

Production Management

Production Economics

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Production Economics

FIXED AND VARIABLE COSTS

Fixed costs

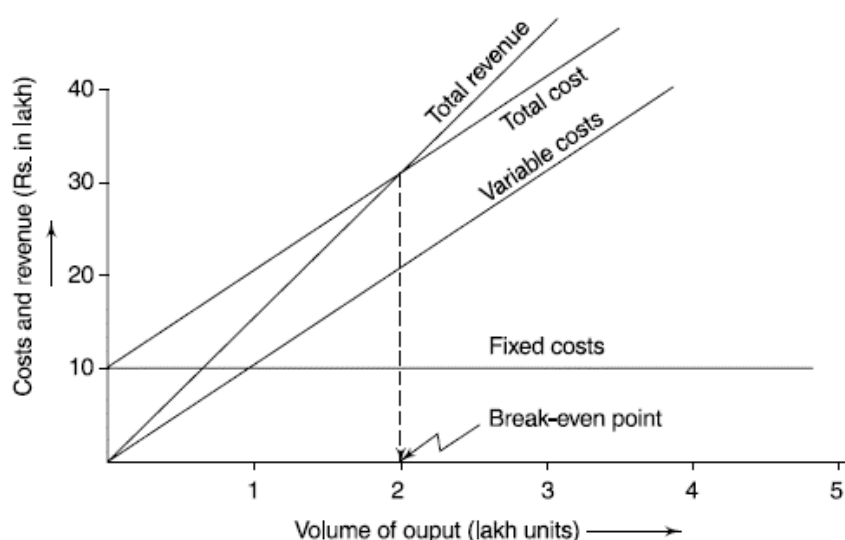
Fixed costs are those costs which remain unchanged in spite of a change in the volume of output or in the level of activity. For instance, the rent to be paid on the office buildings or the allocated depreciation of machinery remains the same irrespective of the volume of the output.

If a plant were to produce one lakh units instead of 75,000 units per year, the fixed cost would remain the same in both the cases.

Variable costs

As opposed to fixed cost, those costs that vary continuously with respect to change in the production output or the level of activity are termed as variable costs. If one were to increase the production output from 75,000 units to 1,00,000 units, that much more raw material has to be procured. The cost of the raw materials is a variable cost. Similarly, more labour hours are to be spent in making the finished product in more quantity; and therefore, the labour-hours are also a variable cost.

A break-even analysis for one type of product is presented in following figure.



Fixed Costs, $F = \text{Rs. } 10,00,000$

Variable Costs, = Rs. 10 per unit

Revenue, $R = \text{Rs. } 15$ per unit

Total costs, TC for a volume of output = (Fixed Cost + Variable Cost for that volume of output)

Break-Even Point (or Break-Even Volume of Output), BEP , is where the Total Revenue and Total Costs are equal.

$$BEP = F / (R - V)$$

OPPORTUNITY COSTS AND THEIR USE

Opportunity cost is another important concept with respect to relevancy. The opportunity cost for a particular decision is the benefit derived from the best of the alternative opportunities lost due to the decision to choose a particular line of action. If you had Rs. 10,000 which you kept at home instead of depositing in a bank, the decision to keep the money at home has an opportunity cost of the 4% bank interest which you would have earned on ₹ 10,000. Reversely, the opportunity cost of keeping the money in a bank instead of keeping it at home, is zero; because by keeping the money at home, you would have earned no interest.

SUNK COSTS

Another distinction is between the incremental and the sunk costs. The incremental costs are those that result from a particular decision, while sunk cost would be incurred regardless of the decision.

For instance, the **obsolescence** part of the **depreciation** is a **sunk cost** which is irrelevant for a decision once the equipment is bought. Whether we drive a car 500 km more or less has no effect on the obsolescence portion of its depreciation; regardless of our decision to put in 500 km less or more, this cost will be incurred. Whereas, any extra wear-and-tear incurred would be quite relevant. In effect, costs incurred in the past which are irrelevant to future decisions are called sunk costs.

DIRECT COST

A direct cost is a price that can be directly tied to the production of specific goods or services. A direct cost can be traced to the cost object, which can be a service, product, or department. Direct costs are often variable costs, meaning they fluctuate with production levels such as inventory. However, some costs, such as indirect costs are more difficult to assign to a specific product. Examples of indirect costs include depreciation and administrative expenses.

