After studying this chapter, you will be able to:

- **Analyse** short-term decisions
- **Analyse** product mix decisions, including circumstances where linear programming methods are needed to identify ‘optimal’ solutions
- **Analyse** information to assess risk and its impact on short-term decisions
- **Discuss** the nature of risk and uncertainty and the attitudes to risk by decision makers
- **Evaluate** information to support project appraisal
- **Analyse** information for use in long-term decision making (including consideration of tax, inflation and other factors)
- **Compare and Contrast** alternative approaches proposed to address business challenges or opportunities for a given entity
CVP ANALYSIS

CVP analysis involves analysing the interrelationships among revenues, costs, levels of activity, and profits. CVP analysis is useful for numerous decisions related to production, pricing, marketing, cost structure, and many more. Although CVP analysis is most useful for planning, it can also be used to assist with controlling decisions and evaluating decisions.

Consider a decision about choosing additional features of an existing product i.e. product modification. Different choices can affect selling prices, variable cost per unit, fixed costs, units sold, and operating income. CVP analysis helps managers make product decisions by estimating the expected profitability of these choices.
Activity Based CVP Analysis

Conventional CVP analysis assumes volume based measures. An alternative approach is activity based costing. In an activity-based costing system, costs are segregated into unit and non-unit-based categories. Activity-based costing acknowledges that some costs vary with units produced and some costs do not. However, while activity-based costing admits that non-unit-based costs are fixed with respect to production volume changes, it also argues that many non-unit-based costs vary with respect to other cost drivers. In contrast, the volume based approach combines the cost of these activities and treat them as fixed costs since they do not vary with output volume. Activity based costing provides a more accurate determination of costs because it separately identifies and traces non-unit based costs to products rather than combining them in a pool of fixed costs as volume based approach does.

The Break-even can then be expressed as follows:

\[
\text{Break-even units} = \frac{[\text{Fixed costs} + (\text{Setup cost} \times \text{Number of Setups}) + (\text{Engineering Cost} \times \text{Number of Engineering Hours})]}{(\text{Price} - \text{Unit Variable Cost})}
\]

A comparison of the ABC break-even point with the conventional break-even point reveals two important differences.

First, the fixed costs differ. Some costs previously identified as being fixed may actually vary with non-unit cost drivers, in this case setups and engineering hours.

Second, the numerator of the ABC break-even equation has two non-unit-variable cost terms: one for batch-related activities and one for product-sustaining activities.

“The use of activity-based costing does not mean that CVP analysis is less valuable. In fact, it becomes more valuable, since it delivers more precise understandings concerning cost behaviour. These understandings produce better decisions. CVP analysis within an activity-based framework, however, must be improved”.

© The Institute of Chartered Accountants of India
Illustration

Catalyst Ltd. Makes a single product with the following details:

<table>
<thead>
<tr>
<th>Description</th>
<th>Current Situation</th>
<th>Proposed Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price (₹/unit)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Direct Costs (₹/unit)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Present number of setups per production period, (before each production run, setup is done)</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Cost per setup (₹)</td>
<td>450</td>
<td>Decrease by ₹90</td>
</tr>
<tr>
<td>Production units per run</td>
<td>960</td>
<td>1,008</td>
</tr>
<tr>
<td>Engineering hours for production period</td>
<td>500</td>
<td>422</td>
</tr>
<tr>
<td>Cost per engineering hour (₹)</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

The company has begun Activity Based Costing of fixed costs and has presently identified two cost drivers, viz. production runs and engineering hours. Of the total fixed costs presently at ₹96,000, after the above, ₹72,100 remains to be analyzed. There are changes as proposed above for the next production period for the same volume of output.

Required

(i) COMPUTE units and production runs Catalyst Ltd. should produce in the changed scenario for break-even.

(ii) ADVISE whether Catalyst Ltd. should continue to break up the remaining fixed costs into activity based costs.

Solution

Workings

Statement Showing ‘Non-unit Level Overhead Costs’

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Current Situation</th>
<th>Proposed Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Production Runs/ Setups</td>
<td>42</td>
<td>40 (960runs×42setup 1,008units)</td>
</tr>
<tr>
<td>Cost per Setup</td>
<td>₹450</td>
<td>₹360</td>
</tr>
<tr>
<td>Production Units per run</td>
<td>960 units</td>
<td>1,008 units</td>
</tr>
<tr>
<td>Production Units</td>
<td>40,320 (960 units × 42)</td>
<td>40,320</td>
</tr>
<tr>
<td>Engineering Hrs.</td>
<td>500</td>
<td>422</td>
</tr>
<tr>
<td>Engineering Cost per hour</td>
<td>₹10</td>
<td>₹10</td>
</tr>
</tbody>
</table>
Requirement of Question

(i) Break Even Point (Changed Scenario)

Break Even Point

\[
\text{Break Even Point} = \frac{\text{Fixed Cost} + (\text{Setup Cost} \times \text{No. of Setups}) + (\text{Engineering Costs} \times \text{No. of Engineering Hrs.})}{\text{(Price - Unit Variable Cost)}}
\]

\[
= \frac{72,100 + (360 \times 40 \text{ Setups}) + (10 \times 422 \text{ hrs.})}{10 - 5}
\]

\[
= 18,144 \text{ units}
\]

Break Even Point (No of Production Runs)

\[
= \frac{\text{Break Even (units)}}{\text{Production (units per run)}}
\]

\[
= \frac{18,144 \text{ units}}{1,008 \text{ units}}
\]

\[
= 18 \text{ Runs}
\]

(ii) A company should adopt Activity Based Costing (ABC) system for accurate product costing, as traditional volume based costing system does not take into account the Non-unit Level Overhead Costs such as Setup Cost, Inspection Cost, and Material Handling Cost etc. Cost Analysis under ABC system showed that while these costs are largely fixed with respect to sales volume, but they are not fixed to other appropriate cost drivers. If break up the remaining ₹ 72,100 fixed costs consist of only a small portion of these costs, ABC need not be applied.

However, it may also be noted that the primary study has resulted in cost savings. If the savings in cost are expected to exceed the cost of study and implementing ABC, it may be justified. Further it is pertinent to mention that ABC offers no increase in product-costing accuracy for single-product setting.

CVP Analysis - Conditions of Uncertainty

Cost-Volume-Profit analysis suffers from a limitation that it does not consider adjustments for risk and uncertainty. A possible approach by which uncertainty can be incorporated into the analysis is to apply normal distribution theory. If the manager is comparing this product with other products then this approach will enable him or her to assess the risk involved for each product, as well as to compare the relative break-even points and expected profits. The analysis can be changed to include fixed cost, variable cost and selling price as uncertain variables. The effect of treating these variables as uncertain will lead to an increase in the standard deviation because the variability of the variable cost, fixed cost and selling price will add to the variability of profits. Probability distributions play important role in providing decision-making information. It provides information that helps the decision maker better understand the risks and uncertainties associated with the problem. Ultimately, this information may assist the decision maker in reaching a good decision.
Example
The selling price of a product for the next accounting period is ₹110, and the variable cost is estimated to be ₹70 per unit. The budgeted fixed costs for the period are ₹1,63,500. Estimated sales for the period are 5,000 units, and it is assumed that the probability distribution for the estimated sales quantity is normal with a standard deviation of 125 units. The selling price, variable cost and total fixed cost are assumed to be certain. What is the probability of profits being greater than ₹40,000?

The calculations are as follows:

\[
\text{Expected Profit} = \text{Expected Sales Volume} \times \text{Contribution per unit} - \text{Fixed Costs} = 5,000 \times (¥40) - ¥163,500 = ¥36,500
\]

\[
\text{Standard Deviation} = \text{Standard Deviation of Sales Volume} \times \text{Contribution per unit} = 125 \times ¥40 = ¥5,000
\]

Probability for profit (₹40,000):

\[
Z = \frac{x-\mu}{\sigma} = \frac{¥40,000 - ¥36,500}{¥5,000} = +0.70
\]

\[
\text{Probability (Z = +0.70)} = 0.7580
\]

Refer now following Figure

We see that a value of 40,000 corresponds to a value of Z = 0.70 on the standard normal distribution. Using the standard normal probability table, we see that the area under the standard normal curve to the left of Z = 0.70 is 0.7580. Thus, 1.000 - 0.7580 = 0.2420 is the probability that profit will exceed 40,000.
CVP Analysis in Service and Non-Profit Organisations

CVP analysis can also be applied to decisions by service and non-profit organisations. To apply CVP analysis in service and non-profit organisations, we need to focus on measuring their output, which is different from tangible units sold by manufacturing and merchandising companies.

Illustration

Expert Roadways Services Pvt. Ltd. is planning to run a fleet of 15 buses in Birpur City on a fixed route. Company has estimated a total of 2,51,85,000 passenger kilometers per annum. It is estimated buses to have 100% load factor. Buses are purchased at a price of ₹44,00,000 per unit whose scrape value at the end of 5 years life is ₹5,50,000. Seating capacity of a bus excluding a Driver’s seat is 42. Each bus can give a mileage of 5 kmpl. Average cost of fuel is ₹66 per liter. Cost of Lubricants & Sundries per 1,000 km would be ₹3,300. Company will pay ₹27,500 per month to Driver and two attendants for each bus.

Other annual charges per bus: Insurance ₹55,000, Garage Charges ₹33,000, Repairs & Maintenance ₹55,000. Route Permit Charges upto 20,000 km is ₹5,500 and ₹2,200 for every additional 5,000 km or part thereof.

Required

(i) CALCULATE a suggested fare per passenger/km taking into account markup on cost @20% to cover general overheads and sufficient profit.

(ii) The Transport Sector of Birpur is highly regulated. The Government has fixed the fare @ ₹1.35 for next 2 years. COMMENT on the two year’s profitability taking into consideration the inflation rate of 8%.

Note: Route permit charges is not subject to Inflation.

