	3.932	3.711	3.264	2.917	2.641	2.421
17	15.633	14.422	12.387	10.762	9.451	8.381	7.501	6.772	6.452	6.159	5.640	5.198	4.818	4.488	4.340	4.201	3.949	3.726	3.271	2.921	2.645	2.422
18	16.473	15.129	12.890	11.122	9.711	8.571	7.640	6.873	6.539	6.213	5.695	5.219	4.838	4.511	4.360	4.218	3.962	3.736	3.276	2.924	2.647	2.421
19	17.305	15.822	13.373	11.462	9.951	8.742	7.763	6.961	6.614	6.297	5.742	5.273	4.873	4.530	4.376	4.232	3.973	3.74				