Any cost that's involved in producing a good, even if it's only a portion of the cost that's allocated to the production facility, are included as direct costs. Some examples of direct costs are listed below:

- Direct labour
- Direct materials
- Manufacturing supplies
- Wages for the production staff
- Fuel or power consumption

INDIRECT COST

Indirect costs are the costs of running a business and going to market with a product or service—regardless of the volume manufactured and/or sold. In other words, they are not directly related to making a product or service, or buying a wholesale product to resell. (This distinguishes them from direct costs.)

Indirect costs include a company's operating expenses (also called selling, general and administration expenses), and are usually closely managed by business owners.

Examples of indirect costs are:

- Accounting and legal expenses
- Administrative salaries
- Office expenses
- Rent
- Security expenses
- Telephone expenses
- Utilities

OVERHEAD COST

Overhead costs, often referred to as overhead or operating expenses, refer to those expenses associated with running a business that can't be linked to creating or producing a product or service. They are the expenses the business incurs to stay in business, regardless of its success level.

Overhead costs are all of the costs on the company's income statement except for those that are directly related to manufacturing or selling a product, or providing a service.

A company's overhead costs depend on the nature of the business. A retailer's expenses will be different from a repair shop or a crafter's.

Typical examples include:

- Rent
- Utilities
- Insurance
- Salaries that aren't job- or product-specific
- Office equipment such as computers or telephones
- Office supplies

FACTORY COST (MANUFACTURING COST)

Factory Costs are the expenses that are incurred by the business to manufacture goods that are intended to be sold to the customers in the normal course of business and includes all cost linked to production like the direct material cost, direct labour cost and other manufacturing overheads.

These costs are categorized into three different costs: they are:

Direct Material

These costs are associated with the procurement of materials required for the production of goods. For example, if a company is in the business of car manufacturing then the purchase of plastic, iron, etc. is the direct material cost, but if the plastic is purchased for any other purpose

and not for the use in manufacturing, then the same will not be considered as direct material cost.

Direct Labour

These costs include the wages and other benefits paid to the factory staff or to the employees that are involved in the manufacturing of goods. For example, workers salary who works in the factory to manufacture goods is the direct labour cost, but the office staff salary is the administrative cost.

Manufacturing Overheads

These costs include all the costs that are directly linked to the production of goods except direct material and direct labour costs. The example of the same is the materials that are not directly allocated to the product but are used in products such as oil, glue, tape, power & fuel, etc. and also the wages paid to the employee is manufacturing overhead who are not working directly to manufacture goods but they are also present in the factory for supervisions and other things like a security guard, supervision employee, etc.

SELLING COST

Selling cost refers to the total expenditure incurred by a monopolistically competitive firm in order to differentiate its product from the product of its competitors. For instance, advertisement expenses incurred by a firm are a part of the selling cost of the product.

Example: Expenditure on advertisement.

PRIME COST

Prime costs are all of the costs that are directly attributed to the production of each product. Prime costs are direct costs, meaning they include the costs of direct materials and direct labour involved in manufacturing an item. Companies use prime costs to price their products.

- A prime cost is the total direct costs of production, including raw materials and labour.
- Indirect costs, such as utilities, manager salaries, and delivery costs, are not included in prime costs.
- The prime cost equation is equal to the cost of raw materials plus direct labour.
- Businesses need to calculate the prime cost of each product manufactured to ensure they are generating a profit.

Prime Cost=Raw Materials + Direct Labour

CAPITAL BUDGETING (CAPITAL INVESTMENT ANALYSIS)

Capital budgeting involves choosing projects that add value to a company. The capital budgeting process can involve almost anything including acquiring land or purchasing fixed assets like a new truck or machinery.

Corporations are typically required, or at least recommended, to undertake those projects that will increase profitability and thus enhance shareholders' wealth.

However, the rate of return deemed acceptable or unacceptable is influenced by other factors specific to the company as well as the project.

For example, a social or charitable project is often not approved based on the rate of return, but more on the desire of a business to foster goodwill and contribute back to its community.

- Capital budgeting is the process by which investors determine the value of a potential investment project.
- The three most common approaches to project selection are **payback period (PB)**, **internal rate of return (IRR)**, and **net present value (NPV)**.
- The payback period determines how long it would take a company to see enough in cash flows to recover the original investment.
- The internal rate of return is the expected return on a project—if the rate is higher than the cost of capital, it's a good project.
- The net present value shows how profitable a project will be versus alternatives and is perhaps the most effective of the three methods.

Payback Period

The payback period is the span of time within which the investment made for the project will be **recovered** by the net returns of the project.

The payback period is the value of n which satisfies the following equation:

$$\frac{I}{\sum_{p=0}^n (R_p - D_p)} = 1$$

Where R_p is the income during the period p;

D_p is the operating cost during the period p; and

I is the initial investment made in period 0.