Solution

(i) Statement Suggesting “Fare per passenger – km (Each Bus)”

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Cost per annum (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Expenses:</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>55,000.00</td>
</tr>
<tr>
<td>Garage Charges</td>
<td>33,000.00</td>
</tr>
<tr>
<td>Depreciation</td>
<td>7,70,000.00</td>
</tr>
<tr>
<td>Running Expenses:</td>
<td></td>
</tr>
<tr>
<td>Repair and Maintenance</td>
<td>55,000.00</td>
</tr>
<tr>
<td>Cost of Lubricants and Sundries</td>
<td>1,38,517.50</td>
</tr>
<tr>
<td>Fuel Cost</td>
<td>5,54,070.00</td>
</tr>
</tbody>
</table>
### Salary of Driver and Two Attendants
3,30,000.00

### Route Permit Charges
16,500.00

### Total Cost per annum
19,52,087.50

### Add: Markup @ 20% of Total Cost or 16.67% of Total Revenue
3,90,417.50

### Total Revenue
23,42,505.00

Rate per passenger- km equals to ₹1.395

#### Workings

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Year 1 (₹)</th>
<th>Year 2 (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Expenses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>59,400.00</td>
<td>64,152.00</td>
</tr>
<tr>
<td>Garage Charges</td>
<td>35,640.00</td>
<td>38,491.20</td>
</tr>
<tr>
<td>Depreciation</td>
<td>7,70,000.00</td>
<td>7,70,000.00</td>
</tr>
<tr>
<td>Running Expenses:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repair and Maintenance</td>
<td>59,400.00</td>
<td>64,152.00</td>
</tr>
<tr>
<td>Cost of Lubricants and Sundries</td>
<td>1,49,598.90</td>
<td>1,61,566.81</td>
</tr>
<tr>
<td>Fuel Cost</td>
<td>5,98,395.60</td>
<td>6,46,267.25</td>
</tr>
<tr>
<td>Salary of Driver and Two Attendants</td>
<td>3,56,400.00</td>
<td>3,84,912.00</td>
</tr>
<tr>
<td>Route Permit Charges</td>
<td>16,500.00</td>
<td>16,500.00</td>
</tr>
<tr>
<td>Total Cost</td>
<td>…[A] 20,45,334.50</td>
<td>21,46,041.26</td>
</tr>
<tr>
<td>Total Revenue (Regulated)</td>
<td>…[B] 22,66,650.00</td>
<td>22,66,650.00</td>
</tr>
<tr>
<td>Profit</td>
<td>…[B] – [A] 2,21,315.50</td>
<td>1,20,608.74</td>
</tr>
<tr>
<td>Profit to Total Revenue</td>
<td>9.76%</td>
<td>5.32%</td>
</tr>
</tbody>
</table>
The gross margin is showing a downward trend because the cost components have taken into the effect of inflation hence increasing year by year but the total revenue has remained stagnant due to Government regulations which resulted in reduction in gross margin per bus.

The company’s gross margin to total revenue ratio has come out to be 9.76% and 5.32% in first and second year respectively but initially the company’s desired gross margin to total revenue ratio is 16.67% to cover general overheads and sufficient profit. Though the amount of general overheads is not given but we can safely assume that they may also subject to inflation i.e. increase year by year then in such case the company needs to maintain or increase its gross margin per bus to maintain its net profit after general overheads which is not possible in regulated environment. The information about regulated fare in the given case is regarding first two years only but if this regulated fare scenario persists for further years then the project may not be viable for the company.

**CVP Analysis in Just in Time Environment**

In a firm has implemented *Just in Time*, the variable cost per unit sold is reduced, and fixed costs are increased. Direct labor is considered as fixed instead of variable. On the other hand, direct material, vary with production volume (unit- based variable cost) due to emphasis on *total quality* and *long-term purchasing*. Waste, scrap, and quantity discounts are removed. Other unit- based variable costs, such as power and sales commissions, also exist. Further, the *batch - level* variable is absent as in Just in Time, the batch is equal to one unit. Therefore, the cost equation for Just in Time can be expresses as follows:

\[
\text{Total Cost} = \text{Fixed Cost} + (\text{Unit variable Cost } \times \text{Number of Units}) + (\text{Engineering Cost } \times \text{Number of Engineering hours})
\]

“Managers often use CVP analysis to guide other decisions, many of them are of strategic nature due to tremendous potential of increase in the profitability and organisational effectiveness”

Short-run decision making involves the act of choosing one course of action among various feasible alternatives available. Short-term decisions sometimes are referred to as tactical, or relevant, decisions because they involve choosing between alternatives with an immediate or limited time frame. Strategic decisions, on the other hand, usually are long term in nature because they involve choosing between different strategies that attempt to provide a competitive advantage over a long time frame. Short run decisions involve evaluation of the costs and benefits of short term actions, such as whether to make a product or outsource, whether to accept a special order, whether to keep or drop an unprofitable segment, and whether to sell a product as is or process it further. If resources are limited, managers may also have to decide on the most appropriate product mix. While such decisions tend to be short run in nature, it should be emphasized that they often have long-run consequences. Consider a second example, Suppose that a company is thinking about producing a component instead of buying it from suppliers. The immediate objective may be to lower the cost of making the main product. Yet this decision may be a small part of the overall strategy of establishing a cost leadership position for the firm. Therefore, short-run decisions often are small-scale actions that serve a larger purpose.2
The tactical decision making approach just described emphasized the importance of identifying and using **relevant costs**. But how do we identify and define the costs that affect the decision? For a cost to be relevant to a decision it must be

1) A future cost, i.e. related to the future.
2) A differential Cost, i.e. its level must be different for each of the alternatives under consideration.

Accordingly, only future costs can be relevant to decisions. However, to be relevant, a cost _must not only be a future cost but must also differ from one alternative to another_. If a future cost is the same for more than one alternative, it has no effect on the decision. Such a cost is irrelevant cost. The ability to identify relevant and irrelevant costs is a vital decision making skill.

**Non-Financial Considerations**

With increase in competition, dynamic market changes and changing needs of customers, non-financial information have gained relevance in the decision-making process. Information to which monetary value can be attached is in the nature of financial information. Information of an organization like number of employees, employee morale, customer satisfaction that cannot be expressed in monetary terms is termed non-financial in nature. Non-financial information is _long term focused and ensures profitability and sustainability in long term for an organization thereby evaluating the internal performance of the company_. Non-financial information which a company should focus that would turn out to be advantageous while making decisions for a company are:

- Quality
- Employee Satisfaction
- Customer Satisfaction
- Corporate Social Responsibility
- Environmental Factors
- Intellectual Property
- Intangible Assets
- Competitor’s Movements
- Brand Name

Decisions made in a business rest on the balance between the perceived effects of financial and non-financial information. Following are Limitations of Non-Financial Information-

- Time and Cost of the company involved.
- Subjective measurement – No proper of common denominator to measure performance.
Improper measures will lead the companies to draw attention on wrong objectives.
Lack of Statistical Reliability – Possible chances of error.
Management Disintegration when excess of measures and indications used by the company.

Ethics

Ethics are moral principles that guide the conduct of individuals. By their behaviour and attitude, managers set the company culture. Guideline for Ethical Conduct:

- Identify an ethical decision by using personal ethical standards of honesty and fairness.
- Identify the consequences of the decision and its effect on others.
- Consider obligations and responsibilities to those that will be affected by decision.
- Make a decision that is ethical and fair to those affected by it.

Some ethical problems can be avoided simply by using common sense and not focusing solely on the short term at the expense of long term.

Firms with a strong code of ethics can create strong customer and employee loyalty. Furthermore, a firm that values people more than profit and is viewed as operating with integrity and honour is more likely to be a commercially successful business.

Decision Making Model

A general approach to tactical decision making includes:

- Define the problem.
- Identify alternatives, eliminating unfeasible alternatives.
- Identify costs & benefits of each alternative.
- Examine total relevant costs, benefits of each alternative.
- Assess non-financial factors and ethical issues.
- Select alternative with greatest overall benefit.

Application

<table>
<thead>
<tr>
<th>Step 1: Define the problem</th>
<th>Due to economic down turn, it is not feasible to operate the plant at the normal capacity, at least during the quarter</th>
</tr>
</thead>
</table>
| Step 2: Identify alternatives | Shut down the plant
Operate the plant |
| Step 3: Identify costs, benefits | Alt 1: <Costs> + Benefits
Alt 2: <Costs> + Benefits |
### Illustration

Recently, Ministry of Health and Family Welfare along with Drug Control Department have come hard on health care centres for charging exorbitant fees from their patients. Human Health Care Ltd. (HHCL), a leading integrated healthcare delivery provider company is feeling pinch of measures taken by authorities and facing margin pressures due to this. HHCL is operating in a competitive environment so; it’s difficult to increase patient numbers also. Management Consultant of the company has come out with some plan for cost control and reduction.

HHCL provides treatment under package system where fees is charged irrespective of days a patient stays in the hospital. Consultant has estimated 2.50 patient days per patient. He wants to reduce it to 2 days. By doing this, consultant has targeted the general variable cost of ₹500 per patient day. Annually 15,000 patients visit to the hospital for treatment.

Medical Superintendent has some concerns with that of Consultant’s plan. According to him, reducing the patient stay would be detrimental to the full recovery of patient. They would come again for admission thereby increasing current readmission rate from 3% to 5%; it means readmitting 300 additional patients. Company has to spend ₹25,00,000 more to accommodate this increase in readmission. But Consultant has found bless in disguise in this. He said every readmission is treated as new admission so it would result in additional cash flow of ₹4,500 per patient in the form of admission fees.

**Required**

(i) CALCULATE the impact of Management Consultant’s plan on profit of the company.

(ii) Also COMMENT on result and other factors that should be kept in mind before taking any decision.
Solution

(i) Impact of Management Consultant's Plan on Profit of the HHCL

Human Health Care Ltd.
Statement Showing Cost Benefit Analysis

<table>
<thead>
<tr>
<th>Particulars</th>
<th>₹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost:</td>
<td></td>
</tr>
<tr>
<td>Incremental Cost due to Increased Readmission</td>
<td>25,00,000</td>
</tr>
<tr>
<td>Benefit:</td>
<td></td>
</tr>
<tr>
<td>Saving in General Variable Cost due to Reduction in Patient Days [15,000 Patients × (2.5 Days – 2.0 Days) × ₹500)</td>
<td>37,50,000</td>
</tr>
<tr>
<td>Revenue from Increased Readmission (300 Patients × ₹4,500)</td>
<td>13,50,000</td>
</tr>
<tr>
<td>Incremental Benefit</td>
<td>26,00,000</td>
</tr>
</tbody>
</table>

(ii) Comment

Primary goal of investor-owned firms is shareholder wealth maximization, which translates to stock price maximization. Management consultant’s plan is looking good for the HHCL as there is a positive impact on the profitability of the company (refer Cost Benefit Analysis).

Also HHCL operates in a competitive environment so for its survival, it has to work on plans like above.

But there is also the second side of a coin that cannot also be ignored i.e. humanity values and business ethics. Discharging patients before their full recovery will add discomfort and disruption in their lives which cannot be quantified into money. There could be other severe consequences as well because of this practice. For gaining extra benefits, HHCL cannot play with the life of patients. It would put a question mark on the business ethics of the HHCL.