Using payback period as the criterion, projects with lower payback periods are preferred.

Merits and Demerits of Payback Period

- One shortcoming of this criterion is that it overlooks the net incomes made available by the project after the payback period..
- Another drawback of this criterion is that the value of money is assumed to be the same over the different years of the payback period. This is obviously wrong, since the value of one rupee available today is not the same as the value of the same rupee received the next year.
- The merit of the payback method lies in its implicit coverage of risk. The user of the payback period criterion may not be sure about the revenues and costs of the project in

the long-term future. His anxiety is to get back the money he has invested (by means of net returns) as soon as possible.

Example

Calculate payback period from following table. Initial investment made during period 0: Rs. 200 lakhs.

<i>Period (year)</i>	<i>Income (₹ in lakhs)</i>	<i>Operating costs (₹ in lakhs)</i>
1	100	70
2	150	90
3	150	90
4	150	90
5	150	90
6	150	90
7	150	90

<i>Period (year)</i>	<i>Income (₹ in lakhs)</i>	<i>Operating costs (₹ in lakhs)</i>	<i>Net returns ($R_p - D_p$) (₹ in lakhs)</i>
1	100	70	30
2	150	90	60
3	150	90	60
4	150	90	60
5	150	90	60
6	150	90	60
7	150	90	60

Solution

Let $n = 4$

$$\sum_0^4 (R_p - D_p) = 30 + 60 + 60 + 60 = 210$$

Initial investment

Using equation

$$\frac{I}{\sum_{p=0}^n (R_p - D_p)} = 1$$

$$\therefore \frac{200}{210} \approx 1$$

Hence, payback period is 4 years.

Net Present Value

The value of one rupee available today is not the same as the value of the same rupee received a year later. This is so because, had we received the rupee today we could have invested the same in a project, or in a bank and earned the interest. Let us say the return or interest was 10%. Then, receiving one rupee today is as good as receiving Rs. 1.10 a year later; it is as good as receiving Rs. 1.21 two years later, and so on. It implies the revenues and costs generated or incurred for the future years of a project have to be **discounted** by the appropriate cost of the money.

It is **not inflation** that we are talking about, but rather the **interest** or return on capital which we would normally expect of our investments. This normally expected return on capital is called **cost of capital**. The revenues and costs should be discounted by this expected return on capital which is necessary for the firm or organisation.

The values of the future net incomes discounted by the cost of capital are called net present values (NPVs).

The general equation for the same is as follows:

$$NPV = -I + \frac{R_1 - D_1}{(1+i)} + \frac{R_2 - D_2}{(1+i)^2} + \dots + \frac{R_n - D_n}{(1+i)^n} = -I + \sum_{p=1}^n \frac{(R_p - D_p)}{(1+i)^p}$$

Example

If the net present value for each of the cash flows were calculated at a 10% interest rate, the net present value cash flow at the end of five years would be:

- A. Greater than the total cash flow without the net present value applied*
- B. Less than the total cash flow without the net present value applied*
- C. The same as the total cash flow without the net present value applied*
- D. Unable to be calculated with the information supplied*

Solution

$$NPV = \left(-\frac{500,000}{(1+0.1)^0} \right) + \left(-\frac{290,000}{(1+0.1)^1} \right) + \left(-\frac{10,000}{(1+0.1)^2} \right) + \left(-\frac{65000}{(1+0.1)^3} \right) + \left(-\frac{50,000}{(1+0.1)^4} \right)$$
$$= -895,000$$

Internal Rate of Return (IRR)

The Internal Rate of Return is that rate of discount that equates the initial investment in the project with the future net income stream. Mathematically, it is expressed as given below:

IRR is that value of i which satisfies the following equation:

$$-I + \sum_{p=1}^n \frac{(R_p - D_p)}{(1+i)^p} = 0$$

The IRR criterion for project acceptance, under theoretically infinite funds is: accept all projects which have an IRR greater than the cost of capital.

The procedure in applying this criterion is

- Assume different values of the discount rate, i .
- For each value of the discount rate, find if the equation given above balances.
- That discount rate for which the equation fits, is the Internal Rate of Return.

Why use capital budgeting?

Too Much at Risk Not to Use Capital Budgeting

With so much at stake with large capital expenditures, companies desperately need a measuring stick that tells them how a big project is faring. Taking the temperature of a capital project's progress on a regular basis allows company decision-makers to make better-informed decisions on that project going forward.

Once a company embarks on a large project, like the purchase and usage of a large fleet of vehicles or the construction of a new manufacturing plant overseas, there comes a point of no return for the company, which must have precise data on the progress of large projects - something capital budgeting can provide.