May be HHCL would able to earn incremental profit due to this practice in short run but It will tarnish the image of the HHCL which would hurt profitability in the long run.

So, before taking any decision on this plan, HHCL should analyze both quantitative as well as qualitative factors.

SOME APPLICATIONS OF CVP ANALYSIS AND COST CONCEPTS

Short run decisions are many and varied but some of the more important ones, we shall look in this chapter include:

- Out Sourcing Decision
- Sell or Further Process
- Minimum Pricing Decisions
Keep or Drop Decisions
- Special Order Decisions
- Product Mix Decision

**Outsourcing Decision**

Outsourcing decision is often called a 'make or buy' decision. It involves a decision of whether to continue 'making' a product versus 'buying' it from an external firm. Outsourcing enables a firm to
- reduce costs
- benefit from supplier efficiencies

Outsourcing decision requires *incremental analysis*. The incremental amounts are based on the difference in the *cost of buying a product or service* compared to the *cost of producing the item or providing the service in house*.

*Incremental costs* are the additional costs incurred from outsourcing. The main cost is the purchase price of the products or the cost of the services that are being provided by external firms.

*Incremental cost savings* are reductions of costs that will no longer be incurred as a result of outsourcing. They are often called avoidable costs because if a company outsources, it can 'avoid' certain costs. Variable product cost savings are always incremental. Because they reduce total costs, they cause profits to increase. In some circumstances, a portion of fixed costs can be saved such as equipment rental costs or supervisor salaries that can be avoided.

*Opportunity costs* are the costs forgone as a result of selecting a different alternative. They are always incremental. For example, if a company decides to outsource, it is able to lease its factory space that the product being outsourced no longer will occupy.

**Outsourcing Decisions- Accept or Reject?**

If incremental cost savings + opportunity costs < incremental costs, reject the outsourcing, unless qualitative factors fiercely impact the decision.

If incremental cost savings + opportunity costs > incremental costs, accept the outsourcing unless qualitative factors fiercely impact the decision.

If incremental cost savings + opportunity costs are = incremental costs, focus primarily on qualitative factors to evaluate the decision.

**Qualitative Factors**

While considering the decision to Outsourcing the management should consider qualitative aspects like quality of goods, reliability of suppliers, impact on the customers and suppliers etc.
A firm generally decides to **outsource**:
- If it costs less rather than to manufacture it internally;
- If the return on the necessary investment to be made to manufacture is not attractive enough;
- If the company does not have the requisite skilled manpower to make;
- If the concern feels that manufacturing internally will mean additional labour problem;
- If adequate managerial manpower is not available to take charge of the extra work of manufacturing;
- If the component shows much seasonal demand resulting in a considerable risk of maintaining inventories;
- If transport and other infrastructure facilities are adequately available;
- If the process of making is confidential or patented;
- If there is risk of technological obsolescence for the component such that it does not encourage capital investment in the component.

**Illustration**

DBA, manufactures and sells 25,000 table fans annually. One of the components required for fans is purchased from an outside supplier at a price of ₹190 per unit. Annually it is purchasing 25,000 components for its usage. The Production Manager is of the opinion that if all the components are produced at own plant, it is possible to maintain better quality in the finished product. Further, he proposed that the in-house production of the component with other items will provide more flexibility to increase the annual production by another 5,000 units. He estimates the cost of making the component as follows:

<table>
<thead>
<tr>
<th></th>
<th>₹ per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct materials</strong></td>
<td>80</td>
</tr>
<tr>
<td><strong>Direct labour</strong></td>
<td>75</td>
</tr>
<tr>
<td><strong>Factory overhead (70% variable)</strong></td>
<td>40</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td>195</td>
</tr>
</tbody>
</table>

The proposal of the Production Manager was referred to the Marketing Manager for his remarks. He pointed out that to market the additional units, the overall unit price should be reduced by 5% and additionally ₹1,00,000 p.m. should be incurred for advertising. Present selling price and contribution per fan are ₹2,500 and ₹600 respectively. No other increase or decrease in all other expenses as a result of this proposal will arise.
**Required**

Since the making cost of the component is more than the buying cost, the Management asks you to:

(i) **ANALYSE the make or buy decision on unit basis and total basis.**

(ii) **RECOMMEND the most profitable alternative.**

**Solution**

(i) DBA purchases 25,000 units of components to manufacture 25,000 fans annually. The external purchase price per component is ₹190 per unit. It has the option of manufacturing these components in house. The cost structure of manufacturing these components would be as below:

<table>
<thead>
<tr>
<th>Cost Structure</th>
<th>Cost per component unit (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Materials</td>
<td>80</td>
</tr>
<tr>
<td>Direct Labor</td>
<td>75</td>
</tr>
<tr>
<td>Variable Factory Overhead (70% of ₹40)</td>
<td>28</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
</tr>
</tbody>
</table>

**Analysis**

If DBA decides to manufacture the components in-house, the following would be the financial impact:

(a) **Production Capacity will increase from 25,000 fans to 30,000 fans.**

(b) **Variable Cost of Production of fan would be ₹1,710 [(2,500 - 600) - 190] per unit.**

(c) **Fixed Factory Overhead of ₹12 per component would be incurred irrespective of whether component is produced or not. Therefore, this cost is not considered.**

(d) **Increase in advertising expense would be ₹100,000 per month or ₹12,00,000 annually.**

(e) **Overall selling price would reduce from the current rate of ₹2,500 per fan to ₹2,375 (95% of ₹2,500) per fan.**

(f) **Current contribution considering a procurement price of ₹190 per component unit, is ₹600 per fan. As calculated above, if produced in house, the variable cost would be ₹183 per component unit. This would result in an increase in contribution by ₹7 per fan (procurement price of ₹190 per component unit less variable cost of ₹183 per component unit). In addition, there is an impact of ₹125 on account of reduction in selling price. Therefore, the contribution if component produced in house would be ₹482 per fan (₹600+₹7-₹125).**

To summarize the above figures:
Therefore, incremental loss by switching to in house production (on a total basis) would be ₹17,40,000 (incremental loss ₹5,40,000 – additional advertising expenses ₹12,00,000). On a per unit basis, it would result in a loss of ₹58 per fan.

(ii) Recommendation

As explained above, if production increases from 25,000 fans to 30,000 fans, it would not be profitable to make these components in house. Overall profit decreased by ₹17,40,000. However, DBA may prefer to make component, even though it could be financially beneficial to buy from outside supplier. Sometimes qualitative factors become very important and can override some financial benefit. This can be coupled with uncertainty about the supplier’s ability or intention to maintain the price, quality, delivery dates of the components etc.

Alternatively, DBA may continue with the sale of 25,000 units without any price reduction and advertising expenses. The component required for the 25,000 fans may be produced internally at a cost of ₹183 per unit. In this situation, the contribution shall be increased by ₹1,75,000 (₹7 × 25,000 units).

Thus, DBA may choice the alternative after due and careful consideration of the facts illustrated above.

**Sell or Further Process**

Sell or process further refers to a decision-making situation where an executive has to decide either to sell a component/product/raw material as it is or alternatively process it further by incurring additional expenses. For instance, sometime, a redundant material lying in stores for a long time may be sold as scrap at a small value or may be thrown away as waste. This material may, however, be converted into a product of higher saleable value by carrying out some further operations or processes. On further processing the component/product/raw material may not only be improved or reconditioned but will mostly fetch a higher sale value as well. Here if the differential sales value is more than the further processing cost, then it is beneficial to process the product further otherwise sell it without further processing. Such type of decision making problems usually arise in the case of joint products.

There are two rules to follow when ascertaining whether the further processing is worthwhile:

- Only the incremental costs and revenues of the further process are relevant
- The joint process costs are irrelevant - they are already 'sunk' at the point of separation
Qualitative Factors

Qualitative factors related to processing further decisions include resource availability such as the readiness of employees to work extra hours to further process the products and availability of materials required for the processing. In addition, the influence on customers that prefer the original product should also be considered, as sales to these customers may be lost to competitors.

Example

A process industry unit manufactures three joint products: A, B and C. C has no realisable value unless it undergoes further processing after the point of separation. The cost details of C are as follows:

<table>
<thead>
<tr>
<th>Upto point of separation</th>
<th>₹ / p.u.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal cost</td>
<td>30</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>20</td>
</tr>
<tr>
<td>After point of separation</td>
<td></td>
</tr>
<tr>
<td>Marginal cost</td>
<td>15</td>
</tr>
<tr>
<td>Fixed cost</td>
<td>5</td>
</tr>
</tbody>
</table>

C can be sold at ₹ 37 per unit and no more.

Cost incurred on Product ‘C’ *upto point of separation* is irrelevant for decision making as Product ‘C’ is a Joint Product. Joint Products are the result of same raw material & same process Operations.

Cost incurred *after point of separation* will be considered for decision making as *specifically* incurred for Product ‘C’.

After further processing Product ‘C’ will contribute ₹17 per unit toward ‘Joint Production Cost’.

Calculation is as follows

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Amount (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price per unit</td>
<td>37.00</td>
</tr>
<tr>
<td>Less: Cost after separation:</td>
<td></td>
</tr>
<tr>
<td>Marginal Cost per unit</td>
<td>15.00</td>
</tr>
<tr>
<td>Fixed Cost per unit</td>
<td>5.00</td>
</tr>
<tr>
<td>Contribution toward ‘Joint Production Cost’</td>
<td>17.00</td>
</tr>
</tbody>
</table>

Hence, *further processing* of Product ‘C’ is recommended.

If Product ‘C’ is not a joint product with same cost structure. In this case there will be *negative contribution* on production of Product ‘C’. The calculation is as follows—→
<table>
<thead>
<tr>
<th>Particulars</th>
<th>Amount (`)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price <em>per unit</em></td>
<td>37.00</td>
</tr>
<tr>
<td>Less: Marginal Cost (**30 + <strong>15)</strong></td>
<td>45.00</td>
</tr>
<tr>
<td>Contribution</td>
<td>(8.00)</td>
</tr>
</tbody>
</table>

Hence, production of Product ‘C’ will not be recommended.

**Minimum Pricing Decisions**

The minimum pricing approach is a useful method in situations where there is a lot of intense competition, surplus production capacity, clearance of old inventories, getting special orders and/or improving market share of the product.

The minimum price should be set at the incremental costs of manufacturing, plus opportunity costs (if any).

For this type of pricing, the selling price is the lowest price that a company may sell its product at usually the price will be the total relevant costs of manufacturing.

**Illustration**

XL Polymers, located in Sahibabad Industrial Area, manufactures high quality industrial products. AT Industries has asked XL Polymers for a special job that must be completed within one week.

Raw material R₁ (highly toxic) will be needed to complete the AT Industries’ special job. XL Polymers purchased the R₁ two weeks ago for `7,500 for a job ‘A’ that recently was completed. The R₁ currently in stock is the excess from that job and XL Polymers had been planning to dispose of it. XL Polymers estimates that it would cost them `1,250 to dispose of the R₁. Current replacement cost of R₁ is `6,000.

Special job will require 250 hours of labour G₁ and 100 hours of labour G₂. XL Polymers pays their G₁ and G₂ employees `630 and `336 respectively for 42 hours of work per week.

XL Polymers anticipates having excess capacity of 150 [G₁] and 200 [G₂] labour hours in the coming week. XL Polymers can also hire additional G₁ and G₂ labour on an hourly basis; these part-time employees are paid an hourly wage based on the wages paid to current employees.

Suppose that material and labour comprise XL Polymers’s only costs for completing the special job.

**Required**

**CALCULATE** the ‘Minimum Price’ that XL Polymers should bid on this job?

**Solution**

Opportunity Cost of Labour - The G₂ labour has zero opportunity cost as there is no other use for the time already paid for and is available. However, XL Polymers needs to pay an additional amount for G₁ labour. This amount can be save if the special job were not there.
Thus, the ‘Opportunity Cost of Labour’ for completing the special job is ₹1,500.

Opportunity Cost of Material – XL Polymers has no alternative use for the ₹1, they must dispose of it at a cost of ₹1,250. Thus, XL Polymers actually saves ₹1,250 by using the materials for the AT Industries’ special job. Consequently, the ‘Opportunity Cost of Material’ is - ₹1,250 (i.e., the opportunity cost of this resource is negative).

The minimum price is the price at which XL Polymers just recovers its ‘Opportunity Cost’. XL Polymers’s ‘Total Opportunity Cost’ is ₹250 (₹1,500 – ₹1,250). Accordingly, minimum Price for the Special Job is ₹250.

Keep or Drop Decisions

Another type of operating decision that management must make is whether to keep or drop unprofitable segments, such as product lines, services, divisions, departments, stores, or outlets.

The decision is based on whether or not the segment’s revenue exceeds the costs directly traceable to the segment, including any direct fixed costs.

Incremental Revenue

- Incremental revenue is the difference in revenue between the original sales revenue and the new revenue that is expected to result due to dropping a segment.
- If dropping a product will cause an increase in demand for another product, the additional revenue for the other product should be taken into consideration.

Incremental Cost Savings

- Variable costs associated with a segment to be dropped are incremental cost savings that cause profit to increase.
- Direct fixed costs related to a segment being dropped are avoidable if that segment is dropped because they can be eliminated if the segment is dropped.

Opportunity Costs

Opportunity costs are common in keep or drop decisions. They often arise due to rental of production space that will become vacant if the decision is made to drop a product. Opportunity costs are always incremental.
Decision - Keep or Drop?

- If incremental cost savings > incremental revenue lost, the segment should be dropped, unless qualitative characteristics fiercely impact the decision.
- If incremental revenue lost = incremental cost savings, qualitative effects must be used to make the decision.
- If incremental cost savings < incremental revenue lost, the segment should not be dropped, unless qualitative characteristics fiercely impact the decision.

Qualitative Factors

Qualitative factors related to keep or drop decisions often include considerations of employees that will be terminated if the product is dropped, the effect a lay off might have on employees that are not terminated, effects of suppliers from which the materials needed for the product will no longer be purchased, and the effect of customers who previously purchased the product being dropped.

Illustration

Rabi Ltd. is considering the discontinuance of Division C. The following information is given:

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Divisions A &amp; B</th>
<th>Division C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (Maximum achievable) (₹)</td>
<td>41,40,000</td>
<td>5,17,500</td>
<td>46,57,500</td>
</tr>
<tr>
<td>Less: Variable cost (₹)</td>
<td>20,70,000</td>
<td>2,76,000</td>
<td>23,46,000</td>
</tr>
<tr>
<td>Contribution (₹)</td>
<td>20,70,000</td>
<td>2,41,500</td>
<td>23,11,500</td>
</tr>
<tr>
<td>Less: Specific avoidable fixed cost (₹)</td>
<td>14,49,000</td>
<td>4,14,000</td>
<td>18,63,000</td>
</tr>
<tr>
<td>Divisional Income (₹)</td>
<td>6,21,000</td>
<td>(1,72,500)</td>
<td>4,48,500</td>
</tr>
</tbody>
</table>

The rates of variable costs are 90% of the normal rates due to the current volume of operation. There is adequate market demand.

For any lower volume of operation, the rates would go back to the normal rates.

Facilities released by discontinuing Division C cannot be used for any other purpose.

Required

COMMENT on the decision to discontinue Division C using relevant cost approach.

Solution

As given in the problem Rabi Ltd. is considering to discontinue the Division C perhaps by seeing the Division C’s income as it is a loss of ₹1,72,500. Discontinuance of Division C might be saving ₹4,14,000 on specific fixed costs to the company but due to this decision company will not only be losing ₹2,41,500 contribution from the Division C but also an additional burden of variable cost of ₹2,30,000 to Divisions A & B and Rabi Ltd. as a whole.

Let assess the decision of the Rabi Ltd. with the help of the Relevant Cost approach.
### Particulars

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Amount (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings Due to Discontinuance</td>
<td></td>
</tr>
<tr>
<td>Specific Fixed Cost</td>
<td>4,14,000</td>
</tr>
<tr>
<td>Total</td>
<td>…(A) 4,14,000</td>
</tr>
<tr>
<td>Loss/ Increase in Cost Due to Discontinuance</td>
<td></td>
</tr>
<tr>
<td>Loss of Contribution</td>
<td>2,41,500</td>
</tr>
<tr>
<td>Increase in Variable Cost (90/20,70,000 × 10)</td>
<td>2,30,000</td>
</tr>
<tr>
<td>Total</td>
<td>…(B) 4,71,500</td>
</tr>
<tr>
<td>Excess of Loss Over Savings</td>
<td>(B) – (A) 57,500</td>
</tr>
</tbody>
</table>

In a nutshell considering the above analysis we can conclude that the decision of discontinuing Division C will not be beneficial for the Rabi Ltd and it should review its decision on the basis of relevant cost approach to reach at right decision.

### Special Order Decisions

Special order decisions focus on whether a special priced order should be accepted or rejected. These orders often can be attractive, especially when the firm is operating below its maximum productive capacity.

Price discrimination laws require that firms sell identical products at the same price to competing customers in the same market. This law does not apply to

- Noncompeting customers from the same market.
- Potential customers in markets not ordinarily served.

Special order decisions are based on incremental analysis. Incremental analysis enables managers to emphasis on the relevant areas of a decision.

- Incremental revenues are the additional revenues generated from accepting the special order. The revenue can result from additional sales of products or from providing services.
  
  If the company is operating at less than capacity, revenue of regular customers will not be affected.
  
  If the company is operating at capacity, it will have to give up some regular sales in order to provide the special order.

- Incremental costs are the additional costs incurred from accepting a special order. Variable operating costs include special packing, commissions, and shipping costs.
  
  Most often, a firm's recurring fixed costs will remain the same in total if a special order is accepted.
Occasionally the acceptance of a special order may cause additional fixed costs such as special purpose tool, Inspection Cost. In these cases, these additional fixed costs are relevant and should be considered in an incremental analysis.

**Decision - Accept or Reject?**

- **If incremental revenue < incremental cost,** reject the special order, unless qualitative characteristics fiercely impact the decision.
- **If incremental revenue = incremental cost,** qualitative effects must be used to make the decision.
- **If incremental revenue > incremental cost,** accept the order, unless qualitative characteristics fiercely impact the decision.

<table>
<thead>
<tr>
<th><strong>Dangers of Concentrating Excessively on a Short-Run Time Horizon</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>All of the costs and revenues are relevant to the decision because some of the costs that were fixed in the short term could be changed in the longer term. Therefore, whether or not a cost is relevant often depends on the time horizon under consideration. Thus, it is vital that the information presented for decision-making relates to the appropriate time horizon. If inappropriate time horizons are selected there is a risk that misleading information will be presented. Our aim should always be to maximize long-term net cash inflows. Utilizing the idle capacity to increase the range of products produced, the production process more complex and consequently the fixed costs of handling the additional complexity will ultimately increase. Long-term considerations should therefore always be taken into account when special pricing decisions are being evaluated. In particular, there is a danger that a series of special orders will be evaluated independently as short-term decisions. Consequently, those resources that cannot be adjusted in the short term will be treated as irrelevant for each decision. However, the effect of accepting a series of successive special orders over several periods constitutes a long-term decision. If special orders are always evaluated as short-term decisions a situation can arise whereby the decision to reduce capacity is continually deferred. If demand from normal business is considered to be permanently insufficient to utilize existing capacity, then a long-term capacity decision is required. This decision should be based on a comparison of the relevant revenues and costs arising from using the excess capacity for special orders with the capacity costs that can be eliminated if the capacity is reduced.</td>
</tr>
</tbody>
</table>

**Illustration**

*BNZ Ltd. is engaged in the manufacture of plastic bottles of a standard size and produced by a joint process of machines. The factory has 5 machines and capable of producing 40 bottles per hour. The variable cost per bottle is `0.32 and the selling price is `0.80 each. The company has received an offer from another company for manufacture of 40,000 units of a plastic moulded toy. The price per toy is `30 and the variable cost is `24 each. In case of the company takes up the job, it has to meet the expenses of making a special mould required for the manufacture of the toy. The cost of the mould is `1,00,000. The company’s time study analysis shows that the machines*
can produce only 16 toys per hour. The company has a total capacity of 10,000 hours during the period in which the toy is required to be manufactured. The fixed costs excluding the cost of construction of the mould during the period will be ₹10 Lakh.

The company has an order for the supply of 3,00,000 bottles during the period.

**Required**

(i) Do you ADVISE the company to take up the order for manufacturing plastic moulded toys during the time when it has an order in its book for the supply of 3,00,000 bottles.

(ii) If the order for the supply of bottles increases to 4,00,000 bottles, will you ADVISE the company to accept the order for the supply of plastic moulded toys? State the reasons.

(iii) An associate company of BNZ Ltd. has idle capacity and is willing to take up the whole or part of the manufacturing of the plastic moulded toys on sub-contracting basis. The subcontract price inclusive of the cost of construction of mould is ₹28 per toy. **DETERMINE** the minimum expected excess machine hour capacity needed to justify producing any portion of the toy order by the company itself rather than subcontracting.