Capital Budgeting Is Flexible

More companies are turning to capital budgeting for other uses, too.

For example, corporate financial officers can leverage capital budgeting in other key financial management areas, such as leasing projects, day-to-day working capital spending, for research and as a measurement tool for new and existing merger and acquisitions, and for assessing potential corporate bond issues (and measuring the progress and performance of existing bond issues.)

For More Robust Portfolio Management Assessment

Equally, capital budgeting can be put to good use in the creation and analysis of a company's investment portfolio, for critical assessment categories like stocks, bonds, real estate, and foreign currencies, among others.

For Proper Risk Assessment

Capital budgeting can also be used to assess any potential risk linked to a large company expenditure. Going into a large project akin to a new manufacturing facility overseas, a company will want to know how much cash it stands to lose if the plans go awry or if the plant doesn't live up to its planned potential. With capital budgeting, financial analysts can assess various risk scenarios and give company decision makers a road map in advance that reveals risks and vulnerabilities in pursuing the project, (particularly on company cash flow scenarios) and give them the information they need to make the best decisions going forward.

To Create a Project Checklist

A good capital budgeting assessment can also assist a company in the actual implementation of more substantial corporate projects. In the above example, the budgeting blueprint should include the plan to pay for the new manufacturing plant, a plan to monitor project financial outlays, and a plan to track cash flow and handle any revenues generated after the facility is up and running.

Steps in the Capital Budgeting Process

Begin by Exploring Opportunities

The capital budgeting process begins with a thorough assessment of potential business opportunities. For example, if a company wants to assess the potential of building a manufacturing facility in a foreign country, that company needs to weigh multiple scenarios (and alternatives to building that facility) for corporate decision makers to mull over. Timing, location, potential costs, and hiring overseas personnel all need to be considered.

Estimate the Project's Total Cost

The next step is to calculate the estimated total cost of your company's project, offering multiple scenarios to maximize the expenditure while still gaining maximum value.

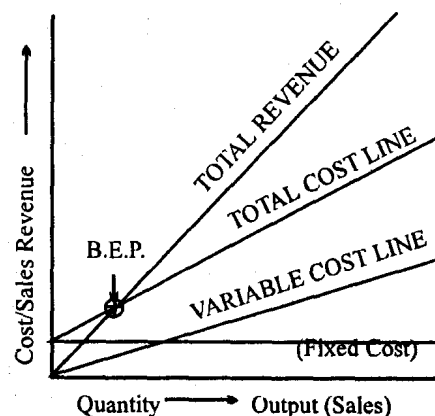
Calculate Your Return on Investment

Capital budgeting assessments can also provide an estimate on the potential return on investment on a large corporate project, including a cash flow estimate stemming from the new project's potential income-producing value.

BREAK-EVEN ANALYSIS

Break Even Analysis in economics, business, and cost accounting refers to the point in which total cost and total revenue are equal. A break-even point analysis is used to determine the number of units or rupees of revenue needed to cover total costs (fixed and variable costs).

Break-even analysis involves estimating the level of sales necessary to operate a business on a break-even basis (i.e., you don't make any money and you don't lose any money). Generally, the sale price for a product or service will more than cover the variable costs of producing that product or service, but the margin from sales must be enough to cover fixed costs, as well. By performing a break-even analysis and then varying the assumptions regarding sales levels and variable and fixed costs, the real factors behind the profit potential (or lack thereof) of a business become more clear.



Fixed Costs (FC)

These costs remain constant (or nearly so) within the projected range of sales levels. These can include facilities costs, certain general and administrative costs, and interest and depreciation expenses. The FC are usually expressed as a lump-sum cost in dollars.

Variable Costs (VC)

These consist of costs that vary in proportion to sales levels. They can include direct material and labour costs, the variable part of manufacturing overhead, and transportation and sales commission expenses. The VC are usually expressed as a cost in dollars per unit.

Contribution Margin (CM)

This is equal to sales revenues less variable costs. This amount is available to offset fixed expenses and (hopefully) produce an operating profit for the business.

Calculating the Break-Even Point

The following steps are involved in calculating the break-even point for a business.