**Solution**

**Workings**

**Statement Showing “Contribution / Machine Hour”**

<table>
<thead>
<tr>
<th></th>
<th>‘Bottle’</th>
<th>‘Toy’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand (units)</td>
<td>3,00,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Sales (₹/u)</td>
<td>0.80</td>
<td>30.00</td>
</tr>
<tr>
<td>Less: Variable Cost (₹/u)</td>
<td>0.32</td>
<td>24.00</td>
</tr>
<tr>
<td>Less: Specific Fixed Cost (₹/u)</td>
<td>---</td>
<td>2.50</td>
</tr>
<tr>
<td>Contribution (₹/u)</td>
<td>0.48</td>
<td>3.50</td>
</tr>
<tr>
<td>Machine Hours Required per unit</td>
<td>0.025</td>
<td>0.0625</td>
</tr>
<tr>
<td>Contribution / Machine Hour</td>
<td>19.20</td>
<td>56.00</td>
</tr>
</tbody>
</table>

**Advice on Supply of 3,00,000/ 4,00,000 Bottles**

(i) BNZ Ltd. can accept plastic moulded toy’s order as sufficient number of hrs. i.e. 2,500 hrs. (10,000 hrs.- 3,00,000 bottles × 0.025 hrs.) are available and would be able to generate additional benefit of ₹3.50 per unit on 40,000 units of toys i.e. ₹1,40,000.

(ii) If the order for the supply of bottles increases to 4,00,000 bottles, then 2,500 more hrs. will be required to produce the additional bottles. BNZ Ltd. has to decide whether to utilize 2,500 hrs. for existing bottle order or for toy Order.
Machine time is limiting factor. Therefore, contribution per machine hour from both the activities (i.e. bottles and toys) should be calculated to decide whether the order should be accepted. Contribution per hour is more in case of toys (refer workings). Therefore, BNZ Ltd. should utilize the remaining 2,500 hours for manufacturing toys rather than to fulfil the order for supply of additional bottles.

Prioritizing production based on contribution per machine hour would maximize profits. However, existing order fulfilment is necessary for building long term and sustainable customer relationship. Developing and maintaining long term and intimate relationships with the profitable customers provides valuable benefits to the company as the relationships between company and customers grow, a customer who is satisfied with the company’s products and services, tends to commit the relationship, and buy more over time. Cost of keeping the existing customers is less expensive than the cost of acquiring new customers.

Hence, BNZ Ltd. should be taken into consideration long term supplier relation before accepting the toy order based on financial consideration as contribution per hour is more in case of toys. Further, company may also explore outsourcing opportunities for production of toys.

(iii) Minimum number of toys needed to be manufactured to justify the increase in fixed cost of $1,00,000 to make the mould is 25,000 toys \( \frac{1,00,000}{(28 - 24)} \). Thus, as long as company has excess capacity available to manufacture more than 25,000 toys it is cheaper to produce than to buy from subcontractor.

Minimum Expected Excess Capacity hours to justify = \( \frac{25,000 \text{ toys}}{16 \text{ toys}} \) = 1,562.5 or 1,563 hrs.

**Product Mix Decision**

Many times, the management has to take a decision whether to produce one product or another instead. Generally, decision is made on the basis of contribution of each product. Other things being the same the product which yields the highest contribution is best one to produce. But, if there is shortage or limited supply of certain other resources which may act as a key factor like for example, the machine hours, then the contribution is linked with such a key factor for taking a decision. For example, in an undertaking the availability of machine capacity is limited and the machine hours required for one unit of the two products are different. In such cases the contribution is to be linked with the machine hour and the product which yields the highest contribution per machine hour is to be preferred for taking decision.

**Illustration**

A company manufactures two products. Each product passes through two departments A and B before it becomes a finished product. The data for the year are as under:
Maximum Capacity of Department A is 3,400 hrs. and Department B is 3,640 hrs.

Maximum Quantity of Direct Materials available is 17,000 kgs. Each product requires 2 kg. of Direct Materials. The Purchase Price of direct materials is ₹5/ kg.

Required

(i) Find optimum product mix.

(ii) In view of the aforesaid production capacity constraints, the company has decided to produce only one of the two products during the year. Which of the two products should be produced and sold in the year to maximise profit? Find the number of units of that product and relevant contribution.

Solution

(i) Calculation of Optimum Production Mix

Statement Showing Limiting Factor

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Material</th>
<th>Hours in Department A</th>
<th>Hours in Department B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required: X</td>
<td>14,800 kg.</td>
<td>3,700 hrs.</td>
<td>2,960 hrs.</td>
</tr>
<tr>
<td>Required: Y</td>
<td>20,000 kg.</td>
<td>3,000 hrs.</td>
<td>4,500 hrs.</td>
</tr>
<tr>
<td>Total Requirement</td>
<td>34,800 kg.</td>
<td>6,700 hrs.</td>
<td>7,460 hrs.</td>
</tr>
<tr>
<td>Available Resources</td>
<td>17,000 kg.</td>
<td>3,400 hrs.</td>
<td>3,640 hrs.</td>
</tr>
<tr>
<td>Shortage</td>
<td>17,800 kg.</td>
<td>3,300 hrs.</td>
<td>3,820 hrs.</td>
</tr>
</tbody>
</table>

Hence all the three resources are limiting factors.

Statement of Rank

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Product X</th>
<th>Product Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Less: Direct Material</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Dept. A</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Dept. B</td>
<td>24</td>
<td>27</td>
</tr>
</tbody>
</table>
To find the optimum mix of products that shall lead to maximum profits while taking into consideration of shortage of resources (i.e. constraints), we have to use Linear Programming.

Let \( x_1 \) and \( x_2 \) donate quantities of product ‘x’ and product ‘y’ respectively.

The linear programming model for the given problem is:

\[
Z_{\text{max}} = 36x_1 + 31x_2
\]

Subject to:

\[
\begin{align*}
2x_1 + 2x_2 & \leq 17,000 & \text{...(for material)} \\
0.5x_1 + 0.3x_2 & \leq 3,400 & \text{...(for dept. A)} \\
0.4x_1 + 0.45x_2 & \leq 3,640 & \text{...(for dept. B)} \\
x_1 & \leq 7,400 & \text{...(demand constraint)} \\
x_2 & \leq 10,000 & \text{...(demand constraint)}
\end{align*}
\]

The graphical solution for the problem is given below:
So, different combinations of product mix include,

<table>
<thead>
<tr>
<th>Combination</th>
<th>$x_1$</th>
<th>$x_2$</th>
<th>Total Contribution (in ₹)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>6,800</td>
<td>0</td>
<td>2,44,800</td>
<td>IV</td>
</tr>
<tr>
<td>Q*</td>
<td>4,171</td>
<td>4,381</td>
<td>2,85,967</td>
<td>-</td>
</tr>
<tr>
<td>R</td>
<td>0</td>
<td>8,089</td>
<td>2,50,759</td>
<td>III</td>
</tr>
<tr>
<td>S</td>
<td>3,700</td>
<td>4,800</td>
<td>2,82,000</td>
<td>II</td>
</tr>
<tr>
<td>T</td>
<td>4,250</td>
<td>4,250</td>
<td>2,84,750</td>
<td>I</td>
</tr>
</tbody>
</table>

**Note (*)**

Combination Q (4,171, 4,381) is not possible as it is satisfying three conditions out of above four conditions. To produce combination Q (4,171, 4,381), requirement of the material will be 17,104 Kgs. (2 Kg × 4,171 units + 2 Kg × 4,381 units). However, material is available 17,000 Kgs. Accordingly, this combination is not possible.

Therefore, optimum product mix = X 4,250 units and Y 4,250 units.
(ii) **Statement Showing Product with Higher Contribution**

<table>
<thead>
<tr>
<th>Product</th>
<th>Maximum Demand</th>
<th>Maximum Production by Dept. A</th>
<th>Maximum Production by Dept. B</th>
<th>Maximum Production with available materials</th>
<th>Feasible Maximum Production (lower of a, b, c and d)</th>
<th>Contribution (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>7,400</td>
<td>6,800</td>
<td>9,100</td>
<td>8,500</td>
<td>6,800</td>
<td>2,44,800</td>
</tr>
<tr>
<td>Y</td>
<td>10,000</td>
<td>11,333</td>
<td>8,089</td>
<td>8,500</td>
<td>8,089</td>
<td>2,50,759</td>
</tr>
</tbody>
</table>

Therefore, Product Y should be produced at 8,089 units resulting in a contribution of ₹2,50,759.

(Source: 5- Managerial Accounting: The Cornerstone of Business Decision-Making By Maryanne M. Mowen, Don R. Hansen, Dan L. Heitger; http://www.unf.edu/; 6-Management Accounting for Business By Colin Drury)

**SUMMARY**

- CVP analysis involves analysing the interrelationships among revenues, costs, levels of activity, and profits. It helps in planning, controlling decisions and evaluating decisions.
- Conventional CVP analysis assumes volume based measures. Activity based costing provides a more accurate determination of costs because it separately identifies and traces non-unit based costs to products rather than combining them in a pool of fixed costs as volume based approach does.
- The Break-even can then be expressed as follows:
  \[
  \text{Break-even units} = \frac{[\text{Fixed costs} + (\text{Setup cost} \times \text{Number of Setups}) + (\text{Engineering Cost} \times \text{Number of Engineering Hours})]}{(\text{Price - Unit Variable Cost})}
  \]
- A comparison of the ABC break-even point with the conventional break-even point reveals two important differences. First, the fixed costs differ. Some costs previously identified as being fixed may actually vary with non-unit cost drivers, in this case setups and engineering hours. Second, the numerator of the ABC break-even equation has two non-unit-variable cost terms: one for batch-related activities and one for product-sustaining activities.
- Cost-Volume-Profit analysis suffers from a limitation that it does not consider adjustments for risk and uncertainty. A possible approach by which uncertainty can be incorporated into the analysis is to apply normal distribution theory. The analysis can be changed to include fixed cost, variable cost and selling price as uncertain variables. The effect of treating these variables as uncertain will lead to an increase in the standard deviation because the variability of the variable cost, fixed cost and selling price will add to the variability of profits.
- To apply CVP analysis in service and non-profit organisations, we need to focus on measuring their output, which is different from tangible units sold by manufacturing and merchandising companies.
- Short run decision making – Based on relevant costs, Short run in nature, referred to as tactical decisions, choosing among alternatives, often have long run consequences, immediate or limited time frame, small scale actions that serve a larger purpose.

- For a cost to be relevant to a decision it must be
  - A future cost, i.e. related to the future.
  - A differential Cost, i.e. its level must be different for each of the alternatives under consideration.

Accordingly, only future costs can be relevant to decisions. However, to be relevant, a cost must not only be a future cost but must also differ from one alternative to another. If a future cost is the same for more than one alternative, it has no effect on the decision. Such a cost is irrelevant cost.

- Non-Financial information which a company should focus that would turn out to be advantageous while making decisions for a company are: Quality, Employee Satisfaction, Customer Satisfaction, Corporate Social Responsibility, Environmental Factors, Intellectual Property, Intangible Assets, Competitor’s Movements, Brand Name.

- Ethics are moral principles that guide the conduct of individuals. By their behaviour and attitude, managers set the company culture.

- Guideline for Ethical Conduct: Identify an ethical decision by using personal ethical standards of honesty and fairness, Identify the consequences of the decision and its effect on others, consider obligations and responsibilities to those that will be affected by decision, make a decision that is ethical and fair to those affected by it.

- Decision Making Model – Define the problem, identify alternatives, eliminating unfeasible alternatives, identify costs & benefits of each alternative, examine total relevant costs, benefits of each alternative, assess non-financial factors and ethical issues, select alternative with greatest overall benefit.

- Some Common Applications –
  (a) Out Sourcing Decision – A ‘make or buy’ decision requires incremental analysis.
      If incremental cost savings + opportunity costs < incremental costs, reject the outsourcing, unless qualitative factors fiercely impact the decision.
      If incremental cost savings + opportunity costs > incremental costs, accept the outsourcing unless qualitative factors fiercely impact the decision.
      If incremental cost savings + opportunity costs are = incremental costs, focus primarily on qualitative factors to evaluate the decision.

  (b) Sell or Further Process – To decide either to sell a component/ product/ raw material as it is or alternatively process it further by incurring additional expenses usually in the case of joint products. Only the incremental costs and revenues of the further process are relevant. The joint process costs are irrelevant - they are already ’sunk’ at the point of separation.
(c) Minimum Pricing Decisions – Relevant where there is a lot of intense competition, surplus production capacity, clearance of old inventories, getting special orders and/or improving market share of the product. The minimum price should be set at the incremental costs of manufacturing, plus opportunity costs (if any).

(d) Keep or Drop Decisions – The decision is based on whether or not the segment’s revenue exceeds the costs directly traceable to the segment, including any direct fixed costs.

(e) Special Order Decisions – Whether a special priced order should be accepted or rejected. Relevant if the firm is operating below its maximum productive capacity. Price discrimination laws require that firms sell identical products at the same price to competing customers in the same market. This law does not apply to - Noncompeting customers from the same market and Potential customers in markets not ordinarily served.

(f) Product Mix Decision – Other things being the same the product which yields the highest contribution is best one to produce. But, if there is shortage or limited supply of certain other resources which may act as a key factor like for example, the machine hours, then the contribution is linked with such a key factor for taking a decision.

TEST YOUR KNOWLEDGE

Decision Making

1. ‘S’ manages the school canteen (approximately 1,600 students) at Noida. The current cash payment system requires three clerks (paid ₹90 per hour), employed for about 4 hours a day. The canteen operates approximately 240 days a year.

‘S’ is considering a Wireless Cash Management System (WCMS), where a student could just swipe an ID Card for payment. This system would cost ₹1,25,000 to setup and ₹36,000 per year to operate. ‘S’ believes that he could manage with one clerk if he were to implement the system.

Required

ADVISE ‘S’ on the choice of a plan, assuming working life of WCMS as 5 years. (Ignore the time vale of money)

2. Aayla runs the Planetarium Station in New Delhi, India. The strength of the station lies in its live interactions and programs for visitors, students and amateur astronomers. The station is always active with programs for school and college students and for amateur astronomers. One of the station’s key attractions is a big screen IMAX theatre. IMAX is a 70 mm motion picture film format which shows images of far greater size and resolution than traditional film systems. The IMAX cinema projection standards were developed in Canada in the late 1960s. Unlike traditional projectors, the film is run horizontally so that the image width is greater than the width of the film.
The average IMAX show at the station attracts 120 visitors (50 children and 70 adults) at a ticket price of ₹160 for children and ₹200 for adults. Aayla estimates that the running costs per IMAX show are ₹10,000. In addition, fixed costs of ₹7,500 are allocated to each show based on annual estimate of the number of IMAX shows.

The Hobart School has approached Aayla about scheduling an extra show for its class VIII students. One hundred students and five teachers are expected to join the special show on the ‘Planets & Solar System’, a feature that is currently showing. The school has asked Aayla for a price quote. The special show will take place at 08:30 AM when the IMAX is not usually open.

**Required**

RECOMMEND the minimum amount that Aayla should charge.

3. Color paints is a manufacturer of industrial dyes. It has received an order for 200 kgs of powder dye that needs to be customized to certain specifications. The job would require the following materials:

<table>
<thead>
<tr>
<th>Material</th>
<th>Total units required</th>
<th>Units already in inventory</th>
<th>Book value of the units in inventory (₹ per unit)</th>
<th>Realizable value (₹ per unit)</th>
<th>Replacement cost (₹ per unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2,000</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>8</td>
</tr>
<tr>
<td>B</td>
<td>3,000</td>
<td>1,200</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>2,000</td>
<td>1,400</td>
<td>12</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>D</td>
<td>500</td>
<td>500</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

I) Material B is used regularly in production of all types of dyes that Color paints produces. Therefore, any stock used towards this job order would need to be replaced to meet other production demands.

II) Inventory of material C and D are from stock that was purchased in excess previously. Material C has no other use other than for this special order. Material D can be used as a substitute for 700 units of material Z which currently costs ₹11 per unit. The company does not have any inventory of material Z currently.

**Required**

ANALYSE the relevant costs of material while deciding whether to accept the order or not?

4. Diezel, is engaged in manufacturing many chemical products. It is using many chemicals some of which are fast moving, some are slow moving and few are in non-moving category. The firm has a stock of 10 units of one non-moving toxic chemical. Its book value is ₹2,400, realizable value is ₹3,500 and replacement cost is ₹4,200.

One of the customers of the firm asks to supply 10 units of a product which needs all the 10 units of the non-moving chemical as an input. The other costs associated with the production of the product are:
Allocated overhead expenses ₹16 per unit
Out of pocket expenses ₹50 per unit
Labour cost ₹40 per hour. For each unit two hours are required.
Other material cost ₹80 per unit.
The labour force required for the production of the product will be deployed from among the permanent employees of the firm. This temporary deployment will not lead to any loss of contribution.

Required
(i) RECOMMEND the minimum unit price to be charged to the customer without any loss to the firm.
(ii) ANALYSE with reasons for the inclusion or exclusion of each of the cost associated with the production of the product.
(iii) ADVICE a pricing policy to be followed by Diezel in perfect competition.

5. Golden Pacific Airlines Ltd. operates its services under the brand ‘Golden Pacific’. The ‘Golden Pacific’ route network spans prominent business metropolis as well as key leisure destinations across the Indian subcontinent. ‘Golden Pacific’, a low-fare carrier launched with the objective of commoditizing air travel, offers airline seats at marginal premium to train fares across India.

Profits of the ‘Golden Pacific’ have been decreasing for several years. In an effort to improve the company’s performance, consideration is being given to dropping several flights that appear to be unprofitable.

Income statement for one such flight from ‘New Delhi’ to ‘Leh’ (GP - 022) is given below (per flight):

<table>
<thead>
<tr>
<th>Description</th>
<th>₹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ticket Revenue</td>
<td>7,35,000</td>
</tr>
<tr>
<td>(175 seats x 60% Occupancy x ₹ 7,000 ticket price)</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Expenses (₹1,400 per person)</td>
<td>1,47,000</td>
</tr>
<tr>
<td>Contribution Margin</td>
<td>5,88,000</td>
</tr>
<tr>
<td><strong>Less: Flight Expenses:</strong></td>
<td></td>
</tr>
<tr>
<td>Salaries, Flight Crew</td>
<td>1,70,000</td>
</tr>
<tr>
<td>Salaries, Flight Assistants</td>
<td>31,500</td>
</tr>
<tr>
<td>Baggage Loading and Flight Preparation</td>
<td>63,000</td>
</tr>
<tr>
<td>Overnight Costs for Flight Crew and Assistants at destination</td>
<td>12,600</td>
</tr>
<tr>
<td>Fuel for Aircraft</td>
<td>2,38,000</td>
</tr>
<tr>
<td>Depreciation on Aircraft</td>
<td>49,000*</td>
</tr>
</tbody>
</table>
DECISION MAKING

<table>
<thead>
<tr>
<th>Liability Insurance</th>
<th>1,47,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Promotion</td>
<td>28,000</td>
</tr>
<tr>
<td>Hanger Parking Fee for Aircraft at destination</td>
<td>7,000</td>
</tr>
<tr>
<td>Net Gain / (Loss)</td>
<td>(1,58,100)</td>
</tr>
</tbody>
</table>

*Based on obsolescence*

The following additional information is available about flight GP-022.

1. Members of the flight crew are paid fixed annual salaries, whereas the flight assistants are paid by the flight.

2. The baggage loading and flight preparation expense is an allocation of ground crew’s salaries and depreciation of ground equipment.

3. One third of the liability insurance is a special charge assessed against flight GP-022 because in the opinion of insurance company, the destination of the flight is in a “high-risk” area.

4. The hanger parking fee is a standard fee charged for aircraft at all airports.

5. If flight GP-022 is dropped, ‘Golden Pacific’ Airlines has no authorization at present to replace it with another flight.

**Required**

Using the data available, prepare an ANALYSIS showing what impact dropping flight GP-022 would have on the airline’s profit.

6. **About Aditya Group**

Aditya Group was established in 1975, manufactures and sells electronic personal grooming and beauty products. The group has two 100% subsidiaries AUS Ltd. and ANZ Ltd. AUS Ltd. manufactures luxury products that cater to niche customers who prefer specialized personal grooming and beauty care. ANZ Ltd. caters to regular daily beauty and grooming requirements that has a wide reach within the market. Factories of both companies are located within India. The products are sold to wholesalers, who supply these products to the retail market.

Aditya Group purchases its raw material requirements from both domestic and overseas markets. Additionally, certain products manufactured by AUS Ltd. can be enhanced based on the products manufactured by ANZ Ltd. Therefore, as per production requirements, AUS Ltd. sources some product components from ANZ Ltd.

Aditya Group has a centralized decision making set-up. Basic policy decisions for functions such as production planning, sales and client relationship, finance and human resources are handled at the group level. Individual units AUS Ltd. and ANZ Ltd. concentrate on the manufacturing alone.