1. Identify the total fixed and variable costs of the business based on actual results during a relevant time period.
2. Calculate the contribution margin as a percent of sales as follows:

$$\text{Contribution margin} = (\text{Total sales} - \text{Variable costs}) / \text{Total sales}$$

3. Calculate the break-even point in rupees of sales revenue as follows:

$$\text{Break-even sales revenue} = \text{Total fixed costs} / \text{Contribution margin}$$

4. If contribution margin is expressed in rupees per unit, calculate the break-even sales volume in units as follows:

$$\text{Break-even unit volume} = \text{Total fixed costs} / \text{Contribution margin per unit}$$

Example

A firm has annual fixed costs of Rs. 32000 and variables cost of Rs. 7 per unit It is considering an additional investment of Rs. 8000 which will increase the fixed costs by Rs. 1500 per year and will increase the contribution by Rs. 2 per unit. No change is anticipated in sales volume. The selling price of Rs. 15 per unit also remains constant. What is the break-even quantity if the new investment is made?

Solution

Sale price S = Rs. 15.00 per unit

Variable cost V = Rs. 7.00 per unit

Fixed cost F = Rs. 32000

Contribution per unit

$$S - V = 15 - 7 = \text{Rs. } 8/- \text{ per unit}$$

If Q is the break-even quantity then

$$\text{Contribution/unit} = \text{Fixed cost}/Q$$

or $Q = 32000/8 = 4000$ units

For the new investments,

$$\text{Fixed cost} = 32000 + 1500 = \text{Rs. } 33500 \text{ per year}$$

New contribution per unit = $8 + 2 = \text{Rs. } 10$ per unit

Let Q_1 be the break-even quantity then

$$Q_1 = \text{New fixed cost}/\text{contribution per unit} = 33500/10 = 3350$$

Example

The controller of ABC Company arrived at the following cost structure relating to the introduction of a new product. Calculate the breakdown volume, assuming a price of Rs. 7.75 per unit. Use linear interpolation, if necessary.

	<i>Production 10,000 units Rs.</i>	<i>Volume 20,000 units Rs.</i>
<i>Capital costs</i>	<i>60,000</i>	<i>60,000</i>
<i>Material at Rs. 1.50 per unit</i>	<i>15000</i>	<i>30000</i>
<i>Labour at Rs. 0.75 per unit</i>	<i>7500</i>	<i>15000</i>
<i>Overhead</i>		
<i>Fixed</i>	<i>10,000</i>	<i>10,000</i>
<i>Variable at Rs. 0.25 per unit</i>	<i>2500</i>	<i>5000</i>

<i>Selling and administrative expenses</i>		
<i>Fixed</i>	5000	5000
<i>Variable</i>	7500	10,000
Total cost	1,07,500	1,35,000

Solution

Case I

Production = 10000 units

Total revenue

$$\text{T.R.} = \text{Rs. } 7.75 \times 10000 = \text{Rs. } 77,500$$

Total variable cost

$$\text{TVC} = \text{Rs. } 2500 + 7500 = 10,000$$

Contribution margin

$$= (\text{TR} - \text{TVC})/\text{TR} = (77500 - 10000)/77500 = 0.87$$

Total fixed costs

$$\begin{aligned} \text{TFC} &= \text{Rs. } 15000 + \text{Capital costs} \\ &= \text{Rs. } 15000 + \text{Rs. } 60000 + \text{Rs. } 15000 + \text{Rs. } 7500 \\ &= \text{Rs. } 97500 \end{aligned}$$

Break-even point

$$\text{BEP} = \text{TFC}/\text{contribution ratio} = 97500/0.87 = 1,12,069$$

Case II

Production = 20000 units

Total revenue

$$\text{T.R.} = \text{Rs. } 7.75 \times 20000 = \text{Rs. } 1,55,000$$

Total variable cost

$$\text{TVC} = \text{Rs. } 5000 + 10000 = 15,000$$

Contribution margin

$$(\text{TR} - \text{TVC})/\text{TR} = (1,55,000 - 15000)/1,55,000 = 0.903$$

Total fixed costs

$$\begin{aligned} \text{TFC} &= \text{Rs. } 15000 + \text{Capital costs} \\ &= \text{Rs. } 15000 + \text{Rs. } 60000 + \text{Rs. } 30,000 + \text{Rs. } 15000 \\ &= \text{Rs. } 1,20,000 \end{aligned}$$

Break-even point

$$\text{BEP} = \text{TFC}/\text{contribution ratio} = 1,20,000/0.903 = 1,32,890$$

Example

A manufacturer of TV buys TV cabinet at Rs. 500 each. In case the company makes it within the factory, the fixed and variable costs would be Rs. 4,00,000 and Rs. 300 per cabinet respectively. Should the manufacturer make or buy the cabinet if the demand is 1,500 TV cabinets?

Solution

Selling price/unit (SP) = Rs. 500

Variable cost/unit (VC) = Rs. 300

Fixed cost (FC) = Rs. 4,00,000

$$\text{BEP} = 400,000/(500 - 300) = 2,000 \text{ units}$$

Since the demand (1,500 units) is less than the break-even quantity, the company should buy the cabinets for its TV production.