**About You**

You are an Assistant Manager in Finance and Accounts department of Aditya Group, headed by Director- Finance Ms. Elsea. You assist and report to Ms. Fiona, Manager of your...
department. Sometime you also assist Director Finance in analysing financial and non-financial information, drafting reports for board meetings, preparation of presentation and staff trainings.

**Business Situation- 1**

**Yesterday, 5.15 P.M.**
You got an email from Ms. Elsea, with Cc to Ms. Fiona. Ms. Elsea, asked you to prepare a cost statement for making a quotation to a new customer. She has also informed you that the customer can also maintain a long-term business relation with us. You have been requested to gather information related to the specification from Sales Manager.

**Yesterday, 5.25 P.M.**
You have been called by Ms. Fiona, and provided the product specification received from Sales Manager for which quotation has to be quoted. Ms. Fiona has also requested you to gather relevant information to prepare cost statement. Due to the expected long term business relationship that AUS Ltd. wants to have with the customer, the sales manager wants to quote the lowest possible price. AUS Ltd. currently has some spare capacity that can be utilized to cater to this entire order. Therefore, only the relevant cost to AUS Ltd. has to be considered to arrive at the quote.

After meeting with your reporting officer, you mailed to various concerned department and requested for data.

The following information has been obtained in relation to the contract:

**Today, 10.05 A.M.**
You got an e-mail from Production Manager, it has been informed that 40 tonnes of material Dx would be required. This material is in regular use by AUS and has a current purchase price of ₹380 per tonne. Currently, there are 5 tonnes in inventory which cost ₹350 per tonne. The resale value of the material in inventory is ₹240 per tonne.

Further, with regards to components, it has been informed that 4,000 components would be required. These could be bought externally for ₹15 each or alternatively they could be supplied by ANZ Ltd. The variable cost of the component if it were manufactured by ANZ Ltd. would be ₹8 per unit. ANZ Ltd. has sufficient capacity to produce 2,500 components without affecting its ability to satisfy its own external customers. However, in order to make the extra 1,500 components required by AUS Ltd., ANZ Ltd. would have to forgo other external sales of ₹50,000 which have a contribution to sales ratio of 40%. To have uniformity in the quality of the component, it is assumed that AUS Ltd. would procure its entire requirement of 4,000 components either externally or from ANZ Ltd. The transfer pricing policy of Aditya Group for sales between units aims at goal congruence. The unit selling the goods would be allowed to charge any opportunity cost on account of catering to internal demand, while the purchasing unit should ensure that the company is not at a loss.

**Today, 10.45 A.M.**
You got an e-mail from Personnel Manager, it has been informed that 2,000 high skilled labour hours would be required. The grade of labour required is currently paid ₹5 per hour.
Highly skilled labour is in short supply and cannot be increased significantly in the short-term. This labour is presently engaged in meeting the demand for product ‘G’, which requires 4 hours of highly skilled labour. The contribution from the sale of one unit of product L is ₹24.

It has also been informed that the contract would require a specialist machine. The machine could be hired for ₹15,000 or it could be bought for ₹50,000. At the end of the contract if the machine were bought, it could be sold for ₹30,000. Alternatively, it could be modified at a cost of ₹5,000 and then used on other contracts instead of buying another essential machine that would cost ₹45,000. The operating costs of the machine are payable by AUS whether it hires or buys the machine. These costs would total ₹12,000 in respect of the new contract.

**Supervisor**

The contract would be supervised by an existing manager who is paid an annual salary of ₹50,000 and has sufficient capacity to carry out this supervision. The manager would receive a bonus of ₹5,000 for the additional work.

**Development Time**

15 hours of development time at a cost of ₹30,000 have already been worked in determining the resource requirements of the contract.

**Fixed Overhead Absorption Rate**

AUS uses an absorption rate of ₹20 per direct labour hour to recover its general fixed overhead costs. This includes ₹5 per hour for depreciation.

Today, 11.15 A.M: Ms. Fiona called you in her place as asked you the following:

Required

(i) CALCULATE the relevant cost of the contract to AUS. You must present your answer in a schedule that clearly shows the relevant cost value for each of the items identified above. You should also EXPLAIN each relevant cost value you have included in your schedule and why any values you have excluded are not relevant. Ignore taxation and the time value of money.

(ii) DISCUSS two problems that can arise as a result of setting prices using relevant costing.

**Business Situation- 2**

Today, 5.26 P.M: A memo from Managing Director of the group has been circulated to all officers of the group which stated “My objective for the forthcoming year is to reduce our quality costs in each of the primary activities in our value chain”. The company is keen to build a reputation for quality and gives a five-year guarantee with all of its products.

Today, 5.37 P.M: Ms. Fiona, called you in her place and asked the following:

**Required**

(iii) EXPLAIN, by giving examples, how each of the four types of quality cost could be reduced. You should also IDENTIFY in which primary activity each one of your examples would occur in Aditya Group’s value chain.
ANSWERS/ SOLUTIONS

1. For each day, ‘S’ spends ₹360 per clerk (₹90 per hr. × 4 hrs.). Therefore, ‘S’ spends ₹1,080 per day to employ three clerks. Annually, this outlay amounts to ₹2,59,200 (₹1,080 per day × 240 days).

Over five years, the outlay would be ₹12,96,000. If the WCMS is implemented, the initial cost is ₹1,25,000. If we add the annual cost of ₹36,000, the total cost over five years amounts to ₹3,05,000. Since one clerk will be needed as well, ‘S’ has to incur ₹4,32,000 over five years to pay clerk (₹4,32,000 = ₹90 × 4 hrs. × 1 clerk × 240 days × 5 years). Therefore, the total cost of this option is ₹7,37,000.

Accordingly, there is cost saving of ₹5,59,000 from WCMS implementation.

Relevant Non-Financial Considerations

The WCMS may be a lot more efficient, but more rigid. For instance, what if, a student forgets to bring his/her card or transaction failure due to connectivity issue, and may not have enough cash to pay. Automated systems may be less able to handle these situations. Having clerks may add an aspect of flexibility and a human aspect that is hard to quantify.

Conclusion

Obviously, WCMS option is more cost effective for ‘S’ because there is a cost saving of ₹5,59,000. But, non-financial factors should also be taken into consideration.

2. The incremental cost associated with the IMAX show appears to be ₹10,000 i.e. cost of running the show. The allocated fixed cost per show is not relevant because the total amount of fixed costs for the year will not change as a result of the special show. Further, the stated ticket prices are not relevant because the show will take place at 08:30 AM when the IMAX is not usually open – thus, the students will not be displacing any regular visitors. Based on the financial data provided, the minimum price quote appears to be ₹10,000.

Aayla should consider the following factors:

- Does the station have a souvenir shop and/or cafeteria?
  
  If so, many students are likely to buy food and/or souvenir items, thereby increasing the station’s contribution. In turn, this would reduce the minimum price quote.

- What is the impact on future revenue?
  
  After seeing the show, many students may return with their parents, thereby increasing future revenue.

- Are there costs linked with the special showing that are not included in the ₹10,000 variable cost number?

For example, will the station have to pay an overtime premium.

Aayla should also consider the educational mission of the Planetarium Station. Such shows directly contribute to this mission, the station, and, hopefully, the betterment of the students. The special shows may be an excellent way to expose some students to earth science –
these students may have never gone through the Planetarium Station if it were not for the school excursion.

Overall, the “best” price to charge is unclear and requires some judgment as Aayla needs to balance an array of financial and non-financial factors.

3. Material A

The requirement of 2,000 units of Material A has to be purchased in entirety since there are no units in stock. Therefore, the relevant cost will be the replacement cost at ₹8 per unit, which for 2,000 units is ₹16,000 (2,000 units × ₹8 per unit).

Material B

There is a requirement of 3,000 units of Material B, of which 1,200 units are in stock. Material B used regularly in the production of all types of dyes. If the 1,200 units in stock are used, they need to be replenished (replaced) in order to meet production demands of other dyes. In addition, for the special order, additional 1,800 units of Material B is required to be procured from the market. Therefore, 3,000 units of Material B has to be procured if the special order is undertaken. The relevant cost will be the replacement cost at ₹10 per unit, which for 3,000 units is ₹30,000 (3,000 units × ₹10 per unit).

Material C

There is a requirement of 2,000 units of Material C, of which 1,400 units are in stock. The balance 600 units have to be procured at the replacement (market) price of ₹14 per unit, which would be ₹8,400. Material C has no other use, so if the special order is not undertaken the stock of 1,400 units can be sold at ₹9 per unit. So, the opportunity cost of undertaking this order is ₹12,600. Therefore, the relevant cost for Material C is procurement cost of 600 units plus the opportunity cost of not disposing the current stock of 1,400 units, which would be ₹8,400 + ₹12,600 = ₹21,000.

Material D

The entire requirement of 500 units of Material D is in stock. If the special order is not accepted, Color paints has two options (i) sell the excess material at ₹12 per unit or (ii) use it as a substitute for Material Z, which would otherwise need to be procured.

(i) The realizable value of Material D is ₹6,000 (500 units × ₹12 per unit).

(ii) Material D can be used as a substitute for 700 units of Material Z. Since there is no stock of Material Z currently, if the special order is accepted, the entire quantity would have to be procured at ₹11 per unit. This would cost the company ₹7,700 (700 units × ₹11 per unit).

Both options (i) and (ii) represent opportunity cost if the special order is accepted. The relevant cost for Material D, if the special order is accepted would be higher of either of these two opportunity costs. The higher opportunity cost of that of procuring Material Z from the market at ₹7,700. Therefore, the relevant cost for Material D is ₹7,700.

Therefore, the relevant cost to accepting the special order would be the cumulative of the relevant cost for Materials A, B, C, and D. This works out to ₹74,700.
4. (i) Diezel has the opportunity to utilize 10 units of non-moving chemical as input to produce 10 units of a product demanded by one of its customers. The minimum unit price to be charged to the customer would be—

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Cost per unit of product (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Material</td>
<td>350</td>
</tr>
<tr>
<td>(Realizable value = ₹3,500 / 10 units of chemical)</td>
<td></td>
</tr>
<tr>
<td>Out of Pocket Expenses</td>
<td>50</td>
</tr>
<tr>
<td>Other Material Cost</td>
<td>80</td>
</tr>
<tr>
<td>Minimum Unit Price that can be charged</td>
<td>480</td>
</tr>
</tbody>
</table>

Therefore, the minimum unit price that can be charged to the customer, without incurring any loss is ₹480 per unit of product. As explained below in point (ii), allocated overhead expenses and labor cost are sunk costs that have been ignored while calculating the minimum unit price to be charged.

(ii) Analysis

(a) Cost of Material: Relevant and hence included at realizable value. Diezel has 10 units of non-moving chemical input that has a book value of ₹2,400, realizable value of ₹3,500 and replacement cost of ₹4,200. Realizable value of ₹3,500 would be the salvage value of the chemical had it been sold by Diezel instead of using it to meet the current order. This represents an opportunity cost for the firm and hence included while pricing the product. Book value would represent the cost at which the inventory has been recorded in the books, a sunk cost that has been ignored. Replacement cost of ₹4,200 would be the current market price to procure 10 units of the input chemical. This would be relevant only when the inventory has to be replenished after use. This chemical is from the non-moving category, that means that it is not used regularly in production process and hence need not be replenished after use. Therefore, replacement cost is also ignored for pricing.

(b) Labour Cost: Not relevant and hence excluded from pricing. It is given in the problem that this order would be met by permanent employees of the firm. Permanent employee cost is a fixed cost that Diezel would incur irrespective of whether this order is produced or not. No additional labour is being employed to meet this order. Therefore, this cost is a sunk cost, excluded from pricing.

(c) Allocated Overhead Expenses: These expenses have been incurred at another Cost Centre, typical example would be office and administration costs. Such costs are fixed in nature that would be incurred irrespective of whether this order is produced or not. Therefore, this cost is a sunk cost, excluded from pricing.
(d) Out of Pocket Expenses: These are expenses that are incurred to meet the production requirement of this order. These are additional variable expenses, that need to be included in pricing.

(e) Other Material Costs: These are expenses that are incurred to meet the production requirement of this order. These are additional variable expenses, that need to be included in pricing.

(iii) Advice on Pricing Policy

Under perfect competition conditions, Diezel can have no pricing policy of its own, here sellers are price takers. It cannot increase its price beyond the current market price. The firm can only decide on the quantity to sell and continue to produce as long as the marginal cost is recovered. When marginal cost exceeds the selling price, the firm starts incurring a loss.

Since Diezel cannot control the selling price individually in the market, it can adopt the going rate pricing method. Here it can keep its selling price at the average level charged by the industry. This would yield a fair return to the firm. An average selling price would help the firm attract a fair market share in competitive conditions.

5. As per the statement given in the problem, FlightGP-022 incurs a net (loss) of `158,100. This is the net result of revenue less costs. Revenue is entirely variable depending upon passenger occupancy. Costs are both variable and fixed nature. To analyze the impact of dropping flight GP-022, we need to re-compute net gain/ (loss) that Golden Pacific earns when it operates the flight based on relevant costing principles.

\[
\text{Net Gain/ (Loss)} = \text{Revenue earned from flight operations less Variable costs of operation}
\]

Revenue earned is the ticket revenue earned from flight operations of GP-022, this is entirely variable. Variable costs of flight operations are those expenses that would be incurred only when the flight is operated. These include variable expenses per passenger, salaries flight assistants, overnight costs for flight crew and assistants, fuel for aircraft, a third portion of flight insurance that is specifically related to this flight sector and flight promotion expense. These are expenses that will not be incurred if the flight is not operated. Hence, relevant for decision making.

Other expenses like salaries of flight crew and hanger parking fees for aircraft are fixed expenses that will be incurred even if the flight does not operate. Loading and flight preparation expense is an allocated cost that will continue to be incurred even if flight GP-022 does not operate. Depreciation of aircraft and liability insurance expense (2/3rd portion not related to a specific flight sector) are sunk costs. These expenses have already been incurred and hence are irrelevant to decision making. Therefore, these fixed, allocated and sunk expenses are ignored while analyzing the decision whether to continue operating flight GP-022.
Flight GP-022
Statement Showing Net Gain/ (Loss)

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution Margin <em>if the flight is continued</em></td>
<td>5,88,000</td>
</tr>
<tr>
<td><strong>Less: Flight Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Flight Promotion</td>
<td>28,000</td>
</tr>
<tr>
<td>Fuel for Aircraft</td>
<td>2,38,000</td>
</tr>
<tr>
<td>Liability Insurance (1/3 × ₹1,47,000)</td>
<td>49,000</td>
</tr>
<tr>
<td>Salaries, Flight Assistants</td>
<td>31,500</td>
</tr>
<tr>
<td>Overnight Costs for Flight Crew and Assistants</td>
<td>12,600</td>
</tr>
<tr>
<td><strong>Net Gain/ (Loss)</strong></td>
<td>2,28,900</td>
</tr>
</tbody>
</table>

If Golden Pacific Airlines Ltd. discontinues flight GP-022, profits will reduce by ₹2,28,900. The statement showing loss in operations of ₹158,100 is misleading for decision making purpose because it accounts for costs that are fixed and irrelevant. However, since flight GP-022 yields a net gain of ₹2,28,900, flight operations should continue.

6. (i) Statement Showing Relevant Cost

<table>
<thead>
<tr>
<th>Type of Cost</th>
<th>Explanation</th>
<th>Amount (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Dx (40 tonnes × ₹380)</td>
<td>1</td>
<td>15,200</td>
</tr>
<tr>
<td>Components</td>
<td>2</td>
<td>52,000</td>
</tr>
<tr>
<td>Direct labour (2,000 hrs. × ₹11)</td>
<td>3</td>
<td>22,000</td>
</tr>
<tr>
<td>Specialist machine</td>
<td>4</td>
<td>10,000</td>
</tr>
<tr>
<td>Machine operating cost</td>
<td>5</td>
<td>12,000</td>
</tr>
<tr>
<td>Supervision</td>
<td>6</td>
<td>5,000</td>
</tr>
<tr>
<td>Development time</td>
<td>7</td>
<td>Nil</td>
</tr>
<tr>
<td>General fixed overhead</td>
<td>8</td>
<td>Nil</td>
</tr>
<tr>
<td><strong>Total relevant cost</strong></td>
<td></td>
<td>1,16,200</td>
</tr>
</tbody>
</table>

**Explanation**

1. Material Dx is in regular use by AUS Ltd. and must be replaced. Consequently, its relevant value is its replacement cost. The historical cost is not relevant because it is a past cost and the resale value is not relevant because AUS Ltd. is not going to sell it because the material is in regular use.

2. AUS Ltd. would like to procure 4,000 components either from ANZ Ltd. or externally from the market. At the current production level, ANZ Ltd. (seller) has available capacity to accommodate part of AUS Ltd's request to the extent of 2,500 components. At this point, ANZ Ltd. would be operating at its maximum capacity.
To cater to the remaining demand of 1,500 units from AUS Ltd., ANZ Ltd. has to forego external sales of ₹50,000 to its own customers. Given that the contribution to sales ratio is 40%. Therefore, ANZ Ltd. has to forego contribution of ₹20,000 (40% of external sales foregone ₹50,000) in order to cater to AUS Ltd.'s request. Fixed cost at ANZ Ltd. is irrelevant, since it would be incurred irrespective of whether AUS Ltd.'s order to catered to or not.

Therefore, in spirit of goal congruence, the transfer price that ANZ Ltd. would charge AUS Ltd. would be the variable cost of ₹8 per unit and ₹20,000 towards lost contribution as explained above. Therefore, the transfer price

\[
= (₹8 \text{ per unit} \times 4,000 \text{ components}) + ₹20,000 \\
= ₹32,000 + ₹20,000 \\
= ₹52,000 \text{ for 4,000 components}
\]

Therefore, per component, the price charged would be ₹52,000 / 4,000 = ₹13 per component. This is lower than the external market price of ₹15 per unit. Therefore, in the interest of goal congruence the cheaper option is preferred. AUS Ltd. should source its components from ANZ Ltd, for a total procurement cost of ₹52,000.

3. Skilled labour is in short supply and can only be obtained by reducing the production of product 'G', resulting in a loss of contribution of ₹24 (given) or ₹6 per hour of skilled labour. Hence the relevant labour cost will be ₹6 (contribution lost per hour) + ₹5 (hourly rate of skilled labour) i.e. ₹11 per hour.

4. AUS Ltd. has a number of options: (a) If the machine were to be hired it would have a cost of ₹15,000; (b) if the machine were bought and then sold at the end of the work it would have a net cost of ₹20,000; or (c) if the machine were bought and then modified to avoid the need to buy the other machine it would have a net cost of ₹10,000 (₹50,000 plus ₹5,000 modifications less ₹45,000 cost of another machine). Thus, the most economic approach is buy the machine and then modify it so the relevant cost is ₹10,000.

5. The machine operating costs are future costs of doing the work and therefore are relevant.

6. The supervisor’s salary is irrelevant, but the bonus needs to be included because it is dependent on this work and therefore is relevant.

7. The development time has already been incurred. Therefore, it is a past cost and not relevant.

8. General fixed overhead costs and their absorption are not relevant because they will be incurred whether the work goes ahead or not. Depreciation is also not relevant because it is an accounting entry based on the historical purchase of assets. It is not affected by the work being considered.
(ii) Two main issues arise when pricing work based on relevant costs:

- Profit reporting; and
- Pricing of future work.

With regard to profit reporting, the decision as to whether to proceed with the work will have been based on the use of relevant costs, but the routine reporting of the profit from the work will be based on the company’s normal accounting system. Since this system will be based on total cost, it is probable that the costs of the work reported will be greater than its relevant cost. Consequently, the amount of profit reported to have been made on this order will be lower than expected and may even be a loss. This may cause difficulties for the manager who accepted the work as an explanation will be required of the reasons why there is such a difference in profit.

With regard to the pricing of future work the difficulty lies in increasing the price for similar items for the same customer in future. Once a price is set, customers tend to expect that any future items will be priced similarly. However, where a special price has been offered based on relevant cost because of the existence of spare capacity the supplier would not be able to continue to price on that basis as it does not recover its long term total costs. There may also be difficulties created by this method of pricing as other customers are being charged on a full cost basis and if they were to discover that a lower price was offered to a new customer they would feel that their loyalty was being penalised.

(iii) Prevention

Operations: Preventative maintenance and checking of the calibration of machinery. This would reduce the number of potentially faulty products being produced and therefore reduce guarantee claims.

Appraisal

Inbound Logistics: Reduce costs of incoming inspections by building close links with suppliers and getting them to adopt TQM. If suppliers can guarantee their quality, then inbound inspections could be eliminated.

Internal Failure

Operations: Reduce costs of re-works by training employees on a continual basis e.g. quality circles. This would reduce failure costs and also improve quality.

External Failure

Service: Design quality into the product to try to prevent guarantee claims and therefore the cost of servicing/repairing the product.