Example

There are three alternatives available to meet the demand of a particular product. They are as follows:

- (a) Manufacturing the product by using process A
- (b) Manufacturing the product by using process B
- (c) Buying the product

The details are as given in the following table:

Cost elements	Manufacturing the product by process A	Manufacturing the product by process B	Buy
Fixed cost/year (₹)	5,00,000	6,00,000	
Variable/unit (₹)	175	150	
Purchase price/unit (₹)			125

The annual demand of the product is 8,000 units. Should the company make the product using process A or process B or buy it?

Solution

Annual cost

Annual cost of process A = FC + VC x Volume

$$= 5,00,000 + 175 \times 8,000$$

$$= \text{Rs. } 19,00,000$$

Annual cost of process B = FC + VC x Volume

$$= 6,00,000 + 150 \times 8,000$$

$$= \text{Rs. } 18,00,000$$

Annual cost of buy

Annual cost of buy = Purchase price/unit x Volume

$$= 125 \times 8,000$$

$$= \text{Rs. } 10,00,000$$

Decision

Since the annual cost of buy option is the minimum among all the alternatives, the company should buy the product.

Problem

Alpha Associates has the following details:

Fixed cost = Rs. 20,00,000

Variable cost per unit = Rs. 100

Selling price per unit = Rs. 200

Find

(a) The break-even sales quantity

(b) The break-even sales

(c) If the actual production quantity is 60,000, find contribution

Answer: 20,000 units; Rs. 40,00,000; Rs. 60,00,000

Example

The company sold in two successive periods 7,000 units and 9,000 units and has incurred a loss of Rs. 10,000 and earned Rs. 10,000 as profit respectively. Find

(i) The amount of fixed expenses.

(ii) The number of units to break-even.

(iii) The number of units to earn a profit of Rs. 40,000.

The selling price per unit can be assumed at Rs. 100.

Solution

	Period 1	Period 2
Sales	₹ 700,000	₹ 900,000
Profit (-)	(-) ₹ 10,000	₹ 10,000

Thus for an additional sales of ₹ 200,000 there is an additional contribution of ₹ 20,000 which has wiped off the loss of ₹ 10,000 of period 1 and earned a profit of ₹ 10,000 in period 2.

$$\begin{aligned} \text{PV ratio} &= (\text{Change in contribution/change in sales}) \times 100 \\ &= (20,000/200,000) \times 100 = 10\% \end{aligned}$$

$$\text{Contribution of period 1} = ₹ 700,000 \times (10/100) = ₹ 70,000$$

$$\text{Loss of period 1 (given)} = ₹ 10,000$$

Break Even Point (BEP)

$$\text{Contribution} = \text{fixed cost} \pm \text{profit/loss}$$

$$\text{Fixed cost} = \text{contribution} \pm \text{loss/profit}$$

$$\text{BEP} = \text{fixed cost/PV ratio} = 80,000/(10/100) = ₹ 800,000$$

Number of units to break-even

It is given by equation

$$\begin{aligned} &\text{break-even sales/selling price per unit} \\ &= 800,000/100 = 8000 \text{ units} \end{aligned}$$

Numbers of units required to earn a profit of ₹ 40,000

$$\begin{aligned} &= (\text{fixed cost} + \text{desired profit})/\text{PV ratio} \\ &= (80,000 + 40,000)/10\% \\ &= (120,000 \times 100)/10 \\ &= 12,00,000 \text{ units} \end{aligned}$$

Assumptions

- Selling prices will remain constant at all sales level.
- There is a linear relationship between sales volume and costs.

- The costs are divided into two categories –fixed cost and variable cost.
- Production and sales quantities are equal.
- No other factors will influence the cost except the quantity.

Advantages of break-even analysis (B.E.A.)

- It is very helpful for forecasting results.
- An important tool for decision making in order to accomplish desired objectives.
- The effect of change in unit sales price and cost of production on profit can be determined.
- Provides more realistic basis policy making.
- The situation of dividend payment to start can be determined with the help of B.E.A.
- B.E.A. can help in giving indications about desirable unit selling price in view of some predetermined policy.

Limitations of Break Even Analysis

As discussed above, B.E.A. is useful in many business situations for the purpose of decision making but there are many short-comings in its analysis and interpretations. Some of these limitations are as follows.

- The unit sales price of the product/item or services is dependent on factors affecting its demand and supply. So variation in sales price will affect the demand of the commodity. This process is not covered in the break-even analysis.
- The fixed costs may not remain fixed or constant as assumed.
- The variable costs may not vary in fixed proportions at various levels of output:
- For sales promotion purposes consumers are given certain discounts. In such cases revenue may not be perfectly variable with level of sales output.
- For all types of products/commodities, the assumption of producer's market phenomenon may not hold good.
- A shift in the product mix may change the location of break even point.
- Identification of variable and fixed cost involved in a production process are not very simple.

Applications of Break Even Analysis

It can be used to determine the following

- Safety margin with proposed volume .
- Quantity required to be produced to have desired profit (3) Effect of change in product price

- Effect of change in product costs
- Whether to accept an order or not
- Whether to add or drop a product line
- To take make or busy decisions.

MAKE-OR-BUY DECISION

A make-or-buy decision is an act of choosing between manufacturing a product in-house or purchasing it from an external supplier.

Also referred to as an outsourcing decision, a make-or-buy decision compares the costs and benefits associated with producing a necessary good or service internally to the costs and benefits involved in hiring an outside supplier for the resources in question.

To compare costs accurately, a company must consider all aspects regarding the acquisition and storage of the items versus creating the items in-house, which may require the purchase of new equipment, as well as storage costs.

- A make-or-buy decision is an act of choosing between manufacturing a product in-house or purchasing it from an external supplier.
- Make-or-buy decisions, like outsourcing decisions, speak to a comparison of the costs and advantages of producing in-house versus buying it elsewhere.
- There are many factors at play that may tilt a company from making an item in-house or outsourcing it, such as labour costs, lack of expertise, storage costs, supplier contracts, and lack of sufficient volume.
- Companies use quantitative analysis to determine whether making or buying is the most cost-efficient method.

Understanding a Make-or-Buy Decision

Regarding in-house production, a business must include expenses related to the purchase and maintenance of any production equipment and the cost of production materials. Costs to make the product can include the additional labour required to produce the items, which takes the form of wages and benefits, storage requirements within the facility, holding costs overall, and the proper disposal of any remnants or by-products from the production process.

Buy costs related to purchasing the products from an outside source must include the price of the good itself, any shipping or importing fees, and applicable sales tax charges. Additionally, the company must factor in the expenses relating to the storage of the incoming product and labour costs associated with receiving the products into inventory. It also includes signing any contracts with suppliers that might require the company to be locked-in to certain deals for a certain period of time.

In a make-or-buy decision, the most important factors to consider are part of quantitative analysis, such as the associated costs of production and whether the business can produce at required levels.

PROFIT-VOLUME RATIO

Profit-volume ratio indicates the relationship between **contribution** and **sales** and is usually expressed in percentage. The ratio shows the amount of contribution per rupee of sales. Since, in the short-term, fixed cost does not change, the profit-volume ratio also measures the rate of change of profit due to change in the volume of sale

The advantages of the profit-volume ratio are that it can be used to measure the profitability of each product, or group of them, separately so that the necessity for continuance of such products can be examined. It may also be used to measure the profitability of each production centre, process or operation.

The Profit/volume ratio, which is also called the 'contribution ratio' or 'marginal ratio', expresses the relation of contribution to sales and can be expressed as under:

$$P/V \text{ Ratio} = \text{Contribution}/\text{Sales}$$

Since Contribution = Sales – Variable Cost = Fixed Cost + Profit, P/V ratio can also be expressed as:

$$P/V \text{ Ratio} = \text{Sales} - \text{Variable cost}/\text{Sales i.e. } S - V/S$$

or,
$$P/V \text{ Ratio} = \text{Fixed Cost} + \text{Profit}/\text{Sales i.e. } F + P/S$$

or,
$$P/V \text{ Ratio} = \text{Change in profit or Contribution}/\text{Change in Sales}$$

Also
$$P/V \text{ ratio} = \text{Fixed cost}/\text{BEP (units)}$$

This ratio can also be shown in the form of percentage by multiplying by 100. Thus, if selling price of a product is Rs. 20 and variable cost is Rs. 15 per unit, then

$$P/V \text{ Ratio} = 20 - 15/20 \times 100 = 5/20 \times 100 = 25\%$$

The P/V ratio, which establishes the relationship between contribution and sales, is of vital importance for studying the profitability of operations of a business. It reveals the effect on profit of changes in the volume.

In the above example, for every Rs. 100 sales, Contribution of Rs. 25 is made towards meeting the fixed expenses and then the profit comparison for P/V ratios can be made to find out which product, department or process is more profitable. Higher the P/V ratio, more will be the profit and lower the P/V ratio, lesser will be the profit. Thus, every management aims at increasing the P/V ratio.

ASSIGNMENT

Q.1. (AMIE S16, 6 marks): Describe the nature of costs.

Q.2. (AMIE W17, 4 marks): Differentiate between direct and indirect cost.

Q.3. (AMIE S 15, 18, W18, 10 marks): Explain the meaning of

(i) factory cost

(ii) selling cost

(iii) manufacturing cost

(iv) prime cost

(v) overheads

Q.4. (AMIE W15, 5 marks): What are the costs incurred, if a company is totally abandoned?

Answer: Abandonment Costs means all costs, charges, expenses, liabilities, Taxes and obligations whatsoever associated with the abandonment of all production facilities.

Q.5. (AMIE W15, 5 marks): Do sunk costs affect the capital budgeting process? Explain.

Q.6. (AMIE S15, 10 marks): Explain break-even analysis with the help of a neat diagram.

Q.7. (AMIE W15, 5 marks): Break-even analysis helps in make or buy decision. Discuss.

Q.8. (AMIE W17, 8 marks): What is break-even analysis? What are the assumptions made in this analysis?

Q.9. (AMIE W17, 8 marks): Discuss the concept of make vs. buy decision. How it is useful in process planning?

Q.10. (AMIE S16, 5 marks): Differentiate between P-system and Q-system in inventory control.

Q.11. (AMIE S20, 10 marks): How you will evaluate capital investments for a company? Discuss capital budgeting of a particular company.

Q.12. (AMIE W15, 5 marks): What would be minimum production quantity so as to earn profit, if fixed cost = ₹ 1,50,000, variable cost = ₹ 10/unit and selling price = ₹ 25/unit? Also, find profit volume ratio.

Answer: 10,000; 0.6

Hint: Find break-even quantity. At this break-even, there will be no profit and no loss.

$$CM = \text{fixed cost}/BEP = 150,000/10,000 = ₹ 15$$

$$PV \text{ ratio} = CM \text{ per unit}/\text{selling price} = 15/25$$

Q.13. (AMIE S16, 18, 8 marks): Following details are available:

Actual sales = ₹ 30,000

Breakdown sales = ₹ 15,000

Fixed cost = ₹ 6000

Find the profit on actual sales.

Answer: ₹ 6000

Hint: PV ratio = 6000/15000 = 0.4

Now, Sales = (fixed cost + profit)/PV ratio

Q.14. (AMIE W18, 10 marks): Two alternative set-ups, A and B are available for the manufacturing of a component on a particular machine, where the operating cost per hour is ₹ 20/-.

	Set-up A	Set-up B
Components/set-up	4000 pieces	3000 pieces
Set-up cost	₹ 300/-	₹ 1500/-
Production rate/hour	10 pieces	15 pieces

Answer: Set up B should be used for long range and economic production.

Hint: Alternative A: Setup cost/piece/component = 300/4000 = 0.075

$$\text{Production cost/piece} = 20/10 = 2$$

$$\text{Total cost per piece} = 2 + 0.075 = 2.075.$$

Q.15. (AMIE S19, 10 marks): A company sold in two successive years 7000 and 9000 units and incurred a loss of ₹ 10,000 and earned ₹ 10,000 as profit respectively. The selling price per unit is ₹ 100. Calculate the (i) amount of fixed cost (ii) number of units to break even (iii) number of units to earn profit of ₹ 50,000.

Answer: ₹ 80,000; 8000; 13000 units

Q.16. (AMIE W19, 6 marks): Zumba style shops operate eight haircut shops in a town on a 250 days year, 8 hours per day basis. They charge \$ 9 for a haircut. One shop has annual fixed costs of \$ 84,000 and variable costs estimated as \$ 2 per customer.

(i) What is contribution per customer?

(ii) How many customers per hour must the shop average in order to break even?

Answer: \$ 7; 0.6

Hint: Contribution per customer = $9 - 2 = \$ 7$

Number of hours spent per year = $250 \times 8 = 2000$ hours

At BEP, number of customers = fixed cost/contribution cost per unit = $84000/7 = 12000$ /year

∴ customer per hour at BEP = $12000/2000 = 0.6$

Q.17. (AMIE W19, 5 marks): A \$ 40,000 extrusion machine is expected to be obsolete after 10 years, which has no salvage value. During its life time, it should generate \$ 8000 per year operating advantage of which \$ 3000 must be paid in taxes. What is the payoff period?

Answer: 8 years

Hint: Payoff period = net initial investment (I)/net annual operating advantage after tax (D – T)

Given I = \$ 40,000; D = \$ 8000; T = \$ 3000